## POST GRADUATE DIPLOMA IN FERMENTATION TECHNOLOGY (PGDFT)

<table>
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<tr>
<th>SEM</th>
<th>COURSE CODE</th>
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<th>HRS / WEEK</th>
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<td>CORE I</td>
<td>Biomolecules and Microbial Biochemistry</td>
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Objective:
The course aims to provide students with a basic understanding of the molecular architecture of eukaryotic cells and organelles, including macromolecules.

UNIT I 18 hours
Carbohydrates: Classification, structure, general properties and functions of polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins. 

UNIT II 18 hours
Proteins: Primary (peptide conformation, N- and C- terminal, peptide cleavage), Secondary (α-helix, sheet, random coil, Ramachandran plot), Tertiary and Quaternary structures of proteins.

UNIT III 18 hours

UNIT IV 18 hours
Aerobic respiration, Fermentation -lactic acid Alcohol, Mixed Acid, 2,3 butanediol, Propionic acid, Butyric acid., Metabolic pathways of Energy Use: Gluconeogenesis, Biosynthesis of Lipid, Aminoacid – Arginine, valine, tryptophan, histidine and methionine, catabolism of threonine, cysteine, tyrosine, tryptophan methionine, biosynthesis of Purine and Pyrimidine, Vitamins- water-soluble and lipid-soluble vitamins.

UNIT V 18 hours
Microbial photosynthesis: prokaryotic and eukaryotic photosynthetic apparatus, photophosphorylation, light and dark, reaction, photorespiration, Biological nitrogen fixation, Biochemistry of nitrogen fixation.

# self-study portion
Text Books

UNIT I Chapter II, T.B.1
UNIT II Chapter VII, T.B. 1
UNIT III Chapter X, T.B.1
UNIT IV Chapter XIV, T.B. 2
UNIT V Chapter XIV, T.B. 2

Books for References
Objective: To identify enzymes of interest for target biotransformations by genome.

UNIT I 18 hours
Catalysis, Biocatalysis, chemical nature of enzymes, characteristics - Enzyme Classification and nomenclature. General properties of enzymes like effect of pH, Temperature, Ions etc.

UNIT II 18 hours
Mechanism of enzyme action – Energy mechanics. Enzyme Kinetics – MM hypothesis, Significance of Km and Vm values, Modifiers of Enzyme activity – Reversible and Irreversible modifications.

UNIT III 18 hours
Enzyme assays – methods, isolated enzymes and cell – free preparations, Immobilization of enzymes, industrial applications.

UNIT IV 18 hours
Microbial biodegradation – aerobic & Anaerobic biodegradation of organic pollutants, Bioremediation using extracellular electron transfer, Bacterial degradation of xenobiotics.

UNIT V 18 hours
Oil biodegradation in marine systems – analysis of waste biotreatment in confined environments, metabolic engineering and biocatalytic applications of the pollutant degradation machinery.

Self-study portion

Text Books:

Books for References:
Objective:
To introduce the students to the various concepts of Microbial fermentation.

UNIT I 18 hours

UNIT II 18 hours
Microbial Nutrition - Nutritional requirements, nutritional types of microorganisms. Effect of environment on microbial growth.

UNIT III 18 hours

UNIT IV 18 hours
Primary and secondary metabolites – Organic feed stocks, organic acids, amino acids, enzymes, nucleosides, nucleotides and related compounds, vitamins and antibiotics.

UNIT V 18 hours
Cell immobilization, microbial transformation, single cell protein, sewage treatment, biosensor, bioleaching and effluent treatment, GMO’s.

# self-study portion

Text Books:

   UNIT I Chapter III, T.B. 1
   UNIT II Chapter IV, T.B. 1
   UNIT III Chapter VI, T.B. 1
   UNIT IV Chapter VII, T.B. 2
   UNIT V Chapter XI, T.B. 3

Books for References:
SEMMESTER I: CORE IV
PRINCIPLES OF FERMENTATION TECHNOLOGY

Objective:
To empower the students with various designs of fermenter. The knowledge on fermentation process enable the students to manipulate microbes for improvement.

UNIT I
Major types of organisms used in fermentation. Microbial growth kinetics, #Batch culture, Continuous Culture, Fed – Batch – Types#, applications, fermentation kinetics.

UNIT II
Isolation, preservation and improvement of industrially important microorganisms, media for industrial fermentations – media formulation, #Development of inoculum for industrial fermentations#.

UNIT III
Fermentor design and types-basic functions of a Fermentor for microbial and animal cell culture – alternative vessel design, common measurements and control systems. #Sensors – solutions to common problems in fermentation#, anaerobic fermentation.

UNIT IV
Control of fermentation – requirements for control, design of a fermentation control systems, sensors and controllers, control of incubation, #aeration and agitation#.

UNIT V
Computers in fermentation, modeling, software sensors, control and supervision of fermentation processes. – #off-line / online measurements – PID#. #self-study portion

Text Books:
   UNIT I Chapter III, T.B.1
   UNIT II Chapter IV, T.B. 1
   UNIT III Chapter V, T.B.1
   UNIT IV Chapter IV, T.B. 2
   UNIT V Chapter V, T.B. 2

Books for References:
Objective:
To train students to understand the concepts of fermentor and microbial enzymes.

1. Media preparation, Sterilization.
2. Culture transfer techniques, Isolation of pure cultures.
3. Microbial isolation and screening.
4. Bacterial staining
5. Bacterial growth curve studies
6. Isolation of Antibiotic producing organism
7. Extracellular activities of micro organisms- amylase, gelatinase, lipase, caseinase
8. Qualitative study of enzyme activity
9. Effect of pH, Temperature, Substrates, Inhibitor on enzyme activity
10. Enzyme kinetics – Km, Vmax, Specific activity and activity determination
11. Anatomy of Fermentor, cleaning of Fermentor, Assembling and final pre-sterilization of Fermentor, Anatomy and calibration of fermentator electrodes / probes, Post – sterilization procedures, Aseptic techniques in inoculation of fermentors
12. Aseptic sampling from fermentors
13. Techniques to determine microbial contaminations
14. Trouble shooting and diagnostics

Text Books:
SEMESTER II: CORE VI
BIOSEPARATIONS AND BIOLOGICAL TECHNIQUES

Course Code : 14PDFT2C6
Max Marks: 100
Hours / Week: 6
Internal Marks: 40
Credit : 4
External Marks : 60

Objective:
To empower students with the concepts and principles Biological techniques.

UNIT I


UNIT II

Electrophoretic techniques - Principle and technique of gel, SDS, high voltage and discontinuous electrophoresis, Isoelectric focussing. Pulsed field gel electrophoresis and capillary electrophoresis.

UNIT III

Spectrophotometry- Basic principles, instrumentation and applications of UV, Visible, IR spectrophotometers and Mass Spectrometry. Flame Photometry - Principles and applications.

UNIT IV

Solid removal operations Centrifugation techniques – Principle, methodology and application of analytical centrifugation, differential centrifugation, density gradient centrifugation, ultracentrifuge.

UNIT V


# self-study portion
Text Books:


UNIT I Chapter I, T.B.1
UNIT II Chapter II, T.B. 1
UNIT III Chapter III, T.B.1
UNIT IV Chapter IV, T.B. 2
UNIT V Chapter X, T.B. 3

Books for References:

Objective:
To understand the critical relationship among animal and plant cell culture.

UNIT I 18 hours
Introduction to mammalian cell culture – mammalian cell characteristics, growth kinetics, metabolism, bioreactors for mammalian cell culture, process monitoring and control. Equipments and requirements for animal cell culture technology, Introduction to balanced salt solution, and simple growth medium, chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and supplements, serum and protein free defined media.

UNIT II 18 hours

UNIT III 18 hours
Insect cell culture, culture techniques – media preparation, Flasks and roller bottles, shakers and spinner flasks, stirred tank reactors, airlift fermentors, fed batch culture, MOI and infectivity, recovery of insect cells, protein expression using stable cell lines. Process issues in large – scale mammalian and insect cell culture, tissue engineering and cell therapy.

UNIT IV 18 hours
Plant secondary metabolites production: cell culture, hairy root culture, Ri plasmid, control mechanism and maintenance of phenyl propanoid pathway, alkaloids, flavonoids, phenols.

UNIT V 18 hours
Nuclear transplantation, therapeutic transplantation, transfection methods- lipofection, electroporation, microinjection, embryonic stem cell transfer, targeted gene transfer, hybridoma technology and production of monoclonal antibodies, stem cells – embryonic & adult stem cells, and potent uses of human stem cells.

# self-study portion
Text Books:

UNIT I Chapter III, T.B.1
UNIT II Chapter IV, T.B. 1
UNIT III Chapter VI, T.B.1
UNIT IV Chapter VII, T.B. 2
UNIT V Chapter X, T.B. 3

Books for References:
SEMESTER II CORE VIII
DOWNSTREAM PROCESSES AND FERMENTATION ECONOMICS

Course Code : 14PDFT2C8
Max Marks : 100
Hours / Week: 6
Internal Marks : 40
Credit : 4
External Marks : 60

Objective:
To learn about the structural features of the components of downstream process.

UNIT I 18 hours
Introduction to recovery and purification of fermentation products, removal of microbial cells and other solid matters. #Foam separation#.

UNIT II 18 hours
Filtration – theory. Use of filter aids – batch filters, continuous filters. Centrifugation. Cell aggregation and flocculation. Cell disruptions – physical, chemical, mechanical, liquid – liquid extraction. #Solvent recovery, two-phase aqueous extraction, super critical fluid extraction#.

UNIT III 18 hours
Techniques in Chromatography for downstream processing – adsorption, affinity, ion-exchange, gel permeation, reverse phase chromatography, HPLC, #ultrafiltration, reverse osmosis, drying, crystallization, whole broth processing#.

UNIT IV 18 hours
Effluent Treatment - dissolved oxygen concentration, strengths of fermentation effluents, #treatment and disposal of effluents, by-products#.

UNIT V 18 hours
Fermentation economics – discovery and process development, strain improvement, market potential, plant and equipment, operating cost, contract manufacturing, return on investment – recovery cost. #Water usage and recycling and effluent treatment#.

# self-study portion

Text Books:
UNIT I Chapter III, T.B.1
UNIT II Chapter IV, T.B. 1
UNIT III Chapter VI, T.B. 1
UNIT IV Chapter VIII, T.B. 2
UNIT V Chapter XI, T.B. 2

Books for References:
Objective:
To understand the potential scientific consequences of industrial fermentation products.

UNIT I 18 hours
Enzyme production – amylase, glucose isomerases, asparaginase, proteases, rennin, pectinases, lipases, penicillin acylase. Enzyme & cell immobilization.

UNIT II 18 hours
Vitamins & Antibiotics – vitamin B12, riboflavin, β carotene, β -lactam antibiotics, amino acids and peptide antibiotics, carbohydrate antibiotics, macro lactone antibiotics, tetracyclines and anthracyclines#, nucleoside antibiotics & aromatic antibiotics.

UNIT III 18 hours
Organic acids & Feed stocks – citric acids, gluconic acids, acetic acids, lactic acids, kojic acids, Itaconic acids – ethanol, glycerol, butanol, acetone, fermentation#.

UNIT IV 18 hours
Amino acids – glutamic acid, lysine, tryptophan, structure and biosynthesis of nucleotides, nucleosides and related compounds#.

UNIT V 18 hours
Ergot alkaloids – significance and occurrence, structure, biosynthesis, strain development, microbial transformations – types, applications - antibiotics, pesticides, non-steroid compounds, sterols and steroids#.

# self-study portion

Text Books:
   UNIT I Chapter III, T.B.1
   UNIT II Chapter III, T.B. 1
   UNIT III Chapter IV, T.B.1
   UNIT IV Chapter V, T.B. 1
   UNIT V Chapter XII, T.B. 2

Books for References:
Objective:

To understand the concepts, principles and design of a fermentor.

1. Introduction to bioprocess technology parts and designs of bioreactors;
2. Production of biomass; batch and continuous fed batch fermentation,
3. Recovery of products
4. Laboratory scale fermentation of antibiotics, immobilization of cells and enzymes.
5. Down Stream Processing with an enzyme
6. Beer or Wine Production and Quality Assessment
7. Citric Acid Production and Quantification.

Text Books:


Books for References: