**Department of Biochemistry**
**Saurashtra University**
**Rajkot**

# Post Graduate Diploma in Applied Microbiology - Bioprocess Technology

## (Semester I & II) Examination

## General Rules

## O.1 PGDAMBPT:

A candidate for post graduate diploma in Applied Microbiology - Bioprocess Technology must possess the B.Sc. degree in science of this university or any other university recognized by the university grants commission, new delhi (graduates in Biochemistry, Biotechnology, Bioinformatics, Botany, Microbiology, Zoology and any life sciences & have passed the post graduate diploma in clinical research after keeping terms as laid down, that is two semesters and have completed the courses as laid down in the relevant regulation.

Entrance test will be conducted and the admission will be offered on the basis of merit list prepared combining 50 % of the entrance test and 50 % of the final year % of the relevant graduate degree.

Enlistment as post graduate diploma student is essential, within one month of the admission to the course. In the registration, candidate must specify the subjects & the paper of study for post graduate diploma in Applied Microbiology - Bioprocess technology.

## O.2 PGDAMBPT:

Post Graduate Diploma in Applied Microbiology - Bioprocess Technology semester I and II examinations will be held at the end of each semester and internal examination and its remedial examination will be held during the middle in each semester.

## O.3 PGDAMBPT:

Candidates for Post Graduate Diploma in Applied Microbiology - Bioprocess Technology (semester - I and II) examination shall be examined after they have satisfactorily completed the prescribed courses of study & have kept the term in an institution recognized for the purpose under the recognized post graduate diploma teachers in prescribed subjects.

## O.4 PGDAMBPT:

The passing standard in theory and practicals will be 40% in each head of passing. The final class will be awarded as under:

The candidate securing greater than or equal to 70% aggregate marks obtained in all semesters together (Sem. I-II) will be awarded a distinction class.

The candidate securing below 70% but less than equal to 60% aggregate marks obtained in all semesters together (Sem. I-II) will be awarded first class.

The candidate securing the aggregate percentage from 48 to less than 60% aggregate marks obtained in all semesters together (Sem. I-II) will be awarded a second class.

Regular records / test of theories, shall be maintained for each student & 30% of the total marks for each subject in theory shall be allotted for these records/tests and min. 75 % of attendance is mandatory.

## O.5 PGDAMBPT:

The syllabus laid down for various paper of Post Graduate Diploma in Applied Microbiology - Bioprocess Technology (semester-I and II) examination is attached separately at the end of the rules.

## O.6 PGDAMBPT:

No class shall be awarded to the successful candidate at the Post Graduate Diploma in Applied Microbiology - Bioprocess Technology (semester-I) examination.

## O.7 PGDAMBPT:

It is essential to attend seminar / conferences / training and visit industry in the relevant areas.

# SYLLABUS

## Post Graduate Diploma in Applied Microbiology - Bioprocess Technology

## (Semester I-II)

### Choice Based Credit System (CBCS)

## Effective from June 2014

## Department of Biochemistry

## Saurashtra University

## Rajkot

Re-Accredited **Grade B** by NAAC

**(CGPA 2.93)**

# POSTGRADUATE DIPLOMA IN APPLIED MICROBIOLOGY - BIOPROCESS TECHNOLOGY

| Course | Name of Paper | Hours / Week | Credits |
|---|---|---|---|
| | **SEMESTER 1** | | |
| **Core Subjects** | | | |
| CBPT-101 | ADVANCES IN BIOMOLECULES | 04 | 04 |
| CBPT -102 | MOLECULAR METHODS AND TECHNIQUES | 04 | 04 |
| CBPT -103 | BIOPROCESSING TECHNOLOGY AND APPLICATION | 04 | 04 |
| **Interdisciplinary Subject** | | | |
| IBPT -101 | DOWNSTREAM PROCESSING | 04 | 04 |
| **Practicals and Class presentations** | | | |
| CBPT -104 | CLASS PRESENTATIONS | 02 | 02 |
| CBPT -105 | PRACTICALS | 12 | 06 |
| | **SEMESTER 2** | | |
| **Elective Subject (any one out of two)** | | 04 | 04 |
| EBPT -101 | FERMENTATION TECHNOLOGY | | |
| EBPT -102 | BIOSAFETY AND IPR | | |
| **Compulsory Research Work** | | | |
| CBPT -106 | DISSERTATION THESIS WORK / PROJECT WORK | 26 | 12 |
| | | Total Credits | 40 |

## Examination Marks Distribution

| Subject | External Marks | | Internal Marks | | Total Marks | |
|---|---|---|---|---|---|---|
| | Max | Min | Max | Min | Max | Min |
| All Theory Papers (Core, Interdisciplinary & Elective) | 070 | 028 | 030 | 012 | 100 | 040 |
| Practicals | 150 | 060 | - | - | 150 | 060 |
| Seminar | 050 | 020 | - | - | 050 | 020 |
| Dissertation | 300 | 120 | - | - | 300 | 120 |

## SEMESTER-I

## PAPER-I

## CBPT -101: ADVANCES IN BIOMOLECULES

### Unit-1: Amino Acids, Peptides and Proteins

pH, Buffers, Henderson- Hasselbalch equation. Amino Acids: Classification, structure, stereochemistry, chemical reactions of amino acids due to carbonyl and amino groups. Titration curve of glycine and pK values. Essential and non-essential amino acids, non-protein amino acids. Peptide bond - nature and conformation. Naturally occurring peptides – glutathione, enkephalin. Proteins: Classification based on solubility, shape and function. Determination of amino acid composition of proteins. General properties of proteins, denaturation and renaturation of proteins. Structural organization of proteins- primary, secondary, tertiary and quaternary structures (Eg. Hemoglobin and Myoglobin), forces stabilizing the structure of protein. Outlines of protein sequencing.

### Unit-2: Enzymes

Introduction to biocatalysis, differences between chemical and biological catalysis. Classification of enzymes. Enzyme specificity. Active site. Principles of energy of activation, transition state. Interaction between enzyme and substrate- lock and key, induced fit models. Definition of holo-enzyme, apo-enzyme , coenzyme, cofactor. Fundamentals of enzyme assay, enzyme units. Factors affecting the catalysis- substrate concentration, pH, temperature. Michaelis - Menten equation for uni-substrate reaction (derivation not necessary), significance of KM and Vmax. Enzyme inhibition- irreversible and reversible, types of reversible inhibitions- competitive and non-competitive. Outline of mechanism of enzyme action- acid-base catalysis, covalent catalysis, electrostatic catalysis, and metal ion catalysis. Regulation of enzyme activity- allosterism and cooperatitvity, ATCase as an allosteric enzyme, covalent modulation- covalent phosphorylation of phosphorylase, zymogen activation- activation of trypsinogen and chymotrypsinogen. Isoenzymes (LDH). Multienzyme complxes (PDH). Ribozyme. Restriction enzymes.

### Unit-3: Nucleic Acids and Porphyrins

Nature of nucleic acids. Structure of purines and pyrimidines, nucleosides, nucleotides. Stability and formation of phosphodiester linkages. Effect of acids, alkali and nucleases on DNA and RNA. Structure of Nucleic acids- Watson-Crick DNA double helix structure, introduction to circular DNA, super coiling, helix to random coil transition, denaturation of nucleic acids-hyperchromic effect, Tm-values and their significance. Reassociation kinetics, cot curves and their significance. Types of RNA and DNA . Prophyrins: Structure, properties and functions of heme, chlorophylls and cytochromes.

## PAPER-II

## CBPT -102: MOLECULAR METHODS AND TECHNIQUES

### Unit-1: Molecular dogma

DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms. RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport. Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins. Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

### Unit-2: Methods in Molecular biology

Cloning, Cloning vectors, Properties and applications of plasmids, phagemids, phage vectors, cosmids, YAC, BAC, etc; Selection and expression of suitable vectors, cDNA libraries and Genomic libraries, DNA sequencing, Site directied mutagenesis, Hybridization techniques, Molecular markers, Transgenic animals and Plants, Applications of recombinant technology

### Unit 3: Characterization of Nucleic acid

Mapping and DNA fingerprinting: Methodology and applications of Restriction mapping; RFLP; RAPD; AFLP; SSR; REMAP and SCAR analysis. DNA sequencing: Principles and methods for DNA sequencing. Polymerase Chain Reaction: Principle and basic types of PCR; Reverse Transcription and Real Time PCRs; Factors affecting PCR; Applications and precautions.

## PAPER-III

## CBPT -103: BIOPROCESSING TECHNOLOGY AND APPLICATION

### Unit-1: General Microbiology

Introduction to Microbiology, Microbial diversity with representative examples, structure and organization of microbial cells, Microbiology of environment, water and sewage, air, environmental pollution and biodegradation. Microbial physiology and biochemistry, Aerobic and anaerobic growth, microbial nutrition, growth kinetics, microbiological methodology with reference to special metabolic pathways and emphasis on industrial applications, Medical microbiology, Microbiology in human disease, Basic immunological techniques, Immunodiagnostic methods with examples of applications, Monoclonal antibodies.

### Unit-2: Basics of Bioprocessing

Raw materials for bioprocessing, comparison of chemical and biochemical processing based on energetics and environmental issues. Development of inocula, kinetics of enzymatic and microbial processes, optimisation studies, sterilization of media, air and equipment, modes of cell cultivation, general principles of bioreactor design and their operation. Media formulation, sterilization of equipments, gas compressor types and principles of compression, air filtration, solid and liquid handling. Industrially fermented broth (filtration and ultrafiltration), centrifugation, solvent extraction, chromatographic separation, liquid extraction of biopolymers and antibiotics ion exchange recovery of antibiotics and proteins.

### Unit-3: Upstream processing

Production of antibiotics vitamins definition, classification of antibiotics and biochemistry, penicillin, streptomycin, tetracycline's, geriosofulvin, cephalosporin, ampicillin, piocyanase, vitamins-A, Riboflavin, cephalosporin, valinomycin, carotenoids, Solvents, biopolymers and microbial insecticides solvents, ethylalcohol, glycerol, acetone, butanol, 2, 3 butandiol, Biopolymers – expolysacharides, alaganides xanthan, dextran, curdlan polyhydroxybutrate

# PAPER-IV

## IBPT -101: DOWNSTREAM PROCESSING

## Unit 1. Basics of downstream processing

Microbial biomass, single cell proteins and its nutritional values, bakers yeast brewers yeast, food and fodder yeast, carbohydrates – whey molasses starch cellulose / wood waste, sulfite liquor, SCP production technology bacterial protein ICI process yeast protein actionomyceatous protein, mycoproteins, algal proteins (spirulina cultivations)

## Unit 2. Downstream processing, application and properties

Downstream processing, separation and purification techniques, quality assurance testing, representative examples of microbial products, vaccines and vaccine development, immobilization of cells and enzymes : principles, methodology and applications, disintegration of cells, separation of solid and liquid phases, isolation and purification techniques for proteins and other products based on different physico-chemical properties, eg., precipitation, adsorption, chromatographic separations, bio-affinity based methods, Principles of bioprocess control, bioprocess automation and application of computers in bioprocessing, recombinant products with representative examples

## Unit 3. Softwares and application

Computer control of fermentation process, hardware and software application in fermentation technology, fermentation economics, fermentation biofertilizer production, fuel alcohol production, biogas production technology, silage production, aspartame

**SEMESTER-II**

# PAPER-V

## EBPT -101: FERMENTATION TECHNOLOGY

## Unit 1. Bioreactor and fermentation

Introduction to Bioreactor & fermentation, scope, concept & range of Fermentation technology, Tabulation of important fermentation processes

## Unit 2. Fermenter Design & types

Fermenter Design, Design of a typical aerobic fermenter, A study of the parameters to be considered in designing a typical fermentor, Examples of fermenters, i. Mechanical – Typical fermentor, Waldoff fermenter, ii. Hydrodynamic- deep-jet fermenter, iii. Pneumatic - air-lift fermenter, bubble-cap fermenter3. Modes of fermentation operation, Aerobic & Anaerobic, Surface & Submerged, Batch & Continuous

## Unit 3. Fermentation process

Overview of a fermentation process, Development of Industrial Process, Screening of industrially useful microbes – ideal characteristics, primary & secondary screening, Stock cultures – primary & working stock cultures, preservation & inoculum preparation & scaleup of culture for a fermentation process, Fermentation media, Upstream Processing of a typical aerobic, submerged batch fermentation – requirements & scale–up

# PAPER-VI

## EBPT -102: BIOSAFETY AND IPR

## Unit 1. Bioethics and Biosafety

Introduction to Bioethics. Social and ethical issues in Pharma and Biotech industrial research, public education of the process of biotechnology involved in generating new forms of life for informed decision making, biosafety regulation and national and international guidelines, r-DNA guidelines, experimental protocol approvals, levels of containment, regulatory bodies in biotechnology, biosafety committee. biosafety and environmental monitoring of GEMs. Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues. Use of genetically modified organisms and their release in to the environment.

## Unit 2. IPR & Trade Marks

Introduction to patents, Intellectual property rights, WTO, TRIPS, International conventions, patents and copy rights, patent claims, methods of applications of patents. Ethical issues, moral values on experimental animals, ethical implications of biotechnological products and techniques. Regulatory requirements for drugs and Biologics. GLP. GMP, Trade Secrets copyrights, Trade Marks, legal implications, farmers rights, plant breeder's rights. International and National conventions on biotechnology and related areas.

## Unit 3. Application

WTO guidelines, Legal implications, biodiversity and farmers right. Beneficial application and development of research focus to the need of the poor, identification of directions for yield effect in pharmaceutical & biotechnological industry, agriculture, aquaculture etc.

## CBPT -106: DISSERTATION THESIS WORK / RESEARCH PROJECT

**All the students will be provided with the different research problems to carry out individually original research work to fulfillment of degree on the basis of their interest in various research areas.**