

**SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR**



**Programme: MSC (CBCS)
Syllabus with effective from: JUNE-2017**

**Industrial Biotechnology
Semester: II**

PS02CIBT21: Bioprocess Technology

Unit I

Introduction to bioprocess technology

Isolation, primary and secondary screening, preservation, maintenance and improvement of industrially important organisms.

Raw materials for fermentation processes

Medium optimization

Unit II

Bioreactor design: Laboratory, pilot and large scale reactors. mechanical, pneumatic and hydrodynamic systems. Plug flow reactors, Immobilization and immobilized enzyme reactors.

Sterilization of media and air.

Scale up and Scale down and containment

Mass transfer of oxygen: Agitation and aeration, Determination of K_La , factors affecting K_La , fluid rheology. Inoculum development, aseptic inoculation and sampling.

Unit III

Bioprocess kinetics: Kinetics of growth and substrate utilization in batch, fed batch and continuous systems.

Control of process parameters: Instrumentation for monitoring bioreactor and fermentation processes, Sensors, Controllers, fermentation control systems and architecture, Incubation and sequence control, advanced control.

Unit IV

Downstream processing:

Bioseparation: filtration, centrifugation, sedimentation, flocculation, cell disruption, liquid liquid extraction. purification by chromatographic techniques, reverse osmosis and ultrafiltration, drying, crystallization, storage and packaging.

Fermentation Economics

Reference Books

Principles of Fermentation Technology : Whitekar & Stanbury

Comprehensive Biotechnology : Murray Moo Young

Methods in Industrial Microbiology : Sikyta

Fermentation Microbiology and Biotechnology, El Mansi and Bryc

PS02CIBT22: Animal and Plant Biotechnology

Unit I : Animal Cell Culture

Brief history of animal cell culture; cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, continuous cell lines, suspension cultures; application of animal cell culture for virus isolation and *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

Unit II: Animal Reproductive Biotechnology and Vaccinology

Animal reproductive biotechnology: structure of sperms and ovum; cryopreservation of sperms and ova of livestock; artificial insemination; super ovulation, embryo recovery and *in vitro* fertilization; culture of embryos; cryopreservation of embryos; application of transgenic animal biotechnology; animal cloning- basic concept, cloning for conservation for conservation endangered species.

Vaccinology: history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, modern vaccines.

Unit III: Plant Tissue Culture

Historical perspective; totipotency; Callus, In vitro Morphogenesis - organogenesis; somatic embryogenesis; establishment of cultures- callus culture, cell suspension culture, media preparation- nutrients and plant hormones; sterilization techniques; application of tissue culture- micropropagation; somaclonal variation; androgenesis; zygotic embryogenesis and its applications in genetics and plant breeding; germplasm conservation and cryopreservation; synthetic seed production; protoplast culture and somatic hybridization – protoplast isolation; culture and usage; somatic hybridization- methods and applications; cybrids and somatic cell genetics; plant cell cultures for secondary metabolite production.

Unit IV: Plant Genetic Manipulation

Genetic engineering: *Agrobacterium*-plant interaction; virulence; Ti and Ri plasmids; opines and their significance; T-DNA transfer; disarmed Ti plasmid; Genetic transformation – *Agrobacterium*-mediated gene delivery; cointegrate and binary vectors and their utility; direct gene transfer – PEG – mediated, electroporation, particle bombardment and alternative methods; screenable and selectable markers; characterization of transgenics; chloroplast transformation; marker-free methodologies; advanced methodologies- cisgenesis, intragenesis and genome editing; molecular pharming- concept of plants as biofactories, production of industrial enzymes and pharmaceutically important compounds.

References:

1. Slater,A., Scott,N. And Fowler,M.R. 2008. Plant Biotechnology: An introduction to Genetic Engineering. Oxford University Press.
2. Umesha,S. 2013. Plant Biotechnology: The energy and resources
3. Slater,A., Scott,N. And Fowler,M.R. 2003. Plant Biotechnology: The genetic manipulation of plants.
4. Razdan,M.K. 2003. Introduction to plant tissue culture. Enfield, NH. Science
5. Primrose, S.B and Twyman, R.M. 2006. Principles of gene manipulation and genomics. Malden, MA., Blackwell Publications.
6. Gordon,I. 2005. Reproductive techniques in farm animals. Oxford. CAB international
7. Levine, M.M. 1997. New Generation vaccines. New York. M.Dekker.
8. Portner, R. 2007. Animal Cell Biotechnology: Methods and protocols. Totowa. NJ. Humana Press.

PS02CIBT23: Environmental Biotechnology

Unit 1

- Waste water treatment- Waste water characterization and its significance: COD, BOD, TOC, TOD, Inorganic constituents, solids, biological components.
- Principles and aims of biological wastewater treatment processes: Primary, secondary and tertiary treatment of waste water.
- Biochemistry and microbiology of inorganic phosphorus and nitrogen removal from waste water.
- Suspended growth processes: Activated sludge process: Biology of activated sludge, flocculation, sludge settling, oxidation ditches, waste stabilization ponds.
- Fixed film processes: Biofilm formation and slaughting, Trickling filters, rotating biological contactors, fluidized bed and submerged aerated filters.

Unit 2

- Anaerobic digestion: microbiological and biochemical fundamentals, factors influencing anaerobic digestion. Anaerobic waste water treatment systems: Upflow anaerobic sludge blanket , rotating biological contactors, anaerobic filters. Merits and demerits of anaerobic treatment of waste.
- Composting: Objectives, fundamentals, microbiology, factors influencing composting and composting systems. Compost quality and uses. Vermicomposting.
- Toxicity testing in waste water treatment plants using microorganisms:
- Monitoring environmental processes with biosensors: BOD biosensor, Pesticide biosensor

Unit 3

- Biodegradation of organic pollutants: Xenobiotic and recalcitrant organic compounds, mechanisms of biodegradation, factors affecting biodegradation, Acclimation phase in biodegradation. Biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes and lignin.
- Bioremediation approaches: Intrinsic bioremediation, Biostimulation, Bioaugmentation: Use of genetically modified organisms.. *In situ* and *ex situ* bioremediation technologies with examples.
- Bioremediation of heavy metal pollution, Phytoremediation.
- Biological treatment of waste gas (polluted air): biofilters, bioscrubbers, membrane bioreactors, biotrickling filters.

Unit 4

- Bioleaching of metals: Characteristics of commercially important microbes, mechanisms of bioleaching, factors affecting bioleaching and current biomining processes. Biobeneficiation of gold ores.
- Bidesulfurization of coal: Removal of organic and inorganic sulfur from coal.
- Microbially enhanced oil recovery.
- Microbial Insecticides: Bacterial, fungal and viral insecticides in pest management.
- Biofertilizers: applications of nitrogen fixing and phosphate solubilising/ mobilizing biofertilizers.

Reference Books:

Comprehensive Biotechnology Vol-4, Murray Moo Young.
Biotechnology-Rehm and Reid.
Waste water microbiology by G. Bitton
Biodegradation and bioremediation by M.Alexander
Waste water treatment for pollution control, 2nd edition. Arceivala
Environmental Biotechnology by H. Jordening and Josef Winter
Handbook of water and waste water Microbiology by Horan
Topic related review articles

PS02EIBT21: Bioinformatics

Unit -I

Introduction to Bioinformatics:

Overview, Internet and bioinformatics, Applications

Databases: Databases in Bioinformatics, various biological databases, Protein and Nucleotide sequence Data bases. Protein sequence, structure and Classification databases, pathway databases

Sequence analysis: Pairwise alignment, local and global alignment, Scoring matrices, multiple sequence alignment, tools for sequence alignment, programming algorithms

Unit-II

Gene prediction: Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods: Neural Networks, Pattern Discrimination methods, Signal sites Predictions, Evaluation of Gene Prediction methods.

Transcriptomics: Complete transcript cataloguing and gene discovery- sequencing based approach, Microarray based technologies and data analysis

RNA secondary structure prediction

Introduction to Chemi-informatics

Unit III

Protein Computational Biology: Structural classification of proteins, Protein structure analysis, structure alignment and comparison, Secondary and tertiary structure prediction and evaluation, prediction of specialized structures, Active site prediction, Protein folding, Protein modeling and drug design

Tools in Bioinformatics: Protparam, Translate, Bioedit, findmod, Coils, TMHMM, Rasmol, Deepview, matlab, and other NCBI and ExPASy tools

Unit IV

Genomics: structural and functional Genomics, Comparative Genomics.

Proteomics: Types of proteomics, tools for proteomics- separation and isolation of proteins, acquisition of protein structure information, databases and applications

Phylogenetic analysis: molecular basis of evolution, Phylogenetic trees & different methods for phylogenetic inference

References:

- Bioinformatics: A Beginners Guide, Clavarie and Notredame
- Bioinformatics: David Mount
- Bioinformatics: Rastogi
- Introduction to Bioinformatics: Arthur M. Lesk
- Bioinformatics: Principles and applications, Ghosh and Mallick
- Bioinformatics: Genes, Proteins and Computer, C A Orengo
- Protein Structure Prediction: Methods and Protocols, Webster, David (Southern Cross Molecular Ltd., Bath, UK)

PS02EIBT22: IPR and Biosafety

UNIT-I

Biotechnology and society: Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding. Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.

UNIT-II

Bio- safety: Definition of bio-safety, Biotechnology and bio-safety concerns at the level of individuals, institutions, society, region, country and world.

Bio-safety in laboratory institution: laboratory associated infection and other hazards, assessment of biological hazards and level of biosafety.

Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions.

UNIT-III

IPR I: Introduction to IPR: Forms of IPR and Intellectual property protection. Concept of property with respect to intellectual creativity, Tangible and Intangible property.

WTO: agency controlling trade among nations, WTO with reference to biotechnological affairs, TRIPs. WIPO, EPO.

UNIT-IV

IPR II: Concept related to patents novelty, non-obviousness, utility, anticipation, prior art etc. Type of patents. Indian patent act and foreign patents.

Patentability, Patent application, Revocation of patent, Infringement and Litigation with case studies on patent, Commercialization and Licensing.

References:

1. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press. ISBN-1555811804, 9781555811808.
2. Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219
3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication. (2007) ISBN: 075069440, 9780750694445.
4. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
5. Intellectual Property Right- Wattal- Oxford Publication House. (1997) ISBN: 0195905024.
6. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2nd ed) ISBN-10 3527304320.
7. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748.
8. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press.
9. B.D. Singh. Biotechnology expanding horizons.
10. H.K.Das. Text book of biotechnology 3rd edition.

PS02CIBT24: Lab I Practicals based on PS02CIBT21 and PS02CIBT22

PS02CIBT25: Lab II Practicals based on PS02CIBT23 and PS02EIBT2X