

THIRD SEMESTER

BTPG11 BIOPROCESS TECHNOLOGY

Number of Hours / Week: 4

Credits: 4

Unit 1.

Isolation of Industrially important microorganism, Primary and secondary screening methods. Methods of strain improvement. Preservation and maintenance. .

Unit 2

Batch culture, specific growth rate, substrate saturation constant, yield coefficient, Monod kinetics, substrate affinity, Continuous culture, Dilution rate, Washing out, Fed batch culture maintenance coefficient, Product yield, solid state, submerged fermentations, Aerobic anaerobic fermentations, Media preparation.

Unit 3.

Bioreactor Parts, function of each part, probes, valves, agitators, aerators, baffles, Types of bioreactors: CSTR, Pneumatically driven fermentors, , Airlift fermentor, Packed Bed, reactor , Fluidized Bed reactor, Reactor performance, oxygen transfer in reactor system , Resistances against oxygen transfer, K_La , Reynold's number, types of fluids.

Unit 4.

Instrumentation of bioreactor online and offline control. pH probe, temperature probe, DO probe, Tacchometer, Load cells Control of Bioreactor, Downstream processing: filtration, centrifugation, cell disruption, liquid/liquid extraction, dialysis, Purification, Drying, Packing and labeling. Market Potential, Good Manufacturing Practices.

Unit 5.

Primary metabolites, secondary metabolites. Fermentative production of alcohol, acetone butanol, citric acid, acetic acid, lactic acid, amino acids, vitamins. Antibiotics-penicillin, streptomycin, cephalosporin, tetracycline. Microbial production of enzymes-amylase, protease, cellulose, pectinase, SCP production. Bread manufacturing, beer manufacturing, Cheese

manufacturing, rennet preparation, fermented dairy products and production of distilled beverages.

Reference

1. Principles of Fermentation Technology, P.F.Stanbury, A Whitaker and S.J.Hall, , 2008. Elsevier
2. Bioprocess Technology, P.T. Kalichelvan and I Arul Pandi, , 2009,MJP Publishers, Chennai.
3. Bioprocess Engineering, M.Shuler & F.Kargi (2002). Prentice Hall (I) Ltd., N.Delhi.
4. Bioprocess Technology- Kinetics and reactors ,Antan Moser and Philip Manor,.1998, Springer
5. Fermentation Microbiology and Biotechnology ,E.M.T. Mansi, C.F.A . Bryce. A.L..Dmain, A.R.Alliman. ,2009, Taylor and Francis. New York
6. Comprehensive Biotechnology. Second edition, Elsevier, 2011, Murray Mor. Young (Editor in chief). ISBN-978-0-08-088504-9
7. Industrial Microbiology, Cassida L.E. 1968.John Wiley and Sons Publishers.

BTPG12 RECOMBINANT DNA TECHNOLOGY

Number of Hours / Week: 4

Credits: 4

Unit I

Histroy. Enzymes for in vitro manipulation – site specific recombinases, thermophilic polymerases, topoisomerases Restriction Endonucleases , Kinases , Phosphatases , DNA Polymerases, Ligases, Terminal Transferases, isolation of genetic material, Modification of Ends , Adapters, Linkers, Homopolymer Tailing, genomic and c DNA library. 12

Unit II

Cloning Vectors Plasmids, desirable properties, E coli based vectors, pBR, pSC, pUC, , pGEM3Z, M13vectors mp7, Bacteriophages λ pEMBL Cosmids, Phasmid , Phagemids with special reference to pBluescript, , pLITMUS, Gateway Cloning, TA cloning Shuttle Vectors pCAMBIA, Vectors for Yeast (YEP, YIP, YRP, YCP,YAC) Artificial Chromosomes, BAC, PAC Mammalian Expression vectors , Plant vectors, CaMV, geminivirus, Ti plasmid 16

Unit III

Gene transfer in prokaryotes, Chemical transfection:Calcium phosphate mediated, Polyplexes mediated, Liposomes and lipoplexes mediated. Electroporation, Biolistics Selection of recombinants, markers in prokaryotes, plants, animals. Blue white screening, Antibiotic resistance, Maximising protein expression in Bacteria, fungi and animal cells – Promoters, and reporter systems. Expression vectors ,Fusion tagged expression system, Reporter Assay, studying the translation product- hybrid arrest and hybrid release translations. Nuclear transfer technology and. Inducible expression system and control of transgene expression through naturally inducible promoters – lac and tet. Steroid hormones as heterologous. inducers. Chemically induced dimerisaion (CID) as inducible transgene regulation. Site specific recombination for efficient gene targeting. systems to study translation 20

Unit IV

Blotting techniques:southern, northern, southwestern, PCR types and applications, DNA foot printing, finger printing, gel shift analysis, DNA microarray, RFLP, RAPD, advanced

molecular markers, chromosome walking, chromosome jumping. DNA sequencing, Site directed Mutagenesis: methods. 18

Unit V

Applications of recombinant DNA technology, recombinant hormones, Gene therapy, Metabolite engineering, Imparting new agronomic traits to plants – resistance to abiotic and biotic stress, improving quality and quantity. Gene Silencing, RNA interference, antisense therapy, Gene Knockout, , animal pharming, nanoparticles for labeling, delivery of drugs and DNA, RNA. Bioethics: laws, possible dangers to society or nature. 14

Reference

1. Principles of gene manipulation – Old and Primrose, Blackwell Scientific publishers, Edns 5th, 6th and 7th.
2. Molecular Biotechnology – Glick and Pasternac
3. From gene to genomes – Dale and Shantz
4. Gene cloning :An Introduction, T A Brown, Chapman and Hall Pub.
5. Biotechnology: An Introduction, Susan R Barnum. Pub: Thomson, Brooks/Cole
6. Molecular cloning : A laboratory Manual, Sambrook and Russel, Cold spring Harbor Lab Pub.
7. DNA science : A first course in rDNA Technology: David Mickols, Carolina Biological Supply.

BTPG13 PLANT AND ANIMAL BIOTECHNOLOGY

Number of Hours / Week: 3

Credits: 3

Unit-I

Animal cell; History of animal cell culture; Laboratory setup and equipments; Types of cell culture media, Selection of media, media constituents ,CO₂ & bicarbonate, Buffering, Balanced salt solution, Cell culture vessels; Preparation &sterilization of cell culture media, Different culture techniques, Secondary culture, Disaggregation of tissue , Trypsinization; cell separation, Continuous cell lines, Passaging number; characteristics of animalcells cultures; Suspension culture; Organ culture and Histotypic cultures; Embryonic and Adult stem cell culture. 10

Unit II

Transfection and Transformation of cell, Vectors for animal cells SV40, Adenovirus vectors, Baculovirus, lenti virus, poxyvirus, Measurement of viability & cytotoxicity; Cell cloning and selection; Cell synchronization; Application of cell culture technology in production of human and animal vaccines and pharmaceutical proteins. Hybridoma technology and its application; Three dimensional culture and tissue engineering. Transgenesis, transgenic mice, fish, cattle. Maintenance of cell Lines Cryopreservation and Germplasm storage; Application of animal cell culture for invitro testing of drugs and testing of toxicity of environmental pollutants; 10

Unit III

Conventional plant breeding. Introduction to cell and tissue culture; Requirements of tissue culture lab, Tissue culture media: Composition and Preparation. Sterilization and agents of sterilization used in tissue culture labs. Initiation and maintenance of callus and suspension cultures. Shoot tip culture; micropropagation, Rapid clonal propagation and production of virus-free plants. Embryo culture and embryo rescue; Single cell clones. Organogenesis; Somatic embryogenesis; Transfer and establishment of whole Anther, pollen and ovary culture for production of haploid plants and homozygous lines. plants in soil. triploid production, 14

Unit IV

Agrobacterium mediated DNA transfer. Basis of tumour formation; Hairy root; Features and Use of Ti and Ri plasmids; Mechanisms of DNA transfer; Role of virulence genes; triparental mating, Binary vectors; Use of 35S and other promoters; Genetic markers; reporter genes; Reporter gene with introns; Methods of nuclear transformation, Viral vectors and their applications; Multiple gene transfers, Vector-less or direct DNA transfer, Transformation of monocots, Transgene stability and gene silencing. 8

Unit V

Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids. Chloroplast transformation Sexual incompatibility, Cryopreservation; Slow growth and DNA banking for germplasm conservation.

Application of plant transformation for productivity and performance Herbicide resistance, insect resistance, Bt genes, Non Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated disease resistance, disease resistance, RIP, antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stressmarker aided breeding –an introduction.– Advantages, Metabolic engineering and industrial products – Plant secondary metabolites. 10

Reference

1. Freshney, culture of Animal cell, 5th edition
2. Ed. John R.W Masters Animal cell culture- Practical approach 3rd edition, Oxford university press-2000
3. In Vitro cultivation of Animal cells. Elsevier India PVT LTD-17-A/1 Main Ring Road, New Delhi-110024
4. R.Sasidhara, Animal Biotechnology MJP publishers-Chennai.
5. Plant biotechnology – J Hammond, et. al., Springer Verlag.
6. Biotechnology in crop improvement – H S Chawla.

7. Practical application of plant molecular biology – R J Henry, Chapman & Hall.
8. Elements of biotechnology – P K Gupta.
9. An introduction to plant tissue culture – M K Razdan.
10. Cell culture and somatic cell genetics of plants (Vols. 1 to 3) – A K Vasil, A. Press.
11. Principles of plant biotechnology: An introduction to genetic engineering in plants – SH Mantell, et. al.
12. Advances in biochemical engineering / Biotechnology – Anderson, et. al.
13. Plant cell and tissue culture – S Narayanswamy, Tata Mc

BTPG14 ENVIRONMENTAL BIOTECHNOLOGY

Hour/ week: 4

Credits: 4

Unit 1

Xenobiotics, biological impacts of polychlorinated biphenyls and dioxans, synthetic polymers, alkylbenzyl sulphonates, hydrocarbons, chlorinated pesticides, heavy metals. biomagnification of recalcitrant molecules Microbial infallibility, types of biodegradation, factors affecting biodegradation, enzymes involved in biodegradation, catabolic plasmids, Molecular Approaches, Biodegradation of Hydrocarbons, cellulose, lignin, pesticides. Bioremediation strategies. 16

Unit 2

Bacillus thuringiensis as a pesticide, viral pesticide, use of biological fertilizers, biological nitrogen fixation: AM, cyanobacteria, molecular mechanism of nitrogen fixation in root nodules, nonsymbiotic nitrogen fixation- *Clostridium*sp., biosurfactants, biofouling, bioleaching. 15

Unit 3

Types of industrial effluents, characterization of the wastewater. Chemical Oxygen Demand, Biological Oxygen Demand, Total organic carbon, Nitrogen contents, Suspended solids. Total heterotrophic bacterial population. Bacteriological analysis of drinking water, Presumptive, completed, and confirmed test. Treatment strategies primary, Secondary and tertiary treatment. Floc based and film based strategies, aerobic and anaerobic methods. Activated sludge process, different stages, Types. Trickling filter process, Rotating Biological contactor, UASB, Submerged aerobic filters, Fluidized Bed Reactor, Packed bed reactor, Oxidation lagoons. Bioreactors for wastewater treatment 22

Unit 4

Advanced treatment strategies Tertiary treatment methods, Disinfection, Chlorination, chlorination derived byproducts Solid waste, Types, Problems, Characterization and sorting of

wastes. Land fill, composting, stages in composting, Types of composting vermicomposting. Methanogenesis, stages in anaerobic digestion, methanogens Anaerobic reactors Biogas generation, Household treatment strategies, Present problem and Possible remedies. 15

Unit 5

GLP, GMP, Biosafety , laws and concerns at different levels-individual, institution, society, IPR forms, IPR in India, patents, process of patenting, Indian and International agencies involved in patenting, GATT 12

Reference

1. Environmental Biochnology, Christopher. F Forster, D.A.John Wase, 1987 Ellis Harwood.
2. Comprehensive Biotechnology. Second edition, Elsevier, 2011, Murray Mor. Young (Editor in chief). ISBN-978-0-08-088504-9
3. Waste water Microbiology, Gabriel Bitton, 2005, John Wiley and Sons, Wiley series in Ecological and Applied Microbiology.
4. Microbial Ecology. Fundamentals and Applications. Atlas and Bartha, Pearson Education , Benjamin Cummingspublishing company.Inc. New Jersey
5. Environmental Biotechnology, sries in Handbook of Environmental Engineering.Vol.10.Wang, L.K., Ivanov V.,Tayi,J.H and Hung Y.T (eds),2010, Humana Press...

BTPG15 Laboratory course III

Number of Hours / Week: 4

Credits: 4

1. Bacteriological examination of water. MPN Method
2. Bacteriological examination of food and milk sample
3. Fermentative production of wine and estimation of alcohol content
4. Fermentative production through Solid state fermentation
5. Immobilisation of microbial cells for enzyme production
6. Estimation of COD
7. Estimation of BOD
8. Bioreactor studies for waste management
9. Biogas production
10. Composting techniques
11. Mushroom cultivation
12. Fermentative production of industrially useful enzyme
13. Plant tissue culture techniques
14. Surface sterilization
16. Callus culture
17. Anther culture
18. Emryo culture
19. Protoplast isolation
20. Somatic Hybridization