

Revised Curriculum

for

**DIPLOMA IN
BIOTECHNOLOGY**

(III Semester)

YEAR 2010

Developed By

DIRECTORATE OF TECHNICAL EDUCATION & TRAINING

Orissa, Cuttack

In Collaboration with

NITTR, KOLKATTA

**STATE COUNCIL FOR TECHNICAL EDUCATION &
VOCATIONAL TRAINING, ORISSA, BHUBANESWAR**

**1. SALIENT FEATURES OF THE DIPLOMA PROGRAMME
IN BIOTECHNOLOGY**

1. Name of the Programme : Diploma Programme in BIOTECHNOLOGY
2. Duration of the Programme : Three Years
3. Entry Qualifications : Matriculation or equivalent as prescribed by AICTE
4. Admission Criteria : Entrance Examination/Test(DET)
5. Intake : 40
6. Pattern of the Programme : Semester Pattern
7. Ratio between Theory & Practical : 50 : 50

2. JOB OPPORTUNITIES

Employment opportunities for diploma holder in BIOTECHNOLOGY are visualized in following industries at various levels/positions:

i) Biotechnology and Allied Industries like

- (a) Pharmaceutical industry
- (b) Tissue culture Laboratory
- (c) Aquaculture field
- (d) Research Laboratory
- (e) Dairy
- (f) Seed producing plants
- (g) Fine chemical industry
- (h) Breweries
- (i) Mineral water industry
- (j) Food Processing industry
- (k) Consumer goods industry etc.
- (l) Chemical process industry
- (m) Food industry
- (n) Agro industry
- (o) Leather industry
- (p) Pharmaceutical industry
- (q) Distilleries
- (r) Plantation

In various functional areas like erection and commissioning of plant, plant operation, production, maintenance and safety, quality control, inspection and testing, marketing and sales, consultancy services and areas concerning environmental protection.

(ii) Research Organizations like CSIR laboratories, Defence laboratories, Atomic energy establishments etc.

(iii) Entrepreneurs to small/tiny units especially food, agro and biochemical industries.

3. COURSE OBJECTIVES

Keeping in view the employment opportunities of diploma holders in Chemical Engineering, the course is aimed at developing following knowledge and skills in the students:

1. Basic understanding of concepts and principles related to applied sciences as a foundation for further studies.
2. Development of communication and interpersonal skills for effective functioning in the world of work.
3. Understanding of basic concepts and principles of mechanical, electrical and civil engineering so as to enable the students to apply the knowledge of these principles to the field of Biochemical engineering.
4. Ability to read and interpret drawings related to plant layout, process equipment and components.
5. Knowledge of various materials used in Biochemical processes, their properties and specifications.
6. Knowledge and associated skills of various unit operations, unit processes and process instrumentation in process industry.
7. Ability to calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process.
8. Ability to control the process and quality of the products commensurating with laid specifications.
9. Understanding of basic principles of managing men, material and machines/ equipment for optimum production.
10. Appreciation of the need of clean environment and its deterioration by various emissions from industry and preventive procedures and knowledge of safety regulations in process industry.
11. Development of generic skills of thinking and problem-solving, communication, attitudes and value system for effective functioning in a process industry.
12. Proficiency in the use of computers.
13. Basic manual and machining skills as an aid to function effectively in the process industry.
14. Knowledge of testing and quality control activities.
15. Detailed knowledge of Biotechnology and Biochemical products along with processes involved in their production.
16. Detailed knowledge of fertilizers and technology involved in their production along with important Biotechnology plants in India.
17. Development of good personality in order to have effective communication and business ethics.

4. DERIVING CURRICULUM AREAS FROM COURSE OBJECTIVES

The following curriculum areas have been derived from course objectives.

Sr. No.	Curriculum Objectives	Curriculum Areas/Subjects
1.	Basic understanding of concepts and principles related to applied sciences as a foundation for further studies.	<ul style="list-style-type: none"> - Applied Physics - Applied Chemistry - Applied Mathematics
2.	Development of communication and interpersonal skills for effective functioning in the world of work.	<ul style="list-style-type: none"> - Communication Skills
3.	Understanding of basic concepts and principles of mechanical, electrical and civil engineering so as to enable the students to apply the knowledge of these principles to the field of chemical engineering.	<ul style="list-style-type: none"> - General Engineering
4.	Ability to read and interpret drawings related to plant layout, process equipment and components.	<ul style="list-style-type: none"> - Engineering Drawing - Process Equipment Design & Drawing
5.	Knowledge of various materials used in biochemical processes, their properties and specifications.	<ul style="list-style-type: none"> - Microbiology - Biochemistry - Cell Biology
6.	Knowledge and associated skills of various unit operations, unit processes and process instrumentation in process industry.	<ul style="list-style-type: none"> - Introduction to Biotechnology - Fluid Flow - Heat Transfer - Mechanical Operations - Mass Transfer - Process Instrumentation - Engineering Thermodynamics - Process Utilities - Reaction Engineering
7.	Ability to calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process.	<ul style="list-style-type: none"> - Stoichiometry - Introduction to Biotechnology
8.	Ability to control the process and quality of the products commensurating with laid specifications.	<ul style="list-style-type: none"> - Elective/Specializations - Pharmaceutical Industries - Plant Biotechnology - Industrial Biotechnology - Bioinformatics

9.	Understanding of basic principles of managing men, material and machines/ equipment for optimum production.	- Entrepreneurship Development and Management
10.	Appreciation of the need of clean environment and its deterioration by various emissions from industry and preventive procedures and knowledge of safety regulations in process industry.	- Environmental Engineering and Safety
11.	Development of generic skills of thinking and problem-solving, communication, attitudes and value system for effective functioning in a process industry.	- Industrial Visits - Project Work
12.	Proficiency in the use of computers.	- Computer Applications in Engineering - Basics of Information Technology
13.	Basic manual and machining skills as an aid to function effectively in the process industry.	- General Workshop Practice
14.	Knowledge of testing and quality control activities.	- Biochemical Process Industries
15.	Development of good personality in order to have effective communication and business ethics.	- Student Centered activity

5. ABSTRACT OF CURRICULUM AREAS/SUBJECTS

a) Basic Sciences and Humanities

1. Communication Skills
2. Basics of Information Technology
3. Entrepreneurship Development and Management

b) Applied Sciences

4. Applied Mathematics
5. Applied Physics
6. Applied Chemistry
7. Organic Chemistry
8. Physical Chemistry
9. Basic Life Science

c) Basic Courses in Engineering/Technology

10. Engineering Drawing
11. General Workshop Practice
12. General Engineering

d) Applied Courses in Engineering/Technology

10. Introduction to Biotechnology
11. Industrial Stoichiometry
12. Applied Microbiology
13. Biochemistry
14. Cell biology
15. Molecular Biology
16. Genetic Engineering & genomics
17. Immunology & Enzyme engineering
18. Fluid Flow
19. Mechanical Operations
20. Engineering Thermodynamics
21. Reaction Engineering
22. Industrial Chemical Calculations
23. Heat Transfer
24. Mass Transfer
25. Environmental Engineering and Safety
26. Process Instrumentation
27. Biochemical Process Industries
28. Process Equipment Design and Drawing
29. Computer Applications in Chemical Engineering
30. Process utilities
31. Minor Project
32. Major Project

e) Specialised Courses in Engineering/Technology)

(Electives, any one of the following)

33. Plant Biotechnology
34. Industrial Biotechnology
35. Pharmaceutical Biotechnology
36. Bioinformatics

SEMESTER: III

Detailed Curriculum Structure for **Diploma in BIOTECHNOLOGY**

TEACHING AND EVALUATION SCHEME

Sl. No.	Subject with Curriculum Reference No	Teaching Scheme (Hours/Week)			Evaluation Scheme						Total Marks
		L	T	P	Theory			Practical			
					End Exam.	Internal Assessment	Class Test	Assignment	End Exam.	Sessional	
1.	Physical Chemistry	3	1	-	80	15	5	-	-	100	
2.	Basic Life Science	3	1	-	80	15	5	-	-	100	
3.	Organic Chemistry	4	0	-	80	15	5	-	-	100	
4.	Introduction to Biotechnology	4	0	-	80	15	5	-	-	100	
5.	Industrial Stoichiometry	3	1	-	80	15	5	-	-	100	
Practical											
1	Physical Chemistry	0	0	4	-	-	-	25	25	50	
2	Basic Life Science	0	0	4	-	-	-	25	25	50	
3	Organic Chemistry	0	0	3	-	-	-	25	25	50	
4	Introduction to Biotechnology	0	0	3	-	-	-	25		25	
5	Technical Seminar	-		2	-	-	-	25		25	
6	Field Study/ Training			3				25	25	50	
	Total	17	3	19	400	75	25	150	100	750	

PHYSICAL CHEMISTRY

L T P
3 1 0

Curri. Ref. No. : CH-405

Total Contact hrs. : 60
Theory : 60

Total Marks : 100

Theory Exam. : 3 hrs.
End Exam. : 80 Marks

I.A. : 15 Marks

Assignment : 05 Marks

Rationale:

The phenomenal progress of technology in the 20th century has brought dramatic changes in human life styles. The technology, which has thus enhanced the quality of human life, is evolved based on scientific research, primarily physical, inorganic and organic Chemistry. Use of various organic and inorganic compounds and their physical phenomenon are very much essential for any process industry. Therefore the knowledge of Chemistry is necessary for the success of Biotechnologists.

Objective:

On completion of study of Physical Chemistry the student will be able to:

1. Conceptualise physical properties of liquid.
2. Understand solution and its properties.
3. Understand the concept of Osmosis and Osmotic Pressure
4. Explain distribution law.
5. Understand the concept of colloids.
6. Understand the concept of Adsorption
7. Understand the concept of photochemistry.

Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1	Physical Properties of Liquids	10	14
2.	Solutions	09	12
3.	Osmosis and Osmotic Pressure	09	09
4.	Distribution Law	08	09
5.	The Colloids	08	12
6.	Adsorption	08	12
7.	Chemical Kinetics	08	12
	Total	60	80

COURSE CONTENT:

1.0 PHYSICAL PROPERTIES OF LIQUIDS

- 1.1 Outline the kinetic molecular description and intermolecular forces in liquid.
- 1.2 Define vapour pressure and determine vapour pressure by static and dynamic method.
- 1.3 Define surface tension and determine surface tension by capillary-rise method and drop formation method.
- 1.4 Define viscosity and measurement of viscosity by Oswald method.
- 1.5 Define refractive index, specific refraction
- 1.6 Define optical activity and measurement of optical activity.
- 1.7 Solve simple problems based on physical properties of liquid.

2.0 SOLUTIONS

- 2.1 Define solution and concentration of solution.
- 2.2 Classify solutions.
- 2.3 Solve numerical related to concentration.
- 2.4 Discuss solubility of partially miscible liquids.
- 2.5 State Rault's Law and explain the lowering of vapour pressure and its measurement.

3.0 OSMOSIS AND OSMOTIC PRESSURE.

- 3.1 Explain osmosis and osmotic pressure with example.
- 3.2 Describe the function of semi permeable membrane.
- 3.3 Determine Osmotic pressure.
- 3.4 Explain the theories of Osmosis
- 3.5 Explain reverse osmosis

4.0 DISTRIBUTION LAW

- 4.1 State and explain Nerst's distribution law
- 4.2 Determination of equilibrium constant from distribution coefficient.
- 4.4 Discuss the concept of liquid-liquid chromatography
- 4.5 Describe the applications of distribution law.

5.0 COLLOIDS

- 5.1 Define colloids
- 5.2 Discuss types of colloidal systems
- 5.3 Discuss characteristics and properties of sols.
- 5.4 Explain methods of preparation of sols.
- 5.5 Explain methods of purification of sols.
- 5.6 Discuss the optical, kinetic and electrical properties of sols.
- 5.7 Define emulsion and explain types of emulsion.

6.0 ADSORPTION

- 6.1 Define adsorption
- 6.2 Compare absorption and adsorption
- 6.3 Discuss types of adsorption.
- 6.4 Compare physical adsorption and Chemisorption.
- 6.5 Explain langmuir adsorption isotherm.

7.0 CHEMICAL KINETICS

- 7.1 Define Order of Reaction, Molecularity of Reactions, Different types of Reactions
- 7.2 Temperature dependency of Rate Constant(no proof is required)
- 7.3 Mechanism of Rate Equation
- 7.4 Integrated form of Zero Order, First Order and Second Order Reactions.
- 7.5 Simple Problems.

TEXT BOOK:

1.0 B.S. Bahl, H.D. Tuli, A. Bahl, “ Essentials of Physical Chemistry” S. Chand & Co.

REFERENCE BOOKS:

1. K.K. Sharma, L.K. Sharma: Physical Chemistry.
2. Puri, Sharma, Pathania : Principle of Physical Chemistry.

PHYSICAL CHEMISTRY LABORATORY

L T P
0 0 4

Curri. Ref. No. :

Total Contact hrs. :60

Total Marks : 50

Practical Exam. : 4 hrs.

Theory : Nil

Practical Exam. : 25 Marks

Practical: 60

Sessional: 25 Marks

List of experiments :

Sr No	Name Of Experiment	No of Periods
1	Determine the viscosity of a liquid by Red wood viscometer at different temperatures and plotting graph between viscosity and temperature.	06
2	Determine the refractive index of different liquids and hence specific and molar refraction	06
3	To determine the percentage of two optically active substances in a given solution polarimetrically.	06
4	To determine the value of rate constant (k) for the hydrolysis of ethyl acetate catalyzed by hydrochloric acid.	06
5	To determine the partition coefficient of iodine between water and carbon tetrachloride.	06
6	To determine the partition coefficient of benzoic acid between water and benzene at room temperature and molecular state of Benzoic acid in benzene as compared to its solution in water.	06
7	To prepare colloidal solution of starch and egg albumin.	06
8	To study the dialysis of starch sol containing sodium chloride through a cell phane of parchment paper.	06
9	To determine the adsorption isotherm of acetic acid by activated charcoal.	06
10	To investigate the adsorption of oxalic acid from aqueous solution of activated charcoal and examines the validity of Freundlich and Langmuir's adsorption isotherm.	06

REFERENCE BOOKS

1. Physical Chemistry by Dr. Sudharani
2. Advanced Practical Physical Chemistry by J.B.Yadav

BASIC LIFE SCIENCE

L T P
3 1 0

Curri. Ref. No. :

Total Contact hrs. : 60
Theory : 60

Total Marks : 100

Theory Exam. : 3 hrs.
End Exam. : 80 Marks

I.A. : 15 Marks

Assignment : 05 Marks

Rationale:

From the pre-historic time, man knew the utilization of plants and animals in various ways. He had the practical interest and curiosity to know the phenomenon of the nature. Primitive man used many wild plants for shelter food, medicine, tools and other purposes. He was also hunting animals for his food and could know how to defend himself from predators. For this, he knows about the habit, habitat and behaviors of various animals and plants. Later useful animals and plants were recognized and man formed stable association with them. This interest of man in animals and plants around him, led the foundation of biology (Basic Life Science)

Objective:

After completion of study of Basic Life Sciences the student will be able to:

1. Know the scope and different aspects of biology in relation to mankind and the Society.
2. Know about the important elements of cell and their physical and chemical behaviour.
3. Know the structure and function of the different systems and their importance for continuation of life in brief.

Topic wise distribution of periods

Sl . No.	Topics	Periods	Marks
1	Introduction to Biology	03	06
2.	Varieties of Life	04	06
3.	Chemicals of Life	09	12
4.	Continuity of Life	09	12
5.	Nutrition	06	10
6.	Respiration	09	10
7.	Transport	09	08
8.	Co- ordination Control	06	08
9.	Reproduction	05	08
	Total	60	80

COURSE CONTENT

1.0 INTRODUCTION TO BIOLOGY

- 1.1 Define and explain Botany
- 1.2 Define and explain Zoology
- 1.3 Define and explain the structure of a Cell
- 1.4 Define Cell as a Basic unit of life
- 1.5 Define Cell theory
- 1.6 Explain unity and diversity of cell
- 1.7 Differentiate between prokaryotic and eukaryotic cell.
- 1.8 Differentiate between plant cell and animal Cell

2.0 VARIETIES OF LIFE

- 2.1. Define and explain five kingdom Classification.
- 2.2. State and explain bacteria and its structure
- 2.3. State and explain the virus and its structure

3.0 CHEMICALS OF LIFE

- 3.1 State and explain physical and Chemical nature of life
- 3.2 State and explain the Chemical elements present in the cell.
- 3.3 State and explain the principal compounds present in the cell.
- 3.4 Define and explain carbohydrates.
- 3.5 Define and explain proteins
- 3.6 Define and explain lipids.
- 3.7 Define and explain nucleic acids.

4.0 CONTINUITY OF LIFE

- 4.1 State and explain the structure and function of cell membrane.
- 4.2 State and explain different cell organelles and their function.
- 4.3 Explain the structure of chromosome.
- 4.4 Explain the process of cell cycle.
- 4.5 Define and explain mitosis.
- 4.6 Define and explain meiosis.
- 4.7 State and explain Mendel's laws of inheritance.
- 4.8 State and explain sex linked inheritance.

5.0 NUTRITION

- 5.1 State and explain photosynthesis.
- 5.2 Explain the digestive system and process of digestion in human being.

6.0 RESPIRATION

- 6.1 Define and explain cellular respiration.
- 6.2 Explain the structure and function of ATP.
- 6.3 Define fermentation.

7.0 TRANSPORT

- 7.1 Explain plant water relationship.
- 7.2 State and explain diffusion.
- 7.3 State and explain osmosis.
- 7.4 State and explain the transport of water and minerals in plants.
- 7.5 State and explain transpiration.
- 7.6 Explain the circulation of blood in human body.
- 7.7 Briefly explain the immune system in human beings.

8.0 COORDINATION CONTROL

- 8.1 State and explain different movements of plants.
- 8.2 Briefly explain the nervous system in human beings.

9.0 REPRODUCTION

- 9.1 Explain reproduction in flowering plants.
- 9.2 Explain reproduction in human beings.

TEXT BOOKS:

1. Text book of Botany by A.K. Nanda
2. Text book of Zoology by S.Pati, R.R.Nanda and K.K.Ghosh

BASIC LIFE SCIENCE LABORATORY

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Curri. Ref. No. :

Total Contact hrs. :60

Total Marks : 50

Practical Exam. : 4 hrs.

Theory : Nil

Practical Exam. : 25 Marks

Practical: 60

Sessional: 25 Marks

List of experiments:

Sr No	Name Of Experiments	No of Periods
1	Study of plant model of monocots and dicots	06
2	Study of different parts of plant	06
3	Root section of monocots and dicot roots	06
4	Transverse section of leaf	06
5	Study of different parts of flower	06
6	Study of angiospermic flower	06
7	Demonstration of transpiration in plants	06
8	Dissection of digestive system	06
9	Dissection of respiratory system	06
10	Dissection of nervous system	06

ORGANIC CHEMISTRY

L T P
3 1 0

Curri. Ref. No. :

Total Contact hrs. : 60

Total Marks : 100

Theory Exam. : 3 hrs.

End Exam. : 80 Marks

Theory : 60

Practical : Nil

I.A. : 15 Marks

Assignment : 05 Marks

Rationale:

Study of organic chemistry as a separate subject is more practical and fruitful. The knowledge of structure and function of a large no. of compounds built of relatively few elements is important for future bio-technologist.

Objective:

On completion of study of Organic Chemistry, the student will be able to:

1. Name organic compound in IUPAC system
2. Understand the concept of isomerisation
3. Acquaint themselves with methods preparation, properties and use of common aromatic and aliphatic compounds.
4. Acquire knowledge carbohydrates, proteins and amino acids.

Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1	Nomenclature	15	10
2.	Aliphatic Compounds	18	30
3.	Aromatic Compounds	07	10
4.	Carbohydrates, Proteins & fats	20	30
	Total	60	80

COURSE CONTENT

1.0 IUPAC NOMENCLATURE

- 1.1 Understand scope of organic chemistry
- 1.2 Differentiate organic compound and inorganic compounds
- 1.3 Outline the importance of organic Chemistry in modern life.
- 1.4 Explain the structure of organic compound
- 1.5 Classify organic compounds
- 1.6 Name aliphatic compounds as per IUPAC system.
- 1.7 Name the aromatic compounds as per the IUPAC systems.
- 1.8 Illustrate isomerisation with examples.

2.0 ALIPHATIC COMPOUNDS

- 2.1 Explain the methods of preparations, properties and uses of methane and ethane.
- 2.2 Explain the methods of preparations properties of ethylene.
- 2.3 Explain the methods of preparation, properties and uses of acetylene.
- 2.5 (a) Explain how to distinguish between 1°, 2°, 3° alcohol
 - (b) Explain the methods of preparation properties and uses of methanol and ethanol
 - (c) Explain absolute alcohol and denatured alcoholic

3.0 AROMATIC COMPOUNDS

- 3.1 Explain the methods of preparation, properties and uses of
 - (a) Benzene
 - (b) Toluene

4.0 CARBOHYDRATES, PROTEINS & FATS

- 4.1 Classify and name carbohydrates
- 4.2 Explain the synthesis and inter conversions of monosaccharides
- 4.3 Explain the manufacturing properties and uses of glucose, fructose, sucrose, and lactose.
- 4.4 Define Amino acid, Peptides and proteins
- 4.5 Classify proteins & Fats
- 4.6 Explain the properties and uses of proteins & Fats
- 4.7 Explain the synthesis of amino acids.

TEXT BOOKS

- 1.0 Advanced organic Chemistry by B.S. Bahl, Arun Bahl.

ORGANIC CHEMISTRY LABORATORY

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Curri. Ref. No. :

Total Contact hrs. : 45

Total Marks : 50

Practical Exam. : 4 hrs.

Theory : Nil

Practical Exam. : 25 Marks

Practical : 45

Sessional : 25 Marks

Sl. No.	List of Experiments	No. of Periods
1.	Detect the following elements in the organic compound i) Nitrogen ii) Sulphur iii) Halogen	09
2.	Determine different functional groups of i) Acids ii) Alcohols iii) Aldehydes iv) Ketones v) Esters vi) Phenol vii) Amines viii) Nitro ix) Amide x) Carbohydrate	18
3.	Systematic qualitative analysis of organic compound	12
4.	Determine boiling point and melting point	06

INTRODUCTION TO BIOTECHNOLOGY

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3 1 0

Curri. Ref. No. :

Total Contact hrs. : 60
Theory : 60

Total Marks : 100

Theory Exam. : 3 hrs.
End Exam. : 80 Marks

I.A. : 15 Marks

Assignment : 05 Marks

Rationale:

The term Biotechnology was coined during late 1970s when the advances in molecular and cell biology catalysed new industrial ventures to exploit these advances for the benefit of mankind. The European Federation of Bio-technology has defined Biotechnology as the integrated use of biochemistry, microbiology and engineering sciences in order to achieve technological or industrial application of capabilities of microorganisms. In simple terms, Biotechnology is the use of living organisms to make products of value of man. The use of term biotechnology may imply a single subject, but the essence of biotech is its multi disciplinary nature. Biotechnology has involved from integrated use of life sciences, chemical sciences and engineering sciences.

Objective:

After completion of the study of Introduction to Biotechnology the student will be able to:

1. know about biotechnology and its relation to society and mankind.
2. know about different branches of biotechnology and their utility to improve the life style.
3. know about different discoveries related to biotechnology and their application to improve the mankind.
4. know about the medicines and antibiotics produced by manipulation and application of some bio-technological processes.

Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1	Biotechnology	05	10
2.	Genetics and Biotechnology	14	15
3.	Bioprocess and Fermentation Technology	10	15
4.	Enzymology	12	15
5.	Environmental Biotechnology	07	09
6.	Medicines in relations to Biotechnology	06	08
7.	Biotechnology in Agriculture and Forestry	06	08
	Total	60	80

1. BIOTECHNOLOGY

- 1.1 Define Biotechnology
- 1.2 Describe the public perception on Biotechnology
- 1.3 Describe about Biotechnology in the developing world
- 1.4 List natural raw materials
- 1.5 List the Chemical and Biochemical feed stocks
- 1.6 State about raw materials and future of Biotechnology

2.0 GENETICS AND BIOTECHNOLOGY

- 2.1 Define industrial genetics
- 2.2 Describe protoplast and cell fusion technologies
- 2.3 Define genetic engineering
- 2.4 Define and explain about PCR

3.0 BIOPROCESS AND FERMENTATION TECHNOLOGY

- 3.1 State the principles of microbial growth
- 3.2 Describe bio reaction
- 3.3 Define scale-up
- 3.4 State the media design for fermentation process
- 3.5 Define down stream processing

4.0 ENZYMOLOGY

- 4.1 State the nature of enzymes
- 4.2 List out the application of enzymes
- 4.3 Describe the technology for enzyme production
- 4.4 Define immobilized enzyme

5.0 ENVIRONMENTAL BIOTECHNOLOGY:

- 5.1 Define environmental biotechnology
- 5.2 Describe waste water and sewage treatment
- 5.3 List out the landfill technology
- 5.4 Describe composting briefly
- 5.5 Define bioremediation
- 5.6 Show the relation between microbes and the geological environment
- 5.7 Define sustainability

6.0 MEDICINES IN RELATIONS TO BIOTECHNOLOGY

- 6.1 Define pharmaceuticals and Biopharmaceuticals
- 6.2 Define and list out different antibiotics
- 6.3 Define vaccines
- 6.4 Define and explain monoclonal antibodies
- 6.5 Explain gene therapy

7.0 BIOTECHNOLOGY IN AGRICULTURE AND FORESTRY

- 7.1 Explain plant biotechnology briefly
- 7.2 Explain animal biotechnological briefly
- 7.3 Describe about biological control
- 7.4 Define and write about forestry

Text books:

1. Biotechnology: Demystifying the concept- D. Bourgaize, T.R.Jewell & R.G.Buiser
(Pearson Education Publ.)
2. Understanding Biotechnology – A.Borem,F.R.Sautaos & D.E.Bower (Pearson Education Publ.)

INTRODUCTION TO BIOTECHNOLOGY LABORATORY

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Curri. Ref. No. :

Total Contact hrs. :45
Theory : Nil

Total Marks : 25

Sessional: 25 Marks

List of experiments:

Sl No	Name Of Experiment	No of Periods
1	Observe Basic instrumentation in biotechnology	03
2	Conduct Protoplast isolation and fusion	06
3	Demonstrate Structure of DNA	06
4	Demonstrate Isolation of DNA	06
5	Demonstrate Quantification of DNA	06
6	Demonstrate PCR (polymerase chain reaction)	03
7	Demonstrate Different types of Centrifugation	03
8	Demonstrate Cell immobilization by using alginate	03
9	Demonstrate Extraction of enzymes	06
10	Demonstrate Enzyme kinetic analysis	03

INDUSTRIAL STOICHIOMETRY

L T P
3 1 0

Curri. Ref. No. :

Total Contact hrs. : 60

Total Marks : 100

Theory Exam. : 3 hrs.

Theory : 60

End Term Exam. : 80 Marks

Practical : Nil

I.A. : 20 Marks

Rationale :

In process industries raw materials are processed to get different products. The components present in the raw material combine in a definite proportion and the percentage of product formed depend on various parameters like temperature and pressure etc. It is highly essential to know the stoichiometry ratio and proportions and the process conditions to achieve maximum product formation and recycle of the unused materials for better economy. Therefore, knowledge of stoichiometry is the first and foremost requirement for the success of a process engineer.

Objective:

On completion of study of industrial stoichiometry the student will be able to:

1. Differentiate between different units and dimensions, dimensional analysis and solve relevant problems
2. Compare density, specific gravity etc. of gaseous mixtures
3. Estimate quantitative requirement of materials for a chemical reaction
4. Understand the concept of equilibrium vaporization and condensation
5. Workout raw material requirement for a chemical process from material balance equation
6. Calculate energy requirement for a chemical process from energy balance equation

Topic wise distribution of periods

Sl. No.	Topics	Periods	Marks
1	Units and dimension	03	04
2.	Mole Concept	08	10
3.	Gases and Gaseous Mixtures	09	12
4.	Stoichiometry	08	12
5.	Material balance without chemical reaction	12	16
6.	Material Balance involving chemical reaction	12	16
7.	Energy Balance	08	10
	Total	60	80

1.0 UNIT AND DIMENSIONS

- 1.1 Explain basic and derived units used in process industry.
- 1.2 Solve numerical on unit conversion from one unit to SI unit.
- 1.3 Explain dimension and application of dimensional analysis.
- 1.4 Explain different graphs used in industry.

2.0 MOLE CONCEPT

- 2.1 Define moles, mole fraction, mass fraction
- 2.2 Explain mole concept with respect to chemical equation.
- 2.3 Describe principle of atom conservation
- 2.4 Solve elementary problems on mole concept.

3.0 GASES AND GASEOUS MIXTURES

- 3.1 Explain applications of idea gas law.
- 3.3 Compute Average molecular weight, density and composition (by weight and volume) of gas mixture and solve problems on it.
- 3.4 Explain partial pressure, Vapour pressure, Amagat's law, Dalton's Law and solve problems on it.
- 3.5 State and explain Roul't's law and Henry's law and solve problems on it.

4.0 STOICHIOMETRY

- 4.1 Define and explain Stoichiometry
- 4.2 Explain Basis of Calculation
- 4.3 Explain the concept of limiting reactants.
- 4.4 Explain atomic weight, molecular weight, Chemical equivalence, empirical formula, Molecular formula and solve problems on it.
- 4.5 Solve problems on Chemical reaction on Mass-mass, mass-volume basis.

5.0 MATERIAL BALANCE WITHOUT CHEMICAL REACTION

- 5.1 State and explain law of conservation of mass
- 5.2 Classify and explain material balance.
- 5.3 Solve problems on material balance based Unit operations like mixing, evaporation, distillation, drying, humidification, extraction, absorption

6.0 MATERIAL BALANCE INVOLVING REACTION

- 6.1 Define and explain stoichiometric ratio, stoichiometric proportions, excess reactants, percentage excess, conversion, yield, selectivity
- 6.2 Explain the concept and reaction mechanism in combustion.
- 6.3 Solve problems on material balance with Chemical reaction and combustion.
- 6.4 Explain recycle and by pass concept and solve problems on it.

7.0 ENERGY BALANCE

- 7.1 Explain forms of energy.
- 7.2 State Law of conservation of energy and explain energy balance.
- 7.3 Describe heat capacity, standard heat of reaction and solve problems on it.
- 7.4 Define Hess's law, Heat of Reaction, Heat of Formation, Heat of Combustion
- 7.5 Simple problems on calculation of heat of reaction

REFERENCE BOOKS

1. 'Chemical Process Principle' - Hougen, Watson
2. 'Stoichiometry' - Bhatt, Bhora
3. 'Solved example in Chemical Engineering' - G.K.Ray
4. 'Modern approach to Chemical calculation' - R.C. Mukherjee
5. 'Introduction to process calculation' - K.A. Govhane
- 6 'Process Calculation' - V.Venkataramani., N.Anantharanyan

FIELD STUDY/TRAINING AND TECHNICAL SEMINAR

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Curri. Ref. No. :

Total Contact hrs. :45

Total Marks : 25

Sessional: 25 Marks

SUBJECT: APPLICATION OF BIOTECHNOLOGY IN INDUSTRY

All students will be divided into groups consisting of maximum 10 students and will visit an industry like Milk dairy, Tissue culture Lab, Breweries, Distillery or pharmaceutical industry to study the raw material, process, product, unit operation used, instrumentation and process control, skill required for Diploma level personnel.