Proposed Syllabus

(With effect from 2014-15)

T.E. Biotechnology

Third Year Biotechnology

Faculty of Engineering and Technology
North Maharashtra University, Jalgaon

T.E. Biotechnology

Semester-V

Third Year Biotechnology

Faculty of Engineering and Technology
North Maharashtra University, Jalgaon

NORTH MAHARASHTRA UNIVERSITY, JALGAON
STRUCTURE OF TEACHING & EVALUATION
T.E. (BIOTECHNOLOGY) W.E.F.2014-2015

Semester V

Course Code	Name Of The Course	Group	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs/Week	Tutorial Hrs/Week	Practical Hrs/Week	Total	ISE	ESE	ICA	ESE		
BTL-501	Bioprocess Instrumentation & Analysis	D	3	--	--	3	20	80	--	--	100	3
BTL-502	Molecular Biology	D	3	--	--	3	20	80	--	--	100	3
BTL-503	Chemical Reaction Engineering	D	3	--	--	3	20	80	--	--	100	3
BTL-504	Enzyme Engineering	D	3	--	--	3	20	80	--	--	100	3
BTL-505	Bioprocess Industrial Economics & Management	C	3	--	--	3	20	80	--	--	100	3
BTP-506	LAB Molecular Biology	D	--	--	4	4	--	--	50	25	75	2
BTP-507	LAB Bioprocess Instrumentation & Analysis	D	--	--	2	2	--	--	25	25	50	1
BTP-508	LAB Chemical Reaction Engineering	D	--	--	2	2	--	--	25	25	50	1
BTP-509	LAB Tissue Culture Engineering	B	1	--	2	3	--	--	50	--	50	2
BTP-510	Industrial Training/EDP/Special Study	D	--	--	--	--	--	--	25	--	25	2
TOTAL			**16**	**--**	**10**	**26**	**100**	**400**	**175**	**75**	**750**	**23**

NOTE: As Molecular Biology practical requires 4 hrs workload for performance of practical hence two laboratory hours are merged to form four hours slot.

Semester VI

Course Code	Name Of The Course	Group	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs/Week	Tutorial Hrs/Week	Practical Hrs/Week	Total	ISE	ESE	ICA	ESE		
BTL-601	Bioprocess Engineering	D	3	--	--	3	20	80	--	--	100	3
BTL-602	Genetic Engineering	D	3	--	--	3	20	80	--	--	100	3
BTL-603	Fermentation Technology	D	3	--	--	3	20	80	--	--	100	3
BTL-604	Mass Transfer	D	3	--	--	3	20	80	--	--	100	3
BTL-605	IPR & Entrepreneurship	C	3	--	--	3	20	80	--	--	100	3
BTP-606	LAB Bioprocess Engineering & Fermentation Technology	D	--	--	4	4	--	--	50	50	100	2
BTP-607	LAB Mass Transfer	D	--	--	2	2	--	--	25	25	50	1
BTP-608	LAB Genetic Engineering	B	--	--	2	2	--	--	25	--	25	1
BTP-609	Minor Project	D	--	--	2	2	--	--	50	--	50	2
BTP-610	Seminar - I	D	--	--	2	2	--	--	25	--	25	2
TOTAL			**15**	**--**	**12**	**27**	**100**	**400**	**175**	**75**	**750**	**23**

NOTE: As Bioprocess Engineering & Fermentation Technology practical requires 4 hrs workload for performance of practical hence two laboratory hours are merged to form four hours slot.

Bioprocess Instrumentation & Analysis

Course Outline

Bioprocess Instrumentation & Analysis	**BIA**	**BTL-501**
Course Title	Short Title	Course Code

Course Description:
This course describes basic principles of instrumentation and instrumental analysis. This course will make the students knowledgeable in various types of measuring instruments used in process industries.

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**45**	**03**

Objective of the Subject:

1. To make the student familiar with various types of Measurement techniques.
2. To make the student familiar with various methods of composition analysis.
3. To understand basic principles behind the working of different analytical instruments and its application in industries.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses

Learning outcomes:
After completion of this course students will able to:
1. Familiar with various standards and calibration methods used in Instrumentation and Instrumental Analysis.
2. Will get knowledge of basic principles behind the working of different analytical instruments and its application in industries.
3. Use suitable measurement technique for process industries.
4. Have ability to control system for monitoring of various parameters in bioprocess industries and to maintain safety.

Course Content

TE Biotechnology **Bioprocess Instrumentation & Analysis** **Semester - V**

Teaching Scheme	**Examination Scheme**	
Theory : 3 hours/ week	End Semester Examination (ESE) :	80 Marks
	Paper Duration (ESE):	03.00 hr
	Internal Sessional Examination (ISE):	20 Marks

Unit: I **No. of Lecture: 8 Hours, Marks: 16**

Qualities of Measurement: The meaning of measurement, the elements of instruments, Expansion Thermometers: Introduction, Constant volume gas thermometer, Bimetallic Thermometer, Industrial pressure spring thermometer, Response of Thermometer. Thermoelectric Temperature Measurement: Introduction, Simple thermocouple circuit, Industrial thermocouples, Thermocouple lead wires, thermal wells, response of thermocouples. Resistance temperature detector

Unit: II **No. of Lecture: 8 Hours, Marks: 16**

Pressure and Vacuum Measurement: Introduction, Indicating pressure gage, Bellows pressure element, Useful ranges of absolute pressure measuring gages, Mclead vacuum gage. Measurement of Level: Float and tape liquid level gage, Float and shaft liquid level unit, Level measurement in pressure vessels, Gamma ray method, Ultrasonic method and resistive method.

Unit-III **No. of Lecture: 8 Hours, Marks: 16**

pH measurement: Introduction , Method of pH Indicator, Potentiometric Method, Application of pH Measurement. Infrared Spectroscopy: Introduction, Instrumentation, Application of Infrared spectroscopy. X-ray diffraction: Introduction, Application of X- ray diffraction.

Unit-IV **No. of Lecture: 8 Hours, Marks: 16**

Refractrometry: Introduction, Abbe refractometer, Application of refractometer.
UV Spectrophotometer: Introduction, Instrumentation, Application of UV Spectrophotometer.
Colorimetery: Introduction, Theory.

Unit-V **No. of Lecture: 8 Hours, Marks: 16**

Flame photometry: Introduction, Instrumentation, Application of Flame photometry.
Scanning Electron Microscope: Introduction, Instrumentation, Application of Scanning Electron Microscope, Transmission Electron Microscope: Introduction, Instrumentation, Application of Transmission Electron Microscope.

Text Books:

1. D.P.Eckman, Industrial Instrumentation, Willey Eastern Ltd., New Delhi.
2. Gurdeep Chatwal and Sham Anand, Instrumental methods of Chemical analysis, Himalaya publication House, Mumbai.

Reference Books:

1. Patranabis D. Industrial Instrumentation, Tata – Mcgraw Hill Publications, New Delhi.
2. P. Kudesia and S.S. Sawhaney, Instrumental methods of chemical analysis Pragati Prakashan, P.O.Box No. 62, Begum Bridge, Meerut 250001,U.P.
3. Nakra B.C. and K.K. Chaudhary, Instrumentation Measurement and Analysis, Tata – McGraw Hill, New Delhi.
4. B.K.Sharma.Goel, Instrumentation methods of chemical analysis, Publishing House,11,Shivaji Road, Meerut-250001,U.P.

Molecular Biology

Course Outline

Molecular Biology	**Mol Bio**	**BTL-502**
Course Title	Short Title	Course Code

Course Description:
This course is aimed at developing the basic knowledge and skills of molecular biology to undergraduate students. The background expected includes a prior knowledge of SE Biotechnology courses. The goals of the course are to understand the basic principles of Molecular Biology and their applications in engineering trade.

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Credits**
	03	**15**	**45**	**03**

Prerequisite Course(s): 11th, 12th Biology, SE Biotechnology courses

General Objective:

- To develop the basic knowledge and skills of molecular biology, including the introduction to central dogma of molecular biology and their role in biological systems,.

Learning Outcomes:
After completion of the course, students will be able to;

- To describe basic molecular and genetic concepts and principles.
- To communicate the fundamental concepts of molecular biology both in written and in oral format.
- Critically evaluate data, develop and design experiments to address a novel problem in the form of project.
- Demonstrate advanced knowledge in a specialized field of molecular biology.

COURSE CONTENT

TE Biotechnology **Molecular Biology** **Semester-V**

Teaching Scheme

Lectures -3 Hrs/week

Examination Scheme

End Semester Exams (ESE): 80 Marks.
Paper Duration: 3 Hours.
Internal Sessional Exam (ISE):20 Marks.

Unit: I: **No. of Lecture: 8 Hours, Marks: 16**

Introduction to Genetic Material

Introduction: Nucleic acids, DNA Chemical Composition, Chargoffs Equimolar Base Ratio, Molecular Structure of DNA, Watson and Crick Double Helical Model of DNA, forms of DNA (B-DNA, A-DNA, C-DNA, D-DNA, E-DNA, Z-DNA)

RNA: Occurrence, types of RNA: rRNA, tRNA, mRNA. Structure of ribosome's. Central Dogma, One Gene – One Polypeptide Hypothesis.

Unit: II **No. of Lecture: 8 Hours, Marks: 16**

DNA Replication

Replication: Overview, Basic rules and requirements of Replication, Types of DNA replication: Generalized Model for the DNA replication, Semi conservative method of replication, Meselson and Stahl experiment, bidirectional DNA replication, Molecular mechanism of DNA replication, Enzymes and proteins involved in DNA replication: Structure and functions of DNA polymerase I,II,III, primase, polynucleotide ligase, endonuclease, helicase, single stranded binding proteins, topoisomerase, Replication Models Theta replication model, Rolling circle Model, D-Loop Model.

Unit: III **No. of Lecture: 8 Hours, Marks: 16**

Transcription

Transcription and Processing of RNA: Transcription, **Mechanism of Transcription in Prokaryotes,** RNA polymerase of prokaryotes (structure, types and function),Transcription Unit, Promoter Site, Molecular Mechanism of Transcription in Prokaryotes, , Molecular **Mechanism of Transcription in Eukaryotes**, RNA polymerase of Eukaryotes (structure, types and function), Transcription Factors, Eukaryotic promoters, **RNA processing/Post transcriptional modification:** Introduction, processing of the pre rRNA, tRNA, and the mRNA transcript(eukaryotic), RNA splicing (mechanism).

Unit: IV **No. of Lecture: 8 Hours, Marks: 16**

Genetic Code and Protein Synthesis

Genetic code: Nature and characteristics of Genetic Code, Reasons for degeneracy, Biological Significance of Degeneracy of Genetic Code

Protein synthesis:- Mechanism of protein synthesis: Transcription Overview,

Translation: Activation of the amino acids, attachment of activated amino acids with tRNA, stages during translation, Translation in Prokaryotes and Eukaryotes, Translocation of proteins, Post translational processing of Proteins (Protein Folding and Biochemical Modifications)

Unit: V **No. of Lecture: 8 Hours, Marks: 16**

Regulation of gene expression & DNA damage and repair

Gene regulation in prokaryotes, Mechanisms of gene regulation at Transcription level, Induction and repression, Lac Operon System, Tryptophan Operon System, Gene regulation and Translation level, Gene regulation in eukaryotes,

DNA damage and repair: Types of damages, damaging agents, repair mechanisms - photoreactivation, dark repair, postreplicational recombination repair, SOS repair.

Reference books:

1. Fundamentals of Molecular Biology by Veer Bala Rastogi; Ane Books Pvt. Ltd
2. Cell and Molecular Biology by P.K.Gupta, Third Edition, Rastogi Publications
3. Molecular Biology of cell – Lodish et al
4. Genes and Genomes – Singer M and Berg P.

Chemical Reaction Engineering

Course Outline

Chemical Reaction Engineering	**CRE**	**BTL-503**
Course Title	Short Title	Course Code

Course Description:
The goal of the course is intended to provide a strong foundation in concepts and principles of Chemical reactions used in bioprocess industries.

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**45**	**03**

Objective of the Subject:

1. To make the student familiar with various types of reactions.
2. Student will be able to understand the kinetic study of various chemical & biochemical reactions.
3. Student will be able to design various types of reactors used in process industries.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Learning outcomes:
After completion of this course students will able to:

1. Determine the rate and order of reaction from experimental data.
2. Analyze and interpret the kinetics of reactions.
3. Apply the fundamentals of chemical reaction engineering to design different types of reactors.
4. Explain heterogeneous system with its applications.

Course Content

TE Biotechnology **Chemical Reaction Engineering** **Semester - V**

Teaching Scheme	**Examination Scheme**	
Theory : 3 hours/ week	End Semester Examination (ESE) :	80 Marks
	Paper Duration (ESE):	03.00 hr
	Internal Sessional Examination (ISE):	20 Marks

Unit: I **No. of Lecture: 8 Hours, Marks: 16**

Introduction to chemical reaction engineering: Classification of chemical reactions, rate of reaction, order and molecularity of reaction, rate constant, activation energy, transition state theory and temperature dependency, comparison of theories, Reaction mechanism.

Unit: II **No. of Lecture: 8 Hours, Marks: 16**

Collection and interpretation of kinetic data, ,integral and differential method of analysis of data, Half life method , Constant volume batch reactor ,Variable volume batch reactor.

Unit: III **No. of Lecture: 8 Hours, Marks: 16**

Ideal reactors, mixed flow reactor, plug flow reactor, space time and space velocity, holding time and space time , comparison in mixed and plug flow reactors, Recycle reactor, Autocatalytic reaction.

Unit: IV **No. of Lecture: 8 Hours, Marks: 16**

Residence time distribution of fluid in vessel, Conversion directly from tracer information, Models for non-ideal flow, Dispersion models, Tank in series model, Concept of micro and macro mixing.

Unit: V **No. of Lecture: 8 Hours, Marks: 16**

Introduction – Rate equations for heterogeneous systems , Contacting patterns in Two –Phase system ,Introduction to fluid particle reaction non-catalytic reactions, un reacted core model for Spherical particle of unchanging size, Rate of reaction for shrinking spherical particles , Determination of rate controlling step , Various contacting patterns in fluid solid reactors for fluid-particle non-catalytic reactions.

Text Books:

1. H. Scott Fogler, Elements of chemical reaction engineering, Prentice Hall New, Jersy.
2. Octave Levenspiel, Chemical reaction engineering, John Wiley and sons.

Reference Books:

1. J.M. Smith, Chemical engineering kinetics, McGraw Hill
2. S.D. Dawande, Principles of reaction engineering, Central Techno publication, Nagpur.
3. Lanny D. Schimdt , Chemical reaction engineering, Oxford University Press.

Enzyme Engineering

Course Outline

Enzyme Engineering	**EE**	**BTL-504**
Course Title	Short Title	Course Code

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**45**	**03**

Course Description: This course is introduced for learning the basic fundamentals of Enzyme Engineering to undergraduate students. The goals of the course are to understand the basic knowledge of Enzymes, their classification, production, purification and Immobilization to be use in different areas.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Objective of the subject

1. Get knowledge of enzyme & its classification & its role in metabolic pathway of living systems.
2. Will get knowledge of enzyme kinetics and its application in production of desired products
3. Can communicate the molecular mechanism of enzyme action and modification to increase its stability.
4. Ability to design and conduct experiments to analyze and interpret enzyme kinetic data for the design of enzyme reactor for production of value added products
5. Get knowledge of various analytical techniques for characterization of enzymes
6. Get knowledge of application of enzymes in various industries used for the production of Bioproduct for the welfare of society.
7. Will have ability to apply knowledge of enzyme kinetics in designing metabolic pathway in living system to produce value added products.

Learning outcomes

After successful completion of this course the student will be able to:

1. Classify enzymes on the basis of their working mechanism.
2. Calculate the enzyme kinetics and activity by performing various assays.
3. Characterize the enzymes by using modern equipments.
4. Immobilize enzyme by various immobilization techniques for better stability and activity as well as to reduce their losses during use.
5. Will able to apply molecular mechanism of various enzymes in different metabolic pathways.

Course Content

TE Biotechnology **Enzyme Engineering** **Semester - V**

Teaching Scheme
Theory: 3 hours/ week

Examination Scheme
End Semester Examination (ESE): 80 Marks
Paper Duration (ESE): 03 Hours
Internal Sessional Examination (ISE): 20 Marks

Unit- I **No. of Lecture: 8 Hours, Marks: 16**

Enzymes

Classification, nomenclature, International units and types of enzymes, General characters of enzymes: characters such as specificity, catalysis and regulation and localization of enzymes in the cell, Structure of enzymes: Primary, secondary and tertiary structure of enzyme, Models of enzyme activity: Lock and key model, Induced fit, Substrate Strain model. Isoenzyme, with example and its application.

Unit- 2 **No. of Lecture: 8 Hours, Marks: 16**

Enzyme Kinetics

Introduction to kinetics: activation energy, transition state theory and energy, consideration, Enzyme kinetics, rate equation, Rate of reaction, First order and second order reaction, Michaelis – menten equation (Steady state kinetics) and Haldane relationship, Significance of Km, Lineweaver – Burk or Double – reciprocal plot, Eadie-Hofstee plot, Hanes plot, Turnover number, Specificity constant, Bisubstrate reaction.

Unit- 3 **No. of Lecture: 8 Hours, Marks: 16**

Enzyme inhibition, its kinetics and Catalysis

Types of inhibition- Reversible and irreversible inhibition, Kinetics of inhibition. Catalytic efficiency- proximity and orientation effects, distortion or strain, Different mechanisms of enzyme catalysis, acid base and covalent catalysis and metal-ion catalysis, Molecular mechanism of action of chymotrypsin, Lysozyme, Chemical modification of enzymes, Bisubstrate or Multisubstrate reaction: Ping – Pong mechanism, sequential mechanism,

Unit-4 **No. of Lecture: 8 Hours, Marks: 16**

Allosteric and regulatory enzyme, enzyme production and purification

Binding of ligands to Protein, Co-operativity models- MWC and KNF model, Regulations by allosteric enzymes, other mechanisms of enzyme regulation-enzyme induction and repression and covalent modification.

Sources of enzymes-animal plant and microbial sources, large scale production of enzymes- basic methodology of production, extraction and purification of enzymes, Enzyme production and recombinant DNA technology.

Unit-5 **No. of Lecture: 8 Hours, Marks: 16**

Enzyme immobilization and Enzyme applications

Methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), and microencapsulation and gel entrapment, Properties of immobilized enzymes, Applications of immobilized enzymes.

Applications of enzymes in food, sugar, leather, detergent industries etc., Uses of enzymes in drug, medicine, industries, Uses of enzymes to make amino acids and peptides, Legislative and safety aspects.

Reference Books:

1. Lehninger, Nelson and cox. Principles of Biochemistry –Macmillan publishers.
2. Voet and Voet, Biochemistry, Wiley publisher.
3. Biotol series, Principles of Cell energetics , Butterworth- Heinemann Ltd,Jordan Hill, Oxford.
4. Biotol Series, Principles of enzymology and its application, Butterworth- Heinemann Ltd,Jordan Hill, Oxford.
5. Nicholascprice and Tewis stereous, Fundamentals of Enzymology, Oxford University press.
6. Palmer, Enzymes, Oxford University press.
7. Michael L. Shuler, Fikret Kargi, Bioprocess Engineering, Basic concepts, Prentice Hall India Pvt. Ltd., New Delhi.. .
8. J. F. Richardson and D. G. Peacock, Coulson and Richardson's Chemical Engineering (Vol: 3) Asian Books Pvt. Ltd., New Delhi
9. Murray moo-young, Comprehensive Biotechnology Pergemon Press(Vol 2)
10. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint of Elsevier.
11. James E. Bailey, David F. Ollis, Biochemical Engineering Fundamentals, Mc Graw-Hill Book Company.
12. Textbook of Biotechnology by B.D.Singh, Kalyani Publication.

Bioprocess Industrial Economics and Management

Course Outline

Bioprocess Industrial Economics and Management	**BIEM**	**BTL-505**
Course Title	Short Title	Course Code

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**45**	**03**

Course Description: This course is introduced for learning the basic fundamentals of Bioprocess Industrial Economics and Management to undergraduate students. The goals of the course are to understand the basic knowledge of economics, various factors to be considered during industrial set up, marketability of product etc.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Course Objectives:

The objective of the course is to provide the basic knowledge of Bioprocess Industrial Economics and Management, economics, profitability, various factors to be considered during industrial set up, marketability of product etc.

Learning outcomes

After completion of this course students will able:

1. To apply the basic knowledge of economics in order to design the bioprocesses at low cost
2. To apply knowledge of marketability to communicate effectively about various bioprocesses of products.
3. To apply the knowledge to set up a bioprocess Industry in all respect
4. To estimate the cost of final product
5. To calculate the profitability and losses during the product formation.

Course Content

TE Biotechnology Bioprocess Industrial Economics and Management Semester - V

Teaching Scheme
Theory: 3 hours/ week

Examination Scheme
End Semester Examination (ESE): 80 Marks
Paper Duration (ESE): 03 Hours
Internal Sessional Examination (ISE): 20 Marks

Unit I

Bio process Design Considerations: **No. of Lecture: 8 Hours, Marks: 16**

Technical feasibility survey, process development, flow diagram, equipment design and specifications, marketability of product, availability of technology, raw materials, equipments, human resources, land and utilities, site characteristics, waste disposal, government regulations and other legal restrictions, community factors and other factors affecting investment and production cost, Indian Bioprocess Industry - Current Status and Trends.

Unit II

Cost Estimation: **No. of Lecture: 8 Hours, Marks: 16**

Factors affecting investment and production cost, capital investment, fixed investment and working capital, estimating equipment cost by 6/10 factor rule, method of estimating capital investment. Different costs involved in total product cost, computer automization in costing.

Unit III

Investment Cost and Profitability: **No. of Lecture: 8 Hours, Marks: 16**

Interest and investment cost, type of interest, types of taxes and tax returns, types of insurance and legal responsibility, depreciation, types of depreciation, and methods of determining depreciation. Profitability, mathematical methods of profitability evaluation, cash flow diagram, break even analysis, balance sheet, pricing issue method and income statement.

Unit IV

Fermentation Economics: **No. of Lecture: 8 Hours, Marks: 16**

Introduction, isolation of microorganisms of potential industrial interest, strain improvement, market potential, effects of legislation on production of antibiotics and recombinant proteins, plant and equipment, media, air sterilization, heating and cooling, aeration and agitation, batch process cycle times, continuous culture, recovery costs, water usage and recycling, effluent treatment.

Unit V

Bioproduct Economics: **No. of Lecture: 8 Hours, Marks: 16**

Bioproduct regulation, Fermentation process economics: A complete example, Economic consideration of commercial Bioproduct: Enzymes, Proteins via rDNA, Antibiotics, Vitamins, Alkaloids, Nucleosides, Steroids, Monoclonal antibodies, Brewing and wine making, Fuel Alcohol Production, Organic and Amino acid manufacture, Single cell protein, Anaerobic methane production.

Reference Books:

1. Peter M.S. Timmerhaus K.D. Plant Design and Economics for Chemical Engineers. McGraw Hill.
2. Vilbrandt F.C. and C.E. Dryden, Chemical Plant Design. McGraw Hill
3. T.R. Banga and S.C.Sharma, Industrial Organization and Engineering Economics, Khanna Publications, New Delhi.
4. O.P.Khanna Industrial Engineering and Management, Dhanpat Rai Publications Pvt. Ltd. New Delhi.
5. Dewett and Varma, Elementary Economic Theory, S Chand and Company Ltd New Delhi
6. James E. Bailey, David F. Ollis, Biochemical Engineering Fundamentals, Mc Graw-Hill Book Company.
7. P. F. Stanbury, A. Whitaker and S. J. Hall, Principles of Fermentation Technology, Aditya Book Private Limited.

Molecular Biology Lab

LAB COURSE OUTLINE

(Molecular Biology Lab)

Molecular Biology	**Mol Bio**	**BTL-506**
Course Title	Short Title	Course Code

Practical	**Hours/ Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	04	**15**	**60**	**02**

Molecular Biology Lab

Course Description:

In this laboratory, course emphasis is on the understanding of basics of Molecular Biology techniques. The learner can use this knowledge and apply in allied branches of Biotechnology as required.

Prerequisite Course(s): 11th, 12th Biology, SE Biotechnology courses

General Objective:

The objective of the laboratory is to impart the fundamental knowledge of molecular biology at the research level to the students and to develop their ability to apply the specific procedures to analyze the experimental results.In this lab, students will be familiar with the molecular Biology lab techniques which they can apply in research and development in the field of Biotechnology.

Learning Outcomes:

After successful completion of this lab student will be able to:

- Isolate the genetic material e.g. DNA & RNA from different cells.
- Isolate the total plasmid DNA from bacteria.
- To calculate molecular weight by using DNA marker with agrose gel electrophoresis
- To spool of chromosomal DNA from onion cells
- To determine the melting temperature (Tm) and base composition of DNA from thermal denaturation characteristics.
- Well versed with the principles and practice of agarose gel electrophoresis.
- To quantify Nucleic acids.

Molecular Biology Lab

Semester-V

Teaching Scheme
Practicals -4 Hrs/week

Examination Scheme
External Sessional Exams (ESE)/Oral (OR):25 Marks.
Internal Continuous Assessment: 50 Marks.

Minimum eight experiments from the following:

1. Isolation of genomic DNA from bacteria.
2. Isolation of RNA from yeast.
3. Isolation of total plasmid DNA from bacteria.
4. Calculation of molecular weight by using DNA marker with agarose gel electrophoresis.
5. DNA extraction from blood.
6. Spooling of chromosomal DNA from onion cells.
7. Determination of melting temperature (Tm) and base composition of DNA from thermal denaturation characteristics.
8. Principles and practice of agarose gel electrophoresis.
9. Quantitation of Nucleic acids.

Reference books:

1. Introduction to Practical Biochemistry, Third Edition, by David Plummer.
2. Biochemical Methods, Second Edition by S. Sadasivam, A. Manickam, New Age International Ltd, Publishers.

Lab Bioprocess Instrumentation & Analysis

LAB COURSE OUTLINE

Bioprocess Instrumentation & Analysis Lab **BIA LAB** **BTP-507**

Course Title Short Title Course Code

Laboratory	**Hours/ Week**	**No. of Weeks**	**Total Hours**	**Semester Credit**
	02	**15**	**30**	**01**

Bioprocess Instrumentation & Analysis Lab

Course Description:

The goal of the lab course is intended to provide a strong foundation in concepts and principles of Bioprocess Instrumentation & Analysis of different materials.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

General Objective: The objective of the laboratory is to impart the fundamental knowledge of Bioprocess Instrumentation & Analysis to the students and develop their ability to apply the specific procedures to analyze the experimental results.

Learning Outcomes:

After successful completion of this lab course the student will be able to:

1. Familiarized with various measurement techniques used in bioprocess industries.
2. Determine purity of product in process industries.
3. Will get knowledge of basic principles behind the working of different analytical instruments and its application in bioprocess industries.

Lab Bioprocess Instrumentation & Analysis

Semester-V

Teaching Scheme
Practicals -4 Hrs/week

Examination Scheme
External Sessional Exams (ESE)/Oral (OR):25 Marks.
Internal Continuous Assessment (ICA): 25 Marks.

Minimum 08 experiments shall be performed from the following:

1. To study the response of bimetallic thermometer.
2. To study Calibration of thermocouple.
3. To measure the pH of given solution.
4. To determine concentration of given solution by colorimeter
5. To study Flame photometry
6. To study Abbey's refractometer
7. To study infra red spectrophotometer
8. To study UV spectrophotometer.

References:

1. Patranabis D. Industrial Instrumentation, Tata – Mcgraw Hill Publications, New Delhi.
2. P. Kudesia and S.S. Sawhaney, Instrumental methods of chemical analysis Pragati Prakashan, P.O.Box No. 62, Begum Bridge,Meerut250001,U.P.
3. Nakra B.C. and K.K. Chaudhary, Instrumentation Measurement and Analysis, Tata – McGraw Hill, New Delhi.
4. B.K.Sharma.Goel, Instrumentation methods of chemical analysis, Publishing House,11,Shivaji Road, Meerut-250001,U.P.

Lab Chemical reaction Engineering

LAB COURSE OUTLINE

Chemical reaction Engineering Lab	**CRE LAB**	**BTP-508**
Course Title	Short Title	Course Code

Laboratory	**Hours/ Week**	**No. of Weeks**	**Total Hours**	**Semester Credit**
	02	**12**	**24**	**01**

Chemical reaction Engineering Lab

Course Description:

The goal of the Lab course is intended to provide a strong foundation in concepts and principles of Chemical reactions used in bioprocess industries.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

General Objective: The objective of the laboratory is to impart the fundamental knowledge of Chemical reaction engineering to the students and develop their ability to apply the specific procedures in industries and to analyze the experimental results.

Learning Outcomes:

After successful completion of this lab course the student will be able to:

1. Understand the kinetic study of various chemical and biochemical reactions used in process industries
2. To design various types of Reactors.
3. Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Lab Chemical Reaction Engineering

Semester-V

Teaching Scheme
Practicals -2 Hrs/week

Examination Scheme
External Sessional Exams (ESE)/Oral (OR):25 Marks.
Internal Continuous Assessment (ICA): 25 Marks.

Minimum 08 experiments shall be performed from the following:

1. To determine the reaction rate constant {k} for given reaction.(CSTR / BATCH / SEMIBATCH / PFR)
2. To determine the effect of temperature on reaction rate constant. .(CSTR / BATCH / SEMIBATCH / PFR)
3. To determine the activation energy {E} for the given reaction. .(CSTR /BATCH / SEMIBATCH / PFR)
4. To draw C [t], E [t] and F [t] curve and to calculate the mean residence time {tm} variance { σ2} and skewness { S3} for plug flow reactor.
5. To draw C [t], E [t] and F [t] curve and to calculate the mean residence time {tm} variance {σ^2} and skewness {S^3} for annular reactor.
6. To draw C [t], E [t] and F [t] curve and to calculate the mean residence time {tm} variance {σ2} and skewness {S3} for packed Bed reactor.
7. To study the cascade CSTR.
8. To study the kinetic in tubular flow reactor [coiled tube] for the given reaction.

Reference Books:

1. H. Scott Fogler, Elements of chemical reaction engineering, Prentice Hall New, Jersy.
2. Octave Levenspiel, Chemical reaction engineering, John Wiley and sons.

Lab Tissue Culture Engineering

Course Outline

Lab Tissue Culture Engineering	TCE	BTP-509
Course Title	**Short Title**	**Course Code**

LAB	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Theory	**01**	**15**	**15**	**02**
Practical	**02**	**15**	**30**	

Course Description:
This course is aimed at introducing the fundamentals of plant tissue culture to TE students. The basics of animal tissue culture techniques are also incorporated in the course. The course also includes the lab designing, sterilization techniques, media involved and various laboratory techniques.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Course Objectives

The objective of the course is to provide the basic knowledge of plant tissue culture and animal tissue culture techniques. Also to get the students acquainted with various laboratory techniques.

Learning outcomes:

After successful completion of this course the students will be able to:

1. Understand the basics of the lab design

2. Understand various sterilization techniques

2. Apply the knowledge of various PTC techniques

3. Understand the fundamentals of ATC

4. Understand the genetic engineering approaches related to the course

Course Content

TE Biotechnology **Tissue Culture Engineering** **Semester – V**

Teaching Scheme
Theory: 1 hours/ week
Practical: 2 hours/week

Examination Scheme
Internal Continuous Assessment (ICA):50 Marks

Theory:

(a) Introduction to PTC

(b) Applications of PTC

(c) Genetic Engineering in plant

(d) Introduction to ATC

(e) Fundamentals of ATC

Lab Work: (Any Eight Experiments from the following)

1. Laboratory Setup & Introduction to PTC techniques

2. General Sterilization techniques

3. Preparation of culture medium sterilization of explants

4. Initiation of callus culture

5. Micropropogation/ Multiple shoot induction

7. Embryo culture

8. In-vitro seed germination

9. Meristem culture

10. RAPD (DEMO)

11. Lab design, sterilization procedures, media preparation for ATC and cryopreservation

12. Hardening and acclimatization of in vitro raised rooted shoots

13. Encapsulate the shoot buds/ seeds to demonstrate the production of synthetic seeds

14. Primary culture from chick embryo.

Reference Books:

1.R.A.Dixon and Gonzales, Plant cell culture : A Practical Approach, IRL Press.

2. S.S.Purohit, Biotechnology Fundamentals and Applications, Agrobios (India), 4th Edition, 2005.

3. S.S.Bhojwani and M.K.Razdan, Plant Tissue Culture : Theory and Practical, (1996) Elsevier, Amsterdam.

4. S.B Primrose and R.M.Twyman, Principles of Gene Manipulation and Genomics, Blackwell publishing, 7th edition, 2006.

5. Plant Biotechnology: The genetic manipulation of plants; A. Slater, N. Scott, M. Fowler; Published by Oxford University press, New York (2003)

6. Methods in Plant Tissue Culture; U Kumar; AgroBios India, (2003)

7. Bernard R. Glick, Molecular Biotechnology 3rd edition, CBS Publishers Distributors.

8. J.Hammond,P.McGarvey and V.Yusibov (Eds.), Plant Biotechnology New Products and Applications, Springer.

Industrial Training / EDP/ Special Study

Course Outline

Industrial Training/EDP/Special Study	**IT/EDP/SS**	**BTP-510**
Course Title	Short Title	Course Code

Examination Scheme
Internal Continuous Assessment: 25 marks

Industrial Training:

• Every student has to undergo industrial/practical training for a minimum period of two weeks during summer vacation after S.E (after fourth semester).

• The industry in which practical training is taken should be a medium or large scale industry.

• The paper bound report on training must be submitted by every student in the beginning of T.E. First term along with a certificate from the company where the student underwent training.

• The report on training should be detailed one.

• Maximum number of students allowed to take training in company should be five. Every student should write the report separately.

OR

Special Study:

• In case if a student is not able to undergo practical training , then the students should be asked to prepare a review paper on a recent topic in Biotechnology and allied fields.

OR

EDP/EAC of 3-5 days:

Student should undergo Entrepreneurship Awareness/Development Camp (EAC/EDP) of minimum 3 days and should submit the certificate of the programme.

Every student shall be required to present a seminar on Industrial Training / EDP/EAC/ Special Study in the presence of two teachers.

These teachers (fixed by the head of department in consultation with the Principal) shall award marks based on the following:

(a) Report 10 marks

(b) Seminar presentation 10 marks

(c) Viva-voce at the time of Seminar presentation 05 marks.

T.E. Biotechnology

Semester-VI

Third Year Biotechnology

Faculty of Engineering and Technology

North Maharashtra University, Jalgaon

Bioprocess Engineering

Course Outline

Bioprocess Engineering	**BPE**	**BTL-601**
Course Title	Short Title	Course Code

	Hours per Week	**No. of Weeks**	**Total Hours**	**Semester Credits**
Lecture	**03**	**15**	**40**	**03**

Course Description:
This course is aimed at introducing the fundamentals of bioprocess engineering. The basics of bioreactor designing have also been incorporated in the course. The course also includes study of various types of bioreactors.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Course Objectives
The objective of the course is to provide the basic knowledge of fermentation processes and media preparations along with the sterilization procedures. The course also deals with various parameters involved in bioreactors designing. The course also aims at providing the knowledge of various types of industrially used bioreactors.

Learning outcomes:

After successful completion of this course the students will be able to:

1. Apply knowledge of chemical and mechanical engineering for design of biological system in biotech industries.
2. Design and conduct experiments on different bioreactors and to analyze and interpret data for optimization of process.
3. Design various bioprocess equipment to meet desired needs of mankind within realistic constrain like social, ethical, health and safety
4. To get the knowledge of properties of materials and its view in designing bioprocess equipment within the standards prescribed by regulating authority in India and world.
5. Integrate knowledge of bioscience, biochemical engineering, , in commercial context to solve a substantial range of bio- processing and biological engineering problems and issues for production of value added products for societal development.

Course Content

TE Biotechnology **Bioprocess Engineering** **Semester – VI**

Teaching Scheme
Theory: 3 hours/ week

Examination Scheme
End Semester Examination (ESE) : 80 Marks
Paper Duration (ESE) : 03 Hours
Internal Sessional Examination (ISE): 20 Marks

UNIT I: **No. of Lecture: 8 Hours, Marks: 16**

Introduction to Fermentation process & Media for Industrial Fermentation Process

Upstream Process, Downstream Process, Range of fermentation process, Component parts of fermentation process , Medium Sterilization. Batch Sterilization: Continuous sterilization, Fermentor Sterilization, Feed Sterilization, Filter sterilization.

Unit II: **No. of Lecture: 8 Hours, Marks: 16**

Design of Bioreactors:

Introduction, Basic objective in design of a reactor, aseptic operation and containment, body construction, aeration and agitation, stirrer glands and bearings, baffles design, sparger system, achievement and maintenance of aseptic conditions, valves and steam traps, types of valves and pressure control valves. Scale up of fermenters, design condition for scale up, scale-up methods.

Unit III: **No. of Lecture: 8 Hours, Marks: 16**

Types of Bioreactors:

Batch bioreactors, Continuous bioreactors, Semi continuous bioreactors, Stirred tank bioreactors, Airlift bioreactor systems, Trickle bed bioreactor, Airlift external loop bioreactors, waldhof-type fermenter, Tower fermenter, Cylindro- conical vessel, Deep jet fermenter, Cyclone column, Rotating disc fermenter, Reactor dynamics: Dynamic models and stability

Unit IV: **No. of Lecture: 8 Hours, Marks: 16**

Solid state & Submerged Fermentation, Process monitoring & Control:

Introductions, types of solid state fermenter, Submerged Fermentation , Brief introduction to pipe joints, Physical and chemical sensors for medium and gases, Online/ Offline sensors.

Unit V: **No. of Lecture: 8 Hours, Marks: 16**

Bioreactor Design Considerations:

Design consideration: Design codes, maximum working pressure, design pressure, design temperature, design stress, factor of safety, and selection of factors of safety, design of wall thickness, corrosion ratio, Poisson ratio, criteria of failure. Materials of construction: mechanical properties, materials, corrosion, protective coating, choice of materials, corrosion prevention.

Reference Books:

1. Biochemical Engineering Fundamentals (1986) (2/e) Bailey JE and Ollis DF, McGraw-Hill International Editions CES, Singapore.

2. Biochemical Engineering (1997) Blanch HW and Clark DS, Marcel Dekker Inc., USA.

3. Bioprocess Engineering Principles (1995) Doran PM, Academic Press Ltd, USA.

4. Bioprocess Engineering: Basic Concepts (2002) Shuler ML and Kargi F, Pearson Education Pvt. Ltd., Singapore.

5. Principles of Fermentation Technology (1995) (2/e) Stanbury PF, Whitaker A and Hall SJ, Butterworth-Hienemann Ltd., UK.

6. Comprehensive Biotechnology Vol. 2 (1985) Moo-Young M, Pergamon Press Ltd., UK.

Genetic Engineering

Course Outline

Genetic Engineering	**GE**	**BTL-602**
Course Title	Short Title	Course Code

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**45**	**3**

Course Description: This course is introduced for learning the basic fundamentals of Genetic Engineering to undergraduate students. The goals of the course are to understand the basic knowledge of Genetics, different enzymes used to engineer the genes, rDNA technology, and applications of rDNA technology.

Course Objectives:
The objective of the course is to provide the basic knowledge of Genetics, different enzymes used to engineer the genes, rDNA technology, and applications of rDNA technology.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Learning outcomes:
After completion of this course students will able:

1. To apply the knowledge of rDNA technology for the construction of novel gene for the better use with wide functionality.
2. To use various vector systems to study functionality of insert gene.
3. To use various instrument to increase the efficiency of the DNA.
4. Apply the knowledge of genetics for human welfare in disease diagnosis, in criminal cases as well as pharmaceuticals for drug designing and development.
5. To express the knowledge of genetic engineering both in written and oral format.

Course Content

TE Biotechnology Genetic Engineering Semester - V

Teaching Scheme
Theory: 3 hours/ week

Examination Scheme
End Semester Examination (ESE): 80 Marks
Paper Duration (ESE): 03 Hours
Internal Sessional Examination (ISE): 20 Marks

Unit I

Recombinant DNA technology **No. of Lecture: 8 Hours, Marks: 16**

The recombinant DNA concept, Important Discoveries, Principles of cloning, Biohazards and Bioethics of Genetic Engineering.

Unit II

The Tools: Enzymes **No. of Lecture: 8 Hours, Marks: 16**

Nucleases, The Restriction Endonucleases Type I, II, III, star activity, isoschizomers Phosphodiesterase,Polynucleotidekinase,DNAligase,DNApolymeraseI,Reversetranscriptase, Terminal deoxynucleotidyl transferase,Poly A polymerase.

Unit III

The Tools: Vector Systems **No. of Lecture: 8 Hours, Marks: 16**

E coli systems – the host cells , *E. coli* – Plasmid Vectors , *E .coli* – Bacteriophage vectors , *E. coli* systems – Plasmid-Phage combination vectors , Other Prokaryotic Host-Vector systems , Eukaryotic Host-Vector Systems: Yeast, Eukaryotic Host-Vector Systems: Animals, Eukaryotic Host-Vector Systems: Plants.

Unit IV **No. of Lecture: 8 Hours, Marks: 16**

Molecular research procedures

DNA sequencing techniques PCR, Blotting Techniques, Gene silencing techniques, RNAi, Knockout Technology, SAGE.

Unit V **No. of Lecture: 8 Hours, Marks: 16**

Significance of rDNA technology and Human Welfare

Gene therapy, Restriction fragment length polymorphism (RFLPs), Random amplified polymorphic DNA (RAPD), SNPs, AFLP, microarray, DNA fingerprinting.

Reference Books:

1. Genes VIII – Benjamin Lewin, Benjamin Cummings; United States edition.
2. Genes and Genomes – Singer M and Berg P
3. Textbook of Biotechnology by R.C.Dubey, S. Chand & Co. P Ltd, New Delhi.
4. Textbook of Biotechnology by B.D.Singh, Kalyani Publication.
5. Textbook of Biotechnology by U.Satyanarayana, Books and Allied Pvt.Ltd.

Fermentation Technology

Course Outline

Fermentation Technology	**FT**	**BTL- 603**
Course Title	Short Title	Course Code

Lectures	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**45**	**03**

Course Description:
This course is introduced for learning the basic fundamentals of Fermentation Process to undergraduate students. The prospectus includes a prior applications involved in Industrial Biotechnology. The goals of the course are to understand the basic principles, Mechanism and working of fermenters and processes and its applications in different areas.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Course Objectives
The objective of the course is to provide the basic knowledge of fermentation technology, preparation of inoculums, sterilization and various fermentation processes.

Learning outcomes:

By completion of this course students will able:

1. Describe the fermentation process and evaluate factors that contribute in enhancement of cell and product formation during fermentation process.
2. Interpret the suitable media to obtain high yield of the product and to develop inoculum for different fermentation processes.
3. Analyze lab scale information and apply it for scaling up process.
4. To design the experiment and fermenter for beverages production.
5. To design the experiment and fermenter for food production.
6. To increase the productivity and yield of fermentation process.

Course Content

TE Biotechnology **Fermentation Technology** **Semester – VI**

Teaching Scheme
Theory: 3 hours/ week

Examination Scheme

End Semester Examination (ESE)	:	80 Marks
Paper Duration (ESE)	:	03 Hours
Internal Sessional Examination (ISE):		20 Marks

UNIT – I **No. of Lecture: 8 Hours, Marks: 16**

Introduction to Fermentation Process & Media Formulation:

An introduction to fermentation process, Isolation methods for Industrial microorganisms, Culture preservation and stability, the improvement of industrial microorganisms. Media for Industrial fermentation, Introduction ,typical media, Medium fermentation: Water, Energy sources, Carbon sources, Nitrogen sources, Minerals, Growth factors, Nutrient recycle, Buffers, Precursors, Metabolic regulators, Oxygen requirement and antifoams, pH.

UNIT – II **No. of Lecture: 8 Hours, Marks: 16**

Types of Sterilization Processes

Sterilization: Introduction, Medium sterilization, Design of Batch sterilization process:
Calculation of Del factor during heating and cooling, Calculation of holding time at constant temperature, Richard's rapid method for the design of sterilization cycles, the scale up of batch sterilization processes, Filter sterilization: Filter sterilization of fermentation media, air and fermenter exhaust air, the theory and design of depth filters.

UNIT –III **No. of Lecture: 8 Hours, Marks: 16**

Inoculum Development Processes

The development of Inocula for industrial fermentation: Introduction, Criteria for the transfer of inoculums, The development of inocula for yeast processes, The development of inocula for bacterial processes, The development of inocula for mycelial processes, The aseptic inoculation of plant fementers, Solid state fermentation.

UNIT –IV **No. of Lecture: 8 Hours, Marks: 16**

Fermentative production of Beverages, Industrial Chemicals and Biomolecules.

Beer, Wine, Rum, Gin, Whisky, Brandy, Champaign. Fermentative production of citric acid, acetic acid, lactic acid, ethanol, acetone and butanol, gluconic acid, steroid biotransformation, Enzyme production- Amylases, Proteolytic enzymes, Invertase enzyme, Pectinases, Lipases; Vitamins: Vitamine B12, Riboflavin, Vitamin A, Amino acid production: LGlutamic acid, L-Lysine, L-Threonine.

UNIT –V **No. of Lecture: 8 Hours, Marks: 16**

Fermentation of food products and Antibiotics.

Fermentative production of food products: cheese and types of cheese, fermented soyabean foods, biomass production (single cell protein, baker's yeast), fermented dairy products like yogurt, cultured buttermilk, Production of penicillin, B-Lactum antibiotics, Streptomycin, Cephalosporin, Tetracycline.

Reference books:

1. P. F. Stanbury, A. Whitaker and S. J. Hall, Principle of Fermentation Technology, Aditya Books (P) Ltd, New Delhi.
2. L. E. Casida, Industrial Microbiology, New Age Industrial Publishers.
3. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint of Elsevier.
4. B.D.Singh, Biotechnology, Kalyani Publication.
5. Prescot and Dun, Industrial Microbiology, McGraw-Hill Book Company, Inc. New York.
6. Text Book of Biotechnology by R.C.Dubey ,S. Chand & Co. P Ltd, New Delhi
7. Text Book of Biotechnology by U. Satyanarayana, Books and Allied Pvt.Ltd.
8. Murray moo-young, Comprehensive Biotechnology Pergemon Press (Vol. 2)

Mass Transfer

Course Outline

Mass Transfer	**MT**	**BTL-604**
Course Title	Short Title	Course Code

Course Description:
The goal of the course is intended to provide a strong foundation in concepts and principles of mass transfer operations used in industries.

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**45**	**03**

Objective of the Subject:
1. Student will be able to understand the basic principles of separation techniques.
2. Student will be able to design various mass transfer equipments.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Learning outcomes:
After completion of this course; students will be able to:
1. Demonstrate the knowledge of various mass transfer operations and its application in process industries.
2. Explain & apply knowledge of different separation techniques in downstream processing.
3. Apply appropriate criteria for selection among alternative separation technologies.
4. Increase yield and purity of various products in process industries by applying knowledge.
5. Ability to analyze and design mass transfer equipments.

Course Content

TE Biotechnology **Mass Transfer** **Semester -VI**

Teaching Scheme
Theory : 3 hours/ week

Examination Scheme
End Semester Examination (ESE) : 80 Marks
Paper Duration (ESE): 03.00 hr
Internal Sessional Examination (ISE): 20 Marks

Unit: I **No. of Lecture: 8 Hours, Marks: 16**

Mass Transfer

Introduction to mass transfer, Equilibrium for mass transfer process: Local two phase mass transfer. Local overall mass transfer coefficient, Use of local overall coefficient. Material balances for steady state co current, countercurrent, cross flow cascade, counter flow cascade. Application of mass transfer processes.

Unit: II **No. of Lecture: 8 Hours, Marks: 16**

Distillation

Introduction to distillation process, Vapor liquid equilibrium, The methods of distillation (Binary mixture), The fractionating column, McCabe Thiele & Lewis Sorel method, Batch distillation, Azeotropic, extractive and steam distillation, Introduction to distillation equipments.

Unit: III **No. of Lecture: 8 Hours, Marks: 16**

Extraction & Leaching

Introduction to extraction process, Liquid equilibria, Material balances for stage wise contact methods, Stage contact and continuous contact type extractors.

Leaching: General principles of leaching, working principle of moving-bed leaching equipments: Bollman extractor, Hildebrandt extractor

Unit: IV **No. of Lecture: 8 Hours, Marks: 16**

Adsorption

Introduction to adsorption operation, Type of adsorption operation, Nature of adsorbents, Adsorption equilibria, Adsorption of liquids, Material balances for stage wise for operation, Continues contact process for adsorption, Principle of ion exchange operation, Equilibria for ion exchange operation, Rate of ion exchange operation, Application of ion exchange operation.

Unit: V **No. of Lecture: 8 Hours , Marks :16**

Crystallization

Introduction to crystallization, Growth and properties of crystals, Effect of impurities in crystallization, Effect of temperature on solubility, Fractional crystallization, Caking and yield of crystals, Different type of crystallizers.

Text Books:

1. R. E. Treybal , Mass transfer operation ,McGraw Hill Publication
2. Coulson and Richardson Chemical Engineering (Vol. I and II), Pergamon Press

Reference Books:

1. Christie J. Geankoplis ,Transport Processes and Unit Operations ,Prentice Hal inc
2. P. Chattopadhayay , Unit operation in Chemical Engg. (Vol. I and II), Khanna Publications Delhi.

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IPR and Entrepreneurship

Course Outline

IPR and Entrepreneurship	**IPRE**	**BTL-605**
Course Title	Short Title	Course Code

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**45**	**03**

Course Description: This course is introduced for learning the basic fundamentals of Intellectual property rights and Entrepreneurship to undergraduate students.The goals of the course are to understand the basic knowledge of Intellectual property rights, trademarks, biosafety & bioethics and entrepreneurship.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Objectives of the subjects

The objective of the course is to provide the basic knowledge of IPR and Entrepreneurship, Intellectual property, trademarks, biosafety & bioethics and entrepreneurship.

Learning outcomes

After successful completion of this course the student will be able to:

1. Choose which type of IPR they should apply for.
2. Adopt environment friendly approach industrially.
3. Understand various ethical issues regarding the field.
4. Understand entrepreneurial aspects.
5. Understand the basics of marketing management.

Course Content

TE Biotechnology **IPR and Entrepreneurship** **Semester - VI**

Teaching Scheme
Theory: 3 hours/ week

Examination Scheme
End Semester Examination (ESE): 80 Marks
Paper Duration (ESE): 03 Hours
Internal Sessional Examination (ISE): 20 Marks

UNIT 1: IPR, Patents and copyright **No. of Lecture: 8 Hours, Marks: 16**

General Overview of Intellectual Property Rights, WIPO, WTO, Trade Related Intellectual Property Rights. Patent- Basic requirements of Patentability, Patentable Subject Matter, Procedure for Obtaining Patent, Provisional and Complete Specification. Copyright-Objectives of copyright, Rights conferred by registration of copyright, Infringement of copyright.

UNIT 2: Trademarks, GI and other types of IPR **No. of Lecture: 8 Hours, Marks: 16**

Trademarks-Basic Principles of Trademark, Rights conferred by Registration of Trademark, Infringement of Trademark. Geographical Indications-Objectives of Geographical Indications, Rights conferred, Infringement of Geographical Indications, International Position, Indian Position, Bioprospecting and Biopiracy. GATT Farmers rights, plant breeders right.

UNIT 3: Biosafety and Bioethics **No. of Lecture: 8 Hours, Marks: 16**

Biosafety and Bioethics Management-Key to environmentally responsible use of biotechnology. Cartagena Protocol on Biosafety, Ethical implications of Biotechnological products and techniques. Contempory ethics of healthcare. Ethical aspects of hazardous worte and toxic substance. Ethical aspects of scientific publishing.

UNIT 4: Entrepreneurship **No. of Lecture: 8 Hours, Marks: 16**

Need, scope and characteristics of entrepreneurship management of self and understanding human behavior, business ethics, performance appraisal, and (SWOT) analysis. Market survey techniques - Criteria for the principles of product selection and development.

UNIT 5: Marketing **No. of Lecture: 8 Hours, Marks: 16**

Elements of Marketing and Sales Management - Nature of product and market strategy, Packaging and advertising, After Sales Service, Pricing techniques. Financial institutions, financial incentives. Technical feasibility of the project, plant layout & process planning for the product, Quality Control, Critical Path Method (CPM) and Project Evaluation Review Techniques (PERT) as planning tools for establishing SSI.

Reference Books:

1. Entrepreneurship: New Venture Creation, David H. Holt.
2. Patterns of Entrepreneurship: Jack M. Kaplan.
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka,Sultan Chand.

Bioprocess Engineering & Fermentation Technology

LAB COURSE OUTLINE

(Bioprocess Engineering & Fermentation Technology Lab)

Genetic Engineering	**BEFT**	**BTP-608**
Course Title	Short Title	Course Code

Practical	**Hours/ Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	04	**15**	**60**	**02**

Course Description:

In this laboratory course, emphasize has given on the understanding of basics of bioreactor design, various sterilization procedures involved, kinetics of the processes and fermentation procedure of various products.

General Objective:

The objective of the laboratory is to impart the basic knowledge of bioprocess engineering. This practical course also focuses on various sterilization techniques involved in the field of bioprocess engineering. This course also deals with the study of kinetics and other aspects of microbial cultures.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

Learning Outcomes:

After successful completion of this lab student will be able to:

1. Understand the basic design of the fermenter.
2. Apply the knowledge to study kinetics of the process.
3. Apply the knowledge of sensors and various sterilization techniques involved in the process.

LAB Course Content

TE Biotechnology Bioprocess Engineering & Fermentation Technology Semester – VI

Teaching Scheme	**Examination Scheme**	
Theory: 3 hours/ week	Internal Continuous Assessment (ICA)	: 50 Marks
	External Sessional Examination (ESE)/ Oral (OR)	: 50 Marks

Minimum eight experiments from the following:

1. Introduction to the fermenter.
2. Feed Sterilization
3. Fermenter Sterilization
4. Growth kinetics of microorganisms using shake flask method.
5. Determination of specific thermal death rate constant (Ka).
6. Determination of Volumetric oxygen transfer coefficient (KLa), effect of aeration and agitation speed.
7. Preparation of Immobilized enzymes and cells and evaluation of kinetic parameters.
8. Kinetics study of Product formation.
9. Effect of substrate and product concentration on biomass yield for baker's yeast production.
10. Studies on settling characteristics of various microbial cultures
11. Study of Physical and chemical sensors for medium and gases.
12. Fermentative production of Sauerkraut.

Reference books:

1. R.A.Dixon and Gonzales, Plant Cell Culture : A Practical Approach, IRL Press.
2. S.S.Purohit, Biotechnology: Fundamentals and Applications, Agrobios (India), 4th Edition, 2005.
3. P.F.Stanbury, A.Whitkar and S.J.Hall, Principles of Fermentation Technology, Aditya Book House, New Delhi.
4. B.D.Singh, Biotechnology: Expanding Horizons, Kalyani Publishers, New Delhi, Second Revised Edition, 2008.
5. Biochemical Methods, Second Edition by S. Sadasivam, A. Manickam, New Age International Ltd, Publishers.

Lab Mass Transfer

LAB COURSE OUTLINE

Mass transfer Lab	**MT LAB**	**BTP-607**
Course Title	Short Title	Course Code

Laboratory	**Hours/Week**	**No. of Weeks**	**Total Hours**	**Semester Credit**
	02	**12**	**24**	**01**

Mass Transfer Lab

Course Description:
The goal of the course is intended to provide a strong foundation in concepts and principles of mass transfer operations used in industries.

Prerequisite Course(s): 12th Std. Science and SE Biotechnology Courses.

General Objective: The objective of the laboratory is to impart the practical knowledge of Mass transfer operations to the students.

Learning Outcomes:
After successful completion of this lab course; the student will be able to:

1. Explain and apply various separation techniques in industries.
2. Determine purity of product in process industries.
3. Increase purity of various products in process industries.

Mass Transfer

Semester-V

Teaching Scheme
Practicals -2 Hrs/week

Examination Scheme
External Sessional Exams (ESE)/Oral (OR):25 Marks.
Internal Continuous Assessment (ICA): 25 Marks.

Minimum 08 experiments shall be performed from the following:

1. To determine mass transfer coefficient for dissolution of benzoic acid without chemical reaction.
2. Simple Distillation: To verify Rayleigh's equation for simple distillation
3. To study Bubble Cap Distillation.
4. Liquid – Liquid Extraction: To study and determine the efficiency of cross Current liquid- liquid extraction.
5. To construct ternary diagram for acetic acid –water –benzene
6. To plot Tie line diagram for acetic acid –water –benzene
7. To determine the percentage leaching of NaOH from a mixture of NaOH and $CaCo_3$.
8. Adsorption: To study adsorption of acetic acid on activated charcoal
9. To calculate percentage yield of crystals obtained with and without seeding in saturated solution of solute.

Reference Books:

1. R. E. Treybal , Mass transfer operation ,McGraw Hill Publication
2. Coulson and Richardson Chemical Engineering (Vol. I and II), Pergamon Press

Genetic Engineering

LAB COURSE OUTLINE

(Genetic Engineering Lab)

Genetic Engineering	**GE**	**BTP-608**
Course Title	Short Title	Course Code

Practical	**Hours/ Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	02	**15**	**30**	**02**

Course Description:
In this laboratory, course emphasis is on the understanding of basics of Genetic Engineering techniques. The learner can use this knowledge and apply in allied branches of Biotechnology as required.

Prerequisite Course(s): 11th, 12th Biology, SE Biotechnology courses

General Objective:
The objective of the laboratory is to impart the fundamental knowledge of Genetic Engineering at the research level to the students and develop their ability to apply the specific procedures to analyze the experimental results. In this lab, students will be familiar with the Genetic Engineering lab techniques which they can apply in research and Development in the field of Biotechnology.

Learning Outcomes:
After successful completion of this lab student will be able to:

1. Use restriction digestion enzyme for various applications of DNA study
2. Use ligation enzyme to join different DNA to form new product
3. Prepare plasmid for various applications
4. Use DNA fingerprinting method by RFLP for various applications.
5. To map the genomic DNA
6. To transform DNA by using various vectors
7. Will be able to apply the knowledge of Southern, Northern and western blotting for the detection of target DNA, RNA and proteins.

LAB COURSE CONTENT

TE Biotechnology **Genetic Engineering** **Semester – V**

Teaching Scheme
Practical: 2 hours/ week

Examination Scheme
Internal Continuous Assessment: 25 Marks

Minimum eight experiments from the following:

1. Restriction digestion of genomic DNA of bacteria
2. Ligation of bacterial DNA.
3. Plasmid preparation.
4. DNA fingerprinting (by RFLP)
5. DNA mapping using restriction enzymes
6. Transformation of *E.coli* with plasmid pBR 322
7. Transduction
8. Southern Blotting
9. Northern Blotting

Reference books:

1. Introduction to Practical Biochemistry, Third Edition, by David Plummer.
2. Biochemical Methods, Second Edition by S. Sadasivam, A. Manickam, New Age International Ltd, Publishers.

Minor Project

Course Outline

Minor Project	Minor Project	BTP-609
Course Title	Short Title	Course Code

Examination Scheme:
Internal Continuous Assessment: 50 Marks
Practical Hrs/week: 2 hrs

A minor project related to Biotechnology and allied fields.
Project report should consist of details of work carried out by the student.
Every student shall be required to present a seminar in the presence of two teachers. These teachers (fixed by the head of department in consultation with the Principal) shall award the marks based on the following:
(a) Report 20 marks
(b) Seminar presentation 20 marks
(c) Viva-voce at the time of Seminar presentation 10 marks

SEMINAR-I

Course Outline

Seminar-I	**Seminar-I**	**BTP-610**
Course Title	Short Title	Course Code

Examination Scheme:
Internal Continuous Assessment: 25 Marks
Practical hrs / week: 2 hrs.

During sixth term, every student individually will study a topic assigned to him and submit a report in a typed form and shall deliver a short lecture / seminar on the topic at the time of seminar oral examination .The topic assigned will be related to the field of Biotechnology, Biochemical Engineering and allied fields.
The students shall deliver the seminar (10 to 15 minutes) and submit the seminar report to the staff member on different technical subjects during the semester. The assessment of the term work shall be based on the: -

1. Attendance to the seminar-5 Mark
2. Performance of the seminar delivery-10 Mark
3. Seminar report -5Mark
4. Viva voce during the seminar- 5 Mark

The staff member/members shall guide the students in:

1. Selecting the seminar topic.
2. Information retrieval (literature survey)

a) Source of Information i.e. names of the journals, reports, books etc.
b) Searching for the information i.e. referring to chemical abstracts etc.

3. Preparing the seminar report
4. Delivering the seminar

The oral examination shall be conducted by a committee of teachers internally which shall include the concerned guide also and shall award the oral marks (at the end of sixth term).