INDUSTRIAL BIOTECHNOLOGY (HARD CORE COURSE)

Hours: 52

Course outcomes:

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

CO 1. Understand basic principles of bioprocess technology and advantages of bioprocess over chemical process.

CO 2. Learn various aspects of up- and down-streaming processes in pilot scale study and application to larger scale in industry and its regulation

CO 3. Have firm knowledge about industrial application of various fermenters and regulation of the fermentation process.

CO 4. Gain knowledge on recovery of products, techniques used for separation of cells, physical and chemical methods of cell lysis, filtration, centrifugation and large-scale separation techniques.

CO 5. Understand basic principles of primary and secondary metabolite production by the microorganisms, and acquire knowledge of their production

CO 6. Know usee of microorganisms as probiotics and the role of nutraceuticals in human health, waste utilization to generate biofuels and biogas.

UNIT I (13 hrs)

Fermentation- Basic principles in bioprocess, advantages of bioprocess over chemical process. Isolation and improvement of industrially important strains. Design of fermentation media, inoculum development. Sterilization – Sterilization of medium, air and fermenters. Thermal death kinetics. Design of a fermenter - criteria for ideal fermenter, aeration, agitation, valves, baffles, heat exchanges., Types of fermenters - tower fermenter, cylindroconical vessels, air-lift fermenter, deep-jet fermenter, the cyclone column, the packed tower, rotating disc fermenter and photobioreactors. Types of fermentation processes: submerged fermentation, surface or solid substrate fermentation, batch fermentation, continuous fermentation, kinetics of fermentation processes. Transport phenomenon in bioprocesses- mass transfer, biological heat transfer and heat transfer coefficients. Online acquisition: Bioprocess control and monitoring of variables such as temperature, agitation, pressure, pH, PID control, use of computers in bioprocess control systems (data logging, analysis and control).

UNIT II (13hrs)

Downstream processing of biological molecules: Separation of cells, foam separation, flocculation, filtration, Basket and bowl centrifugation, cell lysis methods, physical and chemical methods. Large scale separation techniques like Distillation, solvent extraction, liquid-liquid extraction, chromatographic techniques, membrane filtration, ultra filtration, reverse osmosis, crystallization, spray drying, drum drying, freeze drying, whole broth processing. Process flow sheeting – block diagrams, pictorial representation. Application of cells in bioprocess (LAB, PAB, yeast, mixed cultures, plant and animal cells). Biosensors: construction and application, fermentation economics.

UNIT III (13hrs)

Production of primary and secondary metabolites: Primary Metabolites- Production of commercially important primary metabolites like organic acids (Lactic acid, citric acid, acetic acid, glycerol and acetone), amino acids (Glutamic acid and Lycine). Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics (Penicillin,

cephalosporin, Tetracycline, streptomycin) Vitamins (Vitamin B12, Riboflavin, and Vitamin A), peptide antibiotics (Lantibiotics) and Steroids.

UNIT IV (13 hrs)

Production of enzymes and other bioproducts: Production, purification and applications of Industrial Enzymes (Protease, amylase, invertase pectinase, xylanase). Biopreservatives, Biopolymers, Biodiesel, Bioconversion, Biofuels and waste Utilization of biofuels. Microbial exopolysaccharides - classification and applications (Health, Pharmaceuticals and Food industries): Alginate, Cellulose, Hyaluronic acid, Xanthan, Dextran, Gellan, Pullulan, Curdlan, polysaccharides of lactic acid bacteria; Chitin, chitosan and chitin derivatives. Microbial beverages: Production of wine, beer, and vinegar. Microbial foods: Oriental foods, sauerkraut, Cheese, Saffron production, SCP, SCO (PUFA), & Mushroom cultivation, Baker's yeast, Probiotics, silage, nutraceuticals. silk Production. Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture.

References

1. Comprehensive Biotechnology. Vol. 1, 2, 3 & 4. Moo-Young, M., Pergamon Press, 2011
2. Fundamentals of Biotechnology. Prave,P.et al., Wiley-Blackwell Pub., 1987
3. Industrial Microbiology. Cassida, L.E., John Wiley & Sons, 1968
4. Industrial Biotechnology. Crueger, W.&Crueger,A., Sinauer Associates Inc., 1990
5. Industrial Biotechnology. Demain, A.L., American Society for Microbiology, 1986
6. Microbial Biotechnology. Glazer, A.G., WH Freeman and Company, 1994
7. Microbial Technology. Peppler, H.J., Vol. 1 & 2. Academic Press, 1979
8. Biochemical Engineering fundamentals, Bailey J., Bailey J. & Ollis D.F., McGraw-Hill Pub., 1986
9. Chemical Engineering. J.M Coulson &J.F. Richardson, Pergamon Press, 2002
10. Comprehensive Biotechnology. Volumes 1, 2, 3 & 4. Moo-Young M., Pergamon Press, 2011
11. Fundamentals of Biotechnology. Prave P.et al., Wiley-Blackwell Pub., 1987
12. Principles of Fermentation Technology. StanburyP.F. et al Pergamon Press, 1984

AGRIBIOTECHNOLOGY Hours: 52

Course outcomes:

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

CO 1. Compare the plant genome with chloroplast and mitochondrial genomes, to demonstrate the application of plant breeding methods, to differentiate the mechanism involved in different biological process.

CO 2. Demonstrate different techniques involved in the plant tissue culture for the propagation of plants and germplasm preservation.

CO 3. Utilise plant tissue culture methods for the production of commercially important secondary metabolites.

CO 4. Demonstrate the genetic manipulation of plants for the production of elite plants with superior traits such as insect resistance, improved nutrient content etc.

CO 5. Learn protection and registration of new plant varieties and plant germplasm conservation, General agreement on trade and tariff, use of traditional knowledge digital library i.e ayurvedic and unani medicinal plants, Farmers rights and plant breeders rights

UNIT I (13 hrs)

Plant genome structure, gene families in plants, organization of chloroplast genome, mitochondrial genome and their interaction with nuclear genome, RNA editing in plant