DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/B.Sc./CBC&GS/94/2024

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/ Ad-hoc Boards & recommended by the Dean, Faculty of Sciencc & Tcchnology, **Acadcmic Council at its mccting hcld on 08 April 2024 has accepted** thc following Syllabi undcr thc Faculty of Scicncc & Technology **as per Norms of Choiced Based Credit Grading System** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	**B.Sc.Zoology (Optional)**	**Vth & VIth semester**
2.	**B.Sc. Statistics (Optional)**	**Vth & VIth semester**
3.	**B.Sc.Home Science (Degree)**	**Vth & VIth semester**
4.	**B.Sc.Biotechnology (Degree)**	**Vth & VIth semester**

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2024/26484-89
Date:- 20.05.2024

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
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Semester V

	Course Code	Course Title	Total periods (Teaching periods/week)	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min. Marks
Optional **Advanced** Biotechnology-**I** (DSE-I A) Discipline Specific Core **Course**	BIOT 511	Regulation of gene expression	45 (3/wk)	2	50	10	40	20
	BIOT 512	Principles of Genetic Engineering	45 (3/wk)	2	50	10	40	20
	BIOTP 513	Lab course 51 (based on BIOT 511)	45(3/wk)	1.5	50	10	40	20
	BIOTP 514	Lab course 52 (based on BIOT 512)	43{3/wk)	1.5	50	10	40	20
Optional II Frontier Biotechnology-I (DSE- I A) Discipline Specific **Core Course**	BIOT 521	Bioprocess engineering	45 (3/wk)	2	50	10	40	20
	BIOT 522	Bioinformatics- I	45 (3/wk)	2	50	10	40	20
	BIOTP 523	Lab course 53 (based on BIOT 521)	45(3/wk)	1.5	50	10	40	20
	BIOTP 524	Lab course 54 (based on BIOT 522)	45(3/wk)	1.5	50	10	40	20
Optional III Applied Biotechnology-I (DSE- I A) Discipline **Specific** Elective	BIOT-531	DSE-531 A I Industrial fernentations-I B I Metabolism of macromolecules (Select any one paper from A 1/B 1)	45(3/wk)	2	50	10	40	20
	BIOT-532	DSE-532 A 2 Animal cell culture I B 2 Plant tissue culture I (Select any one paper from A2/B2)	45(3/wk)	2	50	IO	40	20
	BIOT-	Lab course 55	45(3/wk)	1.5	50	IO	40	20

	533	(based on BIOT-531)						
	BIOT-534	Lab course 56 (based on BIOT-532)	45(3/wk)	1.5	50	10	40	20
Skill Enhancement course (**SEC-3)**	BIOT-541	SEC-3 E-Advanced chromatography F-Cancer Biology Any one skill to be chosen out of two SEC-3 (E) . SEC-3 (F)	45(3/wk)	2	50	10	40	20
			585	23	650	130	520	650

Total Credits for Semester V : 23 (Theory : 14 ; Laboratory : 09)

Semester VI								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of examinatin			
					Max Marks	CIA	UA	Min Marks
Optional I Advanced Biotechnology II (DSE-1 B) Discipline Specific Core Course	BIOT-611	Recombinant DNA technology	45(3/wk)	2	50	10	40	20
	BIOT-612	Bioinformatics-II (Genomics and Proteomics)	45(3/wk)	2	50	10	40	20
	BIOT-613	Lab course 61 (based on BIOT-611)	45(3/wk)	1.5	50	10	40	20
	BIOT-614	Lab course 62 (based on BIOT-612)	45(3/wk)	1.5	50	10	40	20
Optional II (DSE-I B) Frontier Biotechnology II Discipline Specific Core Course	BIOT-621	Fermenter : Design, types and operations	45(3/wk)	2	50	10	40	20
	BIOT-622	Clinical Biochemistry	45(3/wk)	2	50	10	40	20
	BIOT-623	Lab course 63 (based on BIOT 621)	45(3/wk)	1.5	50	10	40	20
	BIOT-624	Lab course 64 (based on BtOT 622)	45(3/wk)	1.5	50	10	40	20
Optional III Applied Biotechnology II (DSE-I	BIOT-631	DSE-631 A3 Industrial fermentations-II B3 Bio pesticides (Select any one paper from	45(3/wk)	2	50	10	40	20

B)		A3/B3)						
Discipline Specific Elective	BIOT-632	DSE-632 A 4 Animal cell culture I B 4 Plant tissue culture I (Select any one paper from A4/B4)	45(3/wk)	2	50	10	40	20
	BIOT-633	Dissertation in Lieu of lab course 65& 66 (based on BIOT-631&632)		**3.0**	**100**			**40**
Skill Enhancement course (SEC-4)	**BIOT-641**	EC-4 Any one skill to be chosen out of two SEC-4(G) Advanced Microscopy SEC-4 (H) Fermented Foods	**45(3/wk)**	2	50	10	40	20
			585	23	650	130	520	650
Total Credits for Semester VI : 23 (Theory : 14 ; Laboratory : 09)								
Total Credits for tbree years : **Sem I (22.5) + Sem II (22.5) + Sem III (29) + Sem IV (29) + Sem V (23) + Sem VI (23) = 149 Credits**								

Optional I

Advanced Biotechnology - I

Discipline Specific Core Course

Course Code	**BIOT-511**
Course Title	**DSE-1A, Regulation of gene expression**
Marks	**50**
Credit	**02**
Total Periods	**45 (3/wk)**

Unit 1: Basics of Gene Expression Regulatory elements/factors: Inculcate concepts with suitable examples for; Cis acting elements, Trans-acting factors. Exceptional proteins behaving Cis-acting. Regulation of transposition of Tn3 and Tn9. Modifications of Cis-acting elements to influence and to affect regulation. Influencing or affecting gene expression as a presence / or absence of functional form of protein factor. Concept of Activator, Coactivator, Repressor (with suitable examples). Examples with mechanisms; specific regulator and global regulator. DNA protein interactions. RNA protein Interactions – conditions favoring and affecting these interactions (this is to be dealt with ref to Motifs).

Unit 2: Bacterial Gene Expression Concept of Operon. Regulation of gene expression; positive control – the ara operon, negative control –paradigm the lac operon and attenuation mediated control or posttranscriptional regulatory control –the trp operon. Must include structural organization of above operons, functional relevance of genes within, regulatory circuit, modes by which the operon can be regulated other than above mentioned mode. Concept of Catabolite Repression. Examples of non-catabolite sugars and their regulation, catabolite repression in amino acid metabolism –examples at molecular level.

Unit 3: Eukaryotic Gene Expression Activators: gene specific and generalized type of activator. Domains of activators, protein and DNA/ or RNA binding domain. Modification of activator. Enhancer mediated gene expression –examples. Gene expression of metallothionine gene expression. Response elements such as; steroid hormone response elements, metal response elements, Basal Expression response elements. Regulation of gene expression at a step of activation of basal apparatus. Post initiation gene expression – mechanism of relieving roadblock (stuttering of RNA polymerase) with example. Regulation of mRNA molecules involving both nonstop and nonsense mechanisms. Gene regulation with example – post transcriptional –yeast and Drosophila genes, insulators in genomic imprinting –concept and example.

References:

1. Biochemistry –Lehninger
2. Principles of Biochemistry –Nelson and Cox
3. Microbial genetics –David Frifelder
4. Molecular Biology –David Frifelder
5. Genes –IX
6. Genes -X
7. Principles of gene manipulations –Old and Primrose
8. Biochemistry –Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer
9. Principles of Gene Manipulations LPE Pearson -Watson
10. Genetics –Strickberger

Course Code	BIOT-512
Course Title	DSE-1A, Principles of Genetic Engineering
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit 1: DNA modifications and DNA cutting Systems safeguarding DNA –in detail. Concept of restriction endonuclease action with reference to DNA modification. DNA cutting enzymes: Type I, Type II, Type IIs and Type III with reference to properties, essential co-factors, mode of action – specificity and limitations of their applications. DNA modifying enzymes with reference to their structure, function, requirements, reaction and applications: Exonucleases, Endonucleases acting on both single strand and double strand, Polymerases, phosphorylating enzymes, Phosphate removing enzymes, Enzyme adding base/s to the end. Nucleic acid Joining Enzymes: RNA ligase, DNA ligases.

Unit 2: Vectors Concept and types of vectors for genetic engineering, Review of plasmids and modifying natural plasmids to construct a plasmid vector –example of pBR322 – applications, versatility and limitations, cloning of DNA with gene disruption strategy. The pUC18/ pUC19 vectors –with reference to their desing, potential also as an inducible vector system. Viral vectors: M13 life cycle and use of M13 as vector, M13mp1 and M13mp2 design, potential and limitations. Single strand preparations for sequencing reactions. Study of λ-genome to estimate potential as vector system. Concept of insertion and replacement vectors –Two examples with design and application Vectors with two replicons: Phagemids –concept, example with design and application potential and limitations. Vectors for use in Eukaryotic cells-Vectors for plant cell: Ti-plasmid, viral Cauliflower mosaic virus, Binary vectors. Vectors for animal cell: P elements, SV40. Artificial chromosomes, their limitations and applications. Transcriptional and Translational fusion vectors –with examples at least two

Unit 3: Cloning and Sequencing Shotgun cloning; with reference to use of plasmid as vector, mean of cloning foreign piece of DNA (Construction of Chimera), mean to construct genomic library, mean to select recombinant with the use of antibiotic marker –a direct selection example. Generalized strategy of obtaining cDNA from mRNA as a template for PCR (do not teach PCR) or piece of DNA to be cloned in desired vectors. DNA sequencing by chemical method, by Enzymatic method and Chemical synthesis of DNA.

References:

1. An introduction to Genetic Engineering –Desmond S T Nicholl, Cambridge university press, 2nd Ed.

2. Recombinant DNA: A short Course, Watson J.D, CSHL press

3. Short course in Bacterial Genetics –J. H. Miller

4. Molecular Biotechnology Principles & Applications of Recombinant DNA, Bernard R Glick & Jack J Pasternak, ASM press.

5. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell Scientific publications.

6. Ausbel S.M , Brent R, Current Protocols in Molecular Biology., Wiley International New York.

7. Maniatis I, Fritchh E.F ,& Sambrook J, Molecular cloning.

8. D.M Glover , DNA cloning, A practical approach.

9. Methods in Enzymology series, vol 152, 185, Academic press inc, Sandiego.

10. Genes V –Benjamin Lewin

Course Code	BIOTP-513
Course Title	DSE-1A, Lab course 51 (based on BIOT 511)
Marks	50
Credit	1.5
Total Periods	45 (3/wk)

1. Isolation of Lactose negative mutants and mapping the mutation with reference to the lacZ or lacY genes only.

2. Study of catabolite repression with the example of gal operon

3. Study of non-catabolite repression.

4. Study of impact of catabolite repression on amino acid metabolism

5. Yeast β -galactosidase assay.

6. Two-hybrid system demonstration (demonstration thru kit –could be asked in examination).

7. Isolation of Trptophan negative mutant and theoretical mapping.

8. Isolation of Arabinose negative mutant and theoretical mapping.

9. Study of the β galactosidase assay of the lacY and lacZ mutants.

10. Study of mutants isolated with mutagen with reference to differential - galactosidase activity.

Course code	BIOTP 514
Course Title	DSE-1A, Lab course 52 (based on BIOT 512)
Marks	50
Credit	1.5
Total Periods	45 (3/wk)

1. Isolation of plasmid DNA from resistant clinical isolates
2. Transformation of resistance from clinical strain to laboratory strain (sensitive)
3. Blue-white selection assay
4. Study of restriction fragments of -DNA
5. Study of impact of methylation on restriction activity.
6. Shotgun cloning –demonstration of plasmid resistance transfer
7. Shotgun cloning –to introduce chimeric construct
8. Preparation and demonstration of cDNA
9. Shotgun cloning –cloning of cDNA
10. Cloning of DNA with gene disruption strategy

Optional II

Frontier Biotechnology – I

Discipline Specific Core Course

Course Code	BIOT-521
Course Title	DSE-1A, Bioprocess engineering
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit 1:

Introduction to Bioprocess Engineering:

Definition and scope of bioprocess engineering, approach and regulatory limits towards bioprocess research. Introduction to upstream and downstream processes. Microbial growth: Batch, continuous, fed batch and steady state processes. **Commercial applications** of industrially important enzymes, polysaccharide (Xanthan), antibiotic (Penicillin), organic acids (Citric acid), Ethanol, Single Cell Protein.

Unit 2:

Upstream processing:

Isolation, enrichment, screening and selection of industrially important microorganisms, inoculum development, media formulation and development, sterilization of media, maintenance of stock culture and scale up. **Preservation** of industrially important micro-organisms using reduced temperature, Storage in a dehydrated form, Quality control of preserved stock cultures.

Strain improvement: isolation of induced mutants producing improved yields of secondary metabolites where directed selection is difficult to apply. Isolation of auxotrophic mutants, resistant mutants, revertant mutants. Applications of the parasexual cycle, protoplast fusion techniques and recombinant DNA techniques.

Unit 3:

Fermentation kinetics: Batch growth (growth pattern and kinetics in batch culture, environmental factors affecting growth kinetics), Monod's equation, continuous culture, Chemostat and turbitostat (construction and working), industrial utilization of mixed culture.

Transport phenomena in bioprocess system: Gas, liquid, mass transfer in cellular systems, basic mass transfer concept, Rate of metabolic oxygen utilization, Determination on oxygen transfer rates, determination of KLa, Heat transfer, aeration / agitation and its importance.

References:

1. Principles of fermentation technology by Stanbury Whitekar and Hall Pergaman, McNeul, Harvey.

2. Biotechnology – A textbook of industrial microbiology by Creuger and Creuger

3. Bioprocess Engineering Principle by Doran Academic press.

4. Shuler and Fikret Kargi, Bioprocess Engineering basic concepts, 2nd edition, Prentice Hall Publication.

5. Bioprocess Technology: Fundamentals and Applications, Stockholm KTH. Royal Institute of Technology

6. Advances in Biochemical Engineering by T.K. Bhosh, A. Fiechter and N. Blakebrough, Springer, Verlag Publications, New York.

7. Fermentation Biotechnology: Industrial Perspectives by S. Chand and Co.

Course Code	BIOT-522
Course Title	DSE-1A, Bioinformatics – I
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit I:

Overview of Bioinformatics: Scope & Applications, Bioinformatics resources: NCBI, EBI & SIB, Introduction to Bioinformatics databases – Types of Biological data, Nucleotide sequence

Databases:- GenBank, EMBL, DDBJ; Protein sequences Databases:- UniProt, UniProtKB, Swiss-Prot, TrEMBL, PIR, Sequence motifs Databases:- Prosite, ProDom, Pfam, InterPro, Gene Ontology.

Unit II:

Primary structure databases: PDB, NDB, MMDB; Secondary structure databases:-Structural Classification of Proteins –SCOP, Class Architecture Topology Homology –CATH, Families of Structurally Similar Proteins –FSSP, Catalytic Site Atlas –CSA; Molecular functions / Enzymatic catalysis databases:- KEGG & ENZYME database; Protein-Protein interaction database:- STRING; Chemical Structure database:- Pubchem; Gene Epression database:- GEO, ARRAYEXPRESS.

Unit III:

Viral genome database: ICTVdb; Bacterial Genomes database:-Genomes OnLine Database – GOLD, Microbial Genome Database-MBGD; Genome Browsers:- Ensembl, & UCSC Genome Browser; Archeal Genomics, Eukaryotic genomes with special reference to model organisms:- Yeast(SGD), Drosophila (FlyBase), C.elegans (WormBase), plants – Arabidopsis thaliana (TAIR).

Text Books:

- Introduction to Bioinformatics Author(s): Teresa Attwood, David Parry-Smith

Reference Books:

- Ontologies for Bioinformatics Author(s): Kenneth Baclawski and Tianhua Niu
- Bioinformatics: The Machine Learning Approach Author(s): P.Baldi and S. Brunak
- DNA Microarrays and Gene Expression: From Experiments to Data Analysis and Modeling Author(s): Pierre Baldi, G. Wesley Hatfield
- Bioinformatics for Geneticists Author(s): Michael Barnes, Ian C Gray

- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition Author(s): Andreas D. Baxevanis and B. F. Francis Ouellette (Eds) Bioinformatics Computing Author(s): Bryan P. Bergeron

Course Code	BIOTP-523
Course Title	DSE-1A, Lab course 53 (based on BIOT 521)
Marks	50
Credit	1.5
Total Periods	45 (3/wk)

1. Study of fermenter design and parts.

2. Isolation of industrially important microorganisms from soil.

3. Isolation of microorganisms producing secondary metabolites.

4. Extraction and purification of secondary metabolites.

5. Study of Growth Curve

6. Study of bacteria and fungi in relation to their optimum growth conditions i.e. pH, temp, Media components etc.

Course Code	BIOTP-524
Course Title	DSE-1A, Lab course 54 (based on BIOT 522)
Marks	50
Credit	1.5
Total Periods	45 (3/wk)

- To retrieve bioinformatics resources: NCBI, EBI & SIB
- To retrieve biological data from Genbank, EMBL & DDBJ
- To retrieve biological data from Uniprot & PIR
- To retrieve biological data from PDB & MMDB
- To retrieve biological data from EnsEMBL & UCSC Browser
- To retrieve biological data from Prosite & Pfam
- To retrieve biological data from SCOP & CATH database
- To retrieve biological data from PubChem
- To retrieve biological data from KEGG
- To retrieve biological data from Flybase database

Text Books:

- Introduction to Bioinformatics Author(s): Teresa Attwood, David Parry-Smith

Reference Books:

- Ontologies for Bioinformatics Author(s): Kenneth Baclawski and Tianhua Niu
- Bioinformatics: The Machine Learning Approach Author(s): P.Baldi and S. Brunak
- DNA Microarrays and Gene Expression: From Experiments to Data Analysis and Modeling Author(s): Pierre Baldi, G. Wesley Hatfield
- Bioinformatics for Geneticists Author(s): Michael Barnes, Ian C Gray
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition Author(s): Andreas D. Baxevanis and B. F. Francis Ouellette (Eds)
- Bioinformatics Computing Author(s): Bryan P. Bergeron

OPTIONAL III,

Applied Biotechnology – I

Discipline Specific Elective

Course Code	BIOT-531
Course Title	DSE-1A, DSE-531, A1 Industrial fermentations-I
Marks	50
Credit	02
Total Periods	45 (3/wk)

UNIT 1. Fermentation processes: Organic acid production

Study of industrial fermentations with respect to:

Microorganism/s, strain improvement (if any), media used, production process, types of reactors, downstream processing

Citric acid, Lactic acid, Acetic acid, Gluconic acid, L-Ascorbic acid

UNIT 2. Fermentation processes: Antibiotic production

Study of industrial fermentations with respect to:

Microorganism/s, strain improvement (if any), media used, production process, types of reactors, downstream processing

Penicillin, Streptomycin, Tetracycline, Erythromycin, Chloramphenicol

UNIT 3. Fermentation Processes: Amino Acid and Vitamins production

Study of industrial fermentations with respect to:

Microorganism/s, strain improvement (if any), media used, production process, types of reactors, downstream processing

Glutamic acid, L-Lysine, Tryptophan, L-Threonine, L- Phenylalanine, Vitamin B_{12}, $^{\beta}$-Carotene

UNIT 4. Fermentation Processes: Microbial production of organic solvents and Enzyme production

Study of industrial fermentations with respect to:

Microorganism/s, strain improvement (if any), media used, production process, types of reactors, downstream processing

Alcohol, Acetone butanol, Glycerol, Amylase, Pectinase, Proteolytic enzymes

References:

1. Industrial Microbiology by L.E. Casida
2. Biotechnology- A textbook of Industrial, Microbiology by Creuger and Creuger
3. Prescott and Dunn's Industrial Microbiology
4. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK, 2007.

Course Code	BIOT-531
Course Title	DSE-1A, DSE-531, B1 Metabolism of Macromolecules
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit I: Carbohydrate Metabolism

Basic concepts, Importance of glucose in metabolism, Definition, concept, metabolic map with enzyme and overall Balance sheet of Net gain of ATP and regulation: Glycolysis, TCA, HMP, Gluconeogenesis. Electron transport chain & Oxidative Phosphorylation, components involved in Electron transport & mechanism.

Unit II: Lipid Metabolism

Fatty acid activation and transported in Mitochondria. Oxidation of fatty acid (Palmitic acid). Fatty acid biosynthesis: Formation of Malonyl COA from Acetyl COA, FAS – Multienzyme complex & Reaction of palmitic acid.

Unit III Amino Acid Metabolism

Metabolic fates of amino groups, Deamination, Decarboxylation & Transamination reactions. Biosynthesis of Chorismate, Chorismate to Phenylalanine & Tyrosine with chemical reaction and enzymes.

Unit IV: Biosynthesis of nucleotides: -

De-Novo synthesis of purine and pyrimidine nucleotides and its regulation. De-novo purine nucleotide synthesis from PRPP to IMP, IMP to AMP& GMP; Salvage pathways of nucleotides synthesis.

References:

1. Cohn & Stump – Outline of Biochemistry Wiley Eastern Ltd.
2. Harpers Review of biochemistry – Prentice Hall
3. Lubert Stryer – Biochemistry 4th edition, W. H. Freeman. 2002
4. Horton, H.R., Moran, L.A., Ochs R.A., Rawn, J. D. and Scrimgeor, R.S., "Principles of Biochemistry" 3rd edition Prentice Hall,.2001.
5. Voet, D. and Voet, J. G., "Biochemistry" 3rd edition, John Wiley and Sons.2004.
6. Nelson, D.L. and Cox, M.M.,"Lehninger Principles of Biochemistry", 5th edition, W.H. Freeman.2009
7. Satyanarayana U, (2013), Biochemistry Elsevier
8. Karp G. (2015) Cell and Molecular Biology: Concepts and Experiments.5th Edition. John Wiley Publication.

Course Code	BIOT-532
Course Title	DSE-1A, DSE-532, A2 Animal cell culture I
Marks	50
Credit	02
Total Periods	45 (3/wk)

UNIT I

Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture etc.

UNIT II

Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application.

UNIT III

Behaviour of cells in culture conditions, division, their growth pattern, metabolism of estimation of cell number. Development of cell lines, characterization and maintenance of cell lines, stem cells, cryopreservation, common cell culture contaminants.

References:

Ian Freshney (1999) Culture of Animal Cells Set: A Manual of Basic Technique. 3 rd Ed. Wiley–Blackwell

J. M. Davis (2005) Basic Cell Culture. 2nd Ed. Oxford University Press.

Sudha Gangal (2007) Principles and Practice of Animal Tissue Culture. Universities Press

B. Singh, S. K. Gautam and M. S. Chauhan (2013) Textbook of animal biotechnology; TERI.Ashish S. Verma and Anchal Singh (2014) Animal Biotechnology; Elsevier

Course Code	BIOT-532
Course Title	DSE-1A, DSE-532, B2 Plant tissue culture I
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit 1:

Terminology- Totipotency, Competency, Determinism, Requirements of tissue culture facilities, **Sterilization** - Washing, Packing & Sterilization of Glasswares, Plasticwares, Sterilization of explants, media & it's components, Fumigation & Precautions to maintain aseptic conditions.

Unit 2:

Culture media - Major types, Components, composition and constituents; Growth regulators (Auxins, Cytokinins, Gibberellins, Abscisic Acid, Ethylene) origin and role in plant tissue development; Additives - Coconut water, Malt extract, Yeast extract, Potato extract, Banana homogenate, Algal extract; Activated Charcoal.

Basic procedure for Aseptic Tissue transfer.

Unit 3:

Organ culture: Introduction, Protocol, factors affecting Root tip culture, Leaf culture, Shoot Apical Meristem culture, Applications and limitations.

Micropropagation: Different Stages of Micropropagation & Applications.

Callus culture technique: Introduction, Types of calli, morphology & internal structure of callus; Protocol, Factors affecting callus culture, Maintenance of callus, Applications and limitations.

Suspension culture technique: Introduction, Types, Protocol & Factors affecting suspension culture, Maintenance of cultures. Assessment of growth measurements and Viability, Applications and limitations.

Somaclonal Variation: Introduction, Protocol, factors affecting somaclonal variation, morphological and genetical analysis, Applications and limitations

Somatic embryogenesis: Introduction, Types (direct and indirect), Protocol; Induction, development and maturation of Somatic embryos. Factors affecting somatic embryogenesis Applications and limitations.

Androgenesis, Gynogenesis and Irradiation: Introduction, Pre-treatments and Protocol, Pathways of development, Factors affecting Androgenesis, Gynogenesis and Irradiation techniques, Applications and limitations.

Protoplast culture: Isolation, Culture and Fusion - Introduction, Different methods, Protocol, Factors affecting protoplast culture, symmetric and asymmetric hybrids, Applications and limitations; cybrids.

Embryo Rescue: Introduction, Protocol, Factors affecting embryo rescue technique, Applications and limitations.

Synthetic seed production: Method and importance

References:

1. Razdan M.K. (2009) - Introduction to Plant Tissue culture (Oxford & IBH Publ., New Delhi)
2. Bhojwani S.S. & Razdan M.K. (1996) (2016) - Plant Tissue culture: Theory & Practice (Elsevier, New Delhi)
3. Jha T.B. & Ghosh B. (2017) - Plant tissue culture: Basic and applied (Universities Press, Hyderabad) and latest editions
4. Plant Tissue culture (2010) - Kalyan Kumar De (New central Book Agency)
5. Methods in Plant Tissue culture - (2003) U. Kumar Agrobios India
6. Plant cell culture Technology - M.M. Yeomen (2012) Blackwell

Course Code	BIOTP-533
Course Title	DSE-1A, Lab course 55 (based on BIOT-531)
Marks	50
Credit	1.5
Total Periods	45 (3/wk)

A1 Industrial Fermentation I

1. Production of Citric acid
2. Production of Lactic acid
3. Production of Penicillin
4. Alcohol production
5. Amylase production
6. Protease production
7. Glutamic acid Production

B1 Metabolism of Macromolecules

1. Detection of Phospholipids content in oil.
2. Isolation & Detection of Succinate dehydrogenase.
3. Separation of DNA, RNA, Protein from tissue extract.
4. Estimation of amino acid by ninhydrin Method.
5. Estimation of aromatic amino acid by Folin-Phenol reagent.

Course Code	BIOTP-534
Course Title	DSE-1A, Lab course 56 (based on BIOT-532)
Marks	50
Credit	1.5
Total Periods	45 (3/wk)

A2 Animal cell culture I

1. Preparation and sterilization of different types of cell culture media
2. To isolate lymphocytes from whole blood by gradient centrifugation
3. To check cell viability by cell counting
4. Demonstrate the complete process of animal cell culture including freezing, thawing, proliferations etc by taking suitable example of cell line.

B2 Plant Tissue Culture I

1. Nutrient stock preparation and sterilization
2. Plant tissue culture media preparation & sterilization.
3. Organ Culture
4. Callus culture
5. Suspension culture
6. Anther culture
7. Embryo rescue

Course Code	BIOT-541
Course Code	
Course code	BIOT-541
Course Title	SEC-3, E-Advanced chromatography
Marks	50
Credit	02
Total Periods	45 (3/wk)

UNIT I: Introduction to Separation Techniques

Separation Techniques, Classification of chromatographic techniques (Retention mode and sample introduction); fundamentals of paper, TLC Chromatography-Mobile phases and Stationary Phases, development of Chromatograms; Applications in qualitative and quantitative analysis

Unit 2: High Performance Liquid Chromatography

HPLC: Theory, Principle, Instrumentation; Separation Mechanism in HPLC; Applications in qualitative and quantitative analysis.

Unit 3: Ion Exchange Chromatography

Ion Exchange Chromatography: Theory, principle, instrumentations and applications of Ion Exchange Chromatography.

Unit 4: Affinity chromatography

Affinity chromatography: principle, instrumentations of Affinity chromatography; Affinity separations and SDS Gel Electrophoresis-applications in Protein purifications.

Unit 5: Gas Chromatography

Gas Chromatography: Principle, theories of separation process; Instrumentation and Application of GSC and GLC.

References:

1. "Unified Separation Science" by J.C. Giddings
2. "Principles and Practice of Modern Chromatographic Methods" by K. Robards, P.R. Haddad and P. E. Jackson.
3. High Performance liquid chromatography: Principles and Methods, Elena D. Katz (John Wiley & Sons Ltd. 2009)
4. Chromatography and Separation Science Satinder Ahuja, (2003), Academic Press
5. Biophysical Chemistry Upadhyay, Upadhyay & Nath .

Course Title	SEC-3, F - Cancer Biology
Marks	50
Credit	02
Total Periods	45 (3/wk)

Any one skill to be chosen out of two SEC-3 (E), SEC-3 (F)

Unit 1

Introduction to Cancer Biology:

Universal properties of normal and cancer cell, History, Definition of cancer, Benign tumor, Malignant tumor, and classification of cancer with examples, Common symptoms, causative factors. Cancer metastasis, migration & invasion, metastasis steps, epithelial to mesenchymal transition, angiogenesis; hypoxia and crosstalk between autophagy and apoptosis in mammalian cells.

Unit II

Molecular oncology: Oncogenes and Tumor suppressor genes: Retroviral oncogenes, Proto-oncogenes, Cancer-Associated Genes exhibit diverse functions: induction of cellular proliferation, inhibition of cellular proliferation and regulation of programmed cell death. Etiology of cancer: Chemical carcinogenesis, Physical carcinogenesis and virus induced carcinogenesis. Stages of cancer: initiation, promotion, progression. Cell Cycle: Loss of check points control and genetic instability in cancer.

Unit III

Tumor Microenvironment –Immune response and Tumor Escape: Immunesurveillance against strongly Immunogenic Tumors, Innate Immune Response to tumor cells, Tumor antigen: TATA & TSTA –Specific Immune response, Suppression of T cell responses by Regulatory T cells Changes in HLA by Tumor cells.

Unit IV

Cancer Diagnosis and Treatment: Clinical Examination, Radiological examination, Biopsy. Treatment- Surgery, Radiation, Chemotherapy, Hormone therapy, Gene therapy, Cancer Immunotherapy and Cancer Vaccines: Therapeutic vaccine & Vaccine for cancer prevention.

Reference Books:

- The Biology of Cancer, 2nd Edition, Robert A Weingberg, ISBN-10: 0815342209, ISBN-13: 978-0815342205.

- Cancer Biology, 4th Edition, Raymond W Ruddon, ISBN-10: 0195175441 | ISBN13: 978-0195175448.
- Ross, D.W., "Introduction to Oncogenes and Molecular Cancer Medicine" Springer-Verlag.1998.
- Franks, L. M. Teich, N.M., "Introduction to Cellular and Molecular Biology of Cancer", Oxford University Press.1997.
- Kuby - Immunology, 6th ed Freeman press.
- Abbas- Cellular and Molecular Immunology.
- Roger J B King & Mike W Robins, Cancer Biology Third Edition 2006.
- Stephen Clarke and Bob T Li , Immuno-Oncology 2017 Health Press Ltd. www.fastfacts.com
- https://www.dovepress.com/the-role-of-hypoxia-in-cancer-progression-angiogenesis-metastasis-and--peer-reviewed-fulltext-article-HP
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5045092/#:~:text=Hypoxia%20induces%20the%20imbalance%20between,steps%20of%20blood%20vessel%20formation.

Semester VI

B.Sc. Biotechology, Third Year

Semester VI

Optional I Advanced Biotechnology - II

Discipline Specific Core Course

Course Code	**BIOT-611**
Course Title	**DSE-1B, Recombinant DNA Technology**
Marks	**50**
Credit	**02**
Total Periods	**45 (3/wk)**

Unit 1: Isolation, Identification, and Characterization of DNA Fragments: Nucleic Acid Purification methods, Yield Analysis, Radiolabelling of Nucleic acids: Probe preparation by random primer, nick translation, end labelling. Primer extension labelling, Non-radioactive probes, molecular probes (Immunogenetics purposes) Southern and Northern Hybridization –principle, method and listing applications only. Techniques of introducing DNA into cell-calcium chloride transformation & High efficiency transformation by electroporation, Agrobacterium-mediated transformation, Protoplast transformation, Particle gun

Unit 2: Molecular Tools and Applications: Polymerase Chain Reaction-Essential features, design of primers, DNA polymerases for PCR, study with reference to principle, methodology and single application in detail, conventional PCR, RT-PCR. Mutagenesis: random mutagenesis and directed mutagenesis(primer extension method, error prone PCR methods) Applications of rDNA technology – in understanding genes & genomes, in biotechnology (protein production & protein engineering), in medicine & forensics, transgenic plants & animals, Organism cloning, Engineering of β-carotene, engineering of abzymes and phage display for hormone engineering. Mappping: promoter (Foot printing analysis), Transcriptional start site (Primer extension), Size of transcirpt –run off and run on assay.

Unit 3: Gene Cloning strategies and analysis Cloning strategies- cloning from mRNA, cloning from genomic DNA, Cosntruction of Genomic library Maniatis Strategy, cDNA cloning with conventional cDNA and full length cDNA. Genetic selection and screening methods- Chromogenic substrates, insertional inactivation, complementation Screening using nucleic acid hybridization – Nucleic acid probes, screening clone banks Immunological screening for expressed genes Analysis of cloned genes- in vitro mRNA translation, restriction mapping, blotting techniques, DNA sequencing

References:

1. An introduction to Genetic Engineering –Desmond S T Nicholl ,Cambridge university press, 2nd Ed.

2. Recombinant DNA: A short Course, Watson J.D, CSHL press

3. Molecular Biotechnology Principles & Applications of Recombinant DNA, Bernard R Glick & Jack J Pasternak, ASM press.

4. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell Scientific publications.

5. Ausbel S.M , Brent R, Current Protocols in Molecular Biology., Wiley International New York.

6. Maniatis I, Fritchh E.F ,& Sambrook J, Molecular cloning.

7. Winneker From Genes to Clones.

8. Setlow & Hollander A, Genetic Engineering: Principles & Methods, Plenum Press.

9. D.M Glover, DNA cloning, A practical approach.

10. Methods in Enzymology series, vol 152, 185, Academic press inc, Sandiego.

Course Code	BIOT – 612
Course Title	DSE-1B, Bioinformatics – II (Genomics and Proteomics)
Marks	50
Credit	02
Total Periods	45 (3/wk)

Sequence Analysis – Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues and xenologues Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, matrix derivation methods and principles. Repeats: Tandem and Interspersed repeat finding tools, Motifs, consensus, position weight matrices, Readseq-Sequence format conversion tool.

Pairwise sequence alignment – Basic concepts of sequence alignment, gap penalties, Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments and application in Nucleic acid and protein sequences alignments. Data mining tools: BLAST & FASTA (only overview).

Multiple sequence alignments (MSA) – The need for MSA, basic concepts of various approaches for MSA (e.g. progressive, hierarchical etc.). Algorithm of CLUSTAL OMEGA and MUSCLE and application, concept of dendrogram and its interpretation, Use of HMM based Algorithm for MSA (e.g. SAM method)

Text Books:

- Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York.

Reference Books:

- Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd.
- Introduction to Bioinformatics (1st Edition) by Arthur M. Lesk, Oxford University Press.
- Bioinformatics in the Post-Genomic Era by Jeffrey Augen, Addison-Wesley Publisher.

Text Books:

- . Bioinformatics: Sequence and Genome Analysis by Mount D., Cold

Spring Harbor Laboratory Press, New York.

Reference Books:

- Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd.
- Introduction to Bioinformatics (1st Edition) by Arthur M. Lesk, Oxford University Press.
- Bioinformatics in the Post-Genomic Era by Jeffrey Augen, Addison-Wesley Publisher.

Course Code	BIOTP – 613
Course Title	DSE-1B, Lab course 61 (based on BIOT-611)
Marks	50
Credit	1.5
Total Periods	45 (3/wk)

1. Isolation of genomic DNA from bacterial cell.
2. PCR amplification of isolated bacterial genomic DNA using universal primers
3. Extraction and purification of amplified DNA fragment from gel.
4. Ligation of amplified DNA fragment in cloning vector (T/A cloning)
5. Transformation E. coli and screening of recombinants by blue white selection
6. Plasmid Isolation and Characterization from recombinant bacterial colonies
7. Restriction digestion for confirmation of cloned DNA
8. Sequencing of clones
9. Preparation of Biotinylated Probes by Nick Translation
10. Southern Hybridization using Biotinylated probe

Course Code	BIOTP – 614
Course Title	DSE-1B, Lab course 62 (based on BIOT-612)
Marks	50
Credit	1.5
Total Periods	45 3/wk)

1. Biological sequence format interconversion tool-ReadSeq
2. Pairwise sequence alignment of nucleic acid & protein sequences using EMBOSS_Water
3. Pairwise sequence alignment of nucleic acid & protein sequences using EMBOSS_Needle
4. Multiple sequence alignment of nucleic acid & protein sequences using CLUSTAL OMEGA
5. Multiple sequence alignment of nucleic acid & protein sequences using MUSCLE
6. Dendogram prediction using TreeviewX2
7. Tandem repeat prediction using RepeatMaskar
8. Sequence similarity searching using BLAST
9. Sequence similarity searching using FASTA
10. Motif prediction using Scanprosite

Optional II (DSE – 1 B) Frontier Biotechnology – II

Discipline Specific Core Course

Course Code	BIOT-621
Course Title	DSE-1B, Fermenter: Design, types and operations
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit 1:

Basic design of fermenter: Culture vessel, aerators, agitators, valves, foam separators, ports, cooling and heating devices. Characteristic features and types of fermenter: continuous stirred tank reactors (CSTR), packed bed reactors, fluidized bed reactors, plug flow reactors, tube reactors, airlift fermenter, bubble column, tower fermenter. Online monitoring and computer control and computer control of fermentation process. Sterilization of fermenter, nutrients, air supply, product and effluents, process variable and control. Methods of sterilization in fermentation process

Unit 2

Downstream processes: Introduction , Recovery of particulates filtration , centrifugation , sedimentation, , emerging technologies for cell recovery , product isolation , extraction , solvent extraction , aqueous two phase system , sorption , precipitation , reverse osmosis, ultra filtration. Product recovery.

Unit 3:

Industrially important fermentations: Media formulation, Industrial production, Downstream processing, Biosynthesis, Regulation and metabolic control of: Organic acid – Citric acid, Organic solvent – Ethanol, Antibiotic- Penicillin, Biofertilizer- Rhizobium, Azotobacter, Biopesticides - Bacillus thuringiensis, Milk Products- Cheese production.

References:

1. Casida, L. E., 1984, Industrial Microbiology, Wiley Easterbs, New Delhi
2. Peppler, H. L 1979, Microbial Technology, Vol I and II, Academic Press.
3. Stanbury, P. F. and Whittaker, A. 1984 Principles of Fermentation technology, Pergamon press.
4. Prescott. S.C and Dunn, C. G., 1983 Industrial Microbiology, Reed G. AVI tech books
5. A. H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd.
6. Comprehensive Biotechnology volume 3 – Murray Moo- Young
7. Basic biotechnology- Colin Ratledge & Bijon Kritinsen, Cambridge university press, UK
8. Biotechnology: A textbook of microbiology by Cruger and Cruger, Sinaeur associates.ndustrial Microbiology by G.Reed (Ed.), CBS Publishers (AVI Publishing Co.)

Course Code	BIOT622
Course Title	Clinical Biochemistry
Marks	50
Credit	02
Total Periods	45 (3/week)

Unit 1: Basic concepts of clinical biochemistry, scope of clinical biochemistry in diagnostics, brief review of units and abbreviations used in expressing the concentrations and standard solutions, quality control. Manual versus automation in clinical biochemistry. Normal value of important constituents in blood, CSF and urine. Collection and preservation of blood, urine, CSF. Chemical and microbial analysis of blood, urine, sputum and CSF. Definition of functional and non-functional plasma enzyme, isozyme and diagnostics test, disease and diagnostics related to plasma lipase, choline esterase, alkaline phosphatase, SGPT, SGOT, LDH, CKP, immobilized enzymes in diagnostics.

Unit 2: Basics and application of Colorimeter, Turbidometer, Nephlometer and Spectrophotometer. Antibiotic sensitivity testing. Clearance test for urea, Erythrocyte sedimentation rate, Packed Cell Volume. Food infection and adulteration. Nutrition and chronic diseases. Physical and biochemical changes in ageing. Different theories in ageing, importance of superoxide dismutase in ageing.

Unit 3: Inborn errors related metabolic disorders, Galactosemia, Glycogen storage diseases, Phenylketonuria, gout, type I and II Diabetes, Hypoglycemia, Lipid Malabsorption, Statorrehea, Albinism. Chromosome aberration related disorders and their symptoms, diagnosis of Down's syndrome, Turner's syndrome. Neurological and psychiatric disorders as Schizophrenia, Depression, Dementia, Alzheimer's disease, Wilson's disease , Multiple sclerosis , Atherosclerosis.

References:

1. Clinical biochemistry by Kaplan L.A. and Pesce A.J.C.V. Mosby 1998.

2. Clinical biochemistry by W.J. Marshall and S.K. Bangery, Chirchill Livinston N.Y. 1995

3. Textbook of Medical Laboratory Techniques P. B. Godkar and D.P. Godkar, second edition Bhalani publication.

4. Practical Clinical Biochemistry by Gowenlock.

5. Biochemical Aspects of Human Diseases by Elkeles and Tavill

6. Fundamentals of Biochemistry, A. C. Deb.

7. Biochemistry, Pamela Champe and R. Harvey 2 nd edition.

8. Text book of Microbiology Ixth edition Anantnarayan

Course Code	BIOTP – 623
Course Title	DSE-1B, Lab course 63 (based on BIOT-621)
Marks	50
Credit	1.5
Total Periods	45 3/wk)

1. Study of fermenter design and parts.
2. Citric Acid Fermentation and CT
3. Ethanol fermentation and CT
4. Penicillin production
5. Azotobacter/ Rhizobium as biofertilizer
6. BT biopesticide preparation
7. Study of cheese production

Course Code	BIOTP – 624
Course Title	DSE-1B, Lab course 64 (based on BIOT-622)
Marks	50
Credit	1.5
Total Periods	45 3/wk)

1. Residual chlorine in water.
2. Qualitative test for food adulteration in food.
3. Analysis of blood group.
4. Haemocytometric analysis.
5. Serum protein fractionation.
6. Blood haemoglobin determination. Erythrocyte sedimentation rate (ESR).
7. Packed cell volume (PCV).
8. Glucose tolerance test (GTT).
9. Liver function test (SGPT, SGOT, alkaline phosphatase, serum bilirubin).
10. Cardiac function test (Serum cholesterol, LDH- cholesterol, CKP, Triglycerides).
11. Kidney function test (blood urea, creatinine, serum Na^{-} K^{+}).

Optional – III, Applied Biotechnology – II

(DSE – 1 B) Discipline Specific Elective

Course Code	**BIOT-631**
Course Title	**DSE-631, A3 Industrial fermentations-II**
Marks	**50**
Credit	**02**
Total Periods	**45 (3/wk)**

UNIT 1: Modern trends in microbial production

Bioplastics (PHB, PHA), Bioinsecticides (thuricides), Biofertilizer (nitrogen fixer Azotobacter, phosphate solubilising microorganisms), Single cell protein and production of biological weapons with reference to anthrax.

UNIT 2: Microbial Production of Exopolysaccharides, Bioleaching,

Microbial Production of Exopolysaccharides

i) Introduction ii) Nature of Microbial polysaccharides iii) Mechanism of synthesis iv) Xanthan gum production v) Dextran gum vi) Applications of xanthan and dextran gums

Recovery of metals: Bioleaching –

direct and indirect, bioleaching microorganisms, recovery of metals from mining waste; Extractio n of – Copper, uranium, gold

UNIT 3: Biotransformation:

Introduction to biotransformation, types of biotransformation reactions

Biotransformation of antibiotics

Biotransformation of steroids

UNIT – 4: Intellectual Property Rights Introtion to IPR; Types of Intellectual property – Patents, Trademarks, Copyrights and related rights, Plant breeders Right, Farmers Right.

References:

1. Prescott and Dunn's Industrial Microbiology edited by Reed, G., 4th edition, 1982.
2. Biotechnology. A Text Book of Industrial Microbiology by Creuger and Creuger
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK, 2007

Course Code	BIOT-631
Course Title	DSE-631, B3 Biopesticides
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit I: Introduction to Biopesticides

(A) History and concept of biopesticides. Definitions, concepts and classification of biopesticides viz. pathogen, botanical pesticides, and biorationales. Importance, scope and potential of biopesticides. Types and uses of Biopesticides based on regional variations.

(B) Definitions and types of pest (honey bee, silkworm, etc), Target pest: from pathogenic and non-pathogenic micro-organisms sources

Unit II: Mechanism of action

Modes of action of biopesticides based on their types: Naturally derived biological pesticides and its importance (Insecticides, herbicides). Modes of action based on the types of pests. Genetically modified based known biological pesticides, Impacts of biopesticides on human health and environment.

UNIT III: Production and Management

Mass production technology of bio-pesticides. Traditional and Advanced genetic engineering aspects for management of biopesticides. Cost-effectiveness strategies used in production. Integrated Pest Management: Principals and importance.

Textbooks:

1. Biopesticides: Pest management and regulation by A. Bailley and D. Chandler
2. Basics and Applied aspects of Biopesticides by K. Sahayraj

Course Code	BIOT-632
Course Title	DSE-632, A4 Animal cell culture II
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit I:

Cell Culture Laboratory Design and Equipments

Planning, construction and services; Layout; Sterile handling area; Incubation; Hot room; Air circulation; Service bench; Laminar flow; Sterilizer; Incubator; CO2incubator;Refrigerators and freezers; Centrifuge; Inverted stage microscope; Magnetic stirrer; Liquid nitrogen freezers; Slow cooling system for cell freezing; Water bath; Autoclaves and hot air oven; Pipette washers; Water purification system; Fluid handling systems and other equipments; Washing, packing and sterilization of different materials used in animal cell culture; Aseptic concepts; Maintenance of sterility; Cell culture vessels.

Unit II:

Cell Culture Techniques

History of animal cell culture; Different tissue culture techniques; Types of primaryculture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, Common cell culture contaminants.

Unit-III:

Applications of Cell Culture

Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for 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.

Recommended Textbook and References:

1. Culture of Animal Cells (2005) 5th Edition, FreshneyWiley-Liss,

2. Animal Cell Culture - Practical Approach (2000), 3rd Edition, Ed. John R.W. Masters Oxford University Press

3. Animal Cell Culture Techniques. (1998). Ed. Martin Clynes Springer,

Course Code	BIOT-632
Course Title	DSE-632, B4 Plant tissue culture II
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit 1:

Genetic engineering of plants:

Gene transfer methods - Vector mediated gene transfer (Agrobacterium and viruses); Features of Ti and Ri Plasmids and their use as vectors, Binary and co-integrate vectors, Promotors & Terminators; Direct or vectorless gene transfer, Selectable Markers & Reporter genes for plant transformation; Detection, characterization and expression of Transformants; Transgenes stability, expression & gene silencing; Chloroplast transformation.

Unit 2:

Applications of Plant transformations/Transgenic plants:

Applications of plant transformation for productivity and performance: GM technology for Conferring resistance to biotic stresses (pests, viruses and fungi) and abiotic stresses (draught and salt), Herbicide resistance, Prolonged shelf life of fruits, Enhancing the nutritional quality (pro-vitamin A)

Unit 3:

Global GM crop cultivation, Statutory bodies on GM crop regulation, rules for the manufacture, use/import/export and storage of hazardous genetically engineered organisms, barriers and paths to market for genetically engineered crops, Genetically Modified Crops and Regulations in India – Myths vs Facts

References:

U. Satyanarayana (2020), Biotechnology, Publisher - Books & Allied Ltd.

H. S. Chawla (2000), Introduction to Plant Biotechnology, Third Edition, Science Publishers.

B. D. Singh (2022), Plant Biotechnology, fourth Edition, MedTech Science Press.

Stewart C. N. (2008). Plant Biotechnology and Genetics: Principles, techniques and applications. John Wiley and Sons. Inc. New York.

P. B. Kavi Kishor, Manchikatla Venkat Rajam, T. Pullaiah (2020), Genetically Modified Crops: Current Status, Prospects and Challenges Volume 1, Springer Nature.

Leandro Pena (2004) Transgenic Plants: Methods and Protocols: v. 286 (Methods in Molecular Biology) Humana Press Inc.

Web sources:

http://www.geacindia.gov.in/resource-documents/17_2-Genetically_Modified_Crops_An_Overview.pdf

http://www.geacindia.gov.in/resource-documents/biosafety-regulations/acts-and-rules/Rules-for-the-manufacture-use-import-export-and-storage-1989.pdf

https://onlinelibrary.wiley.com/doi/10.1111/j.1467-7652.2009.00464.x

2019 Genetically Modified Crops and Regulations in India – Myths vs Facts, 2019.pdf

https://www.ejplantbreeding.org/index.php/EJPB/article/view/3283

Course Code	BIOT-641
Course Title	SEC-4, G - Advanced Microscopy
Marks	50
Credit	02
Total Periods	45 (3/wk)

Unit I: Electron Microscopy: Transmission Electron Microscopy & Scanning Electron Microscopy

Principle of electron microscopy. Instrumentation and operation of TEM & SEM. Imaging techniques: bright-field imaging, dark-field imaging, and high-resolution imaging using techniques like electron diffraction. Applications of TEM & SEM. Principle & Applications of scanning transmission electron microscopy (STEM).

Unit II: Fluorescence microscopy

Principle, Instrumentation and operation of fluorescence microscopy. Types of fluorescence microscopy: Wile-field fluorescence microscopy (WFM), Confocal Fluorescence Microscopy (CFM) & Total Internal Refraction Microscopy (TIRFM). Principle, Advantages and limitation of WFM, CFM & TIRFM.

Unit III: Atomic Force Microscopy (AFM)

Principle of AFM, Instrumentation and operation of AFM: Discuss the components of an AFM system, including the cantilever, laser beam deflection detection system, and feedback mechanism. Imaging modes: Provide detailed explanations of each imaging mode in AFM,

highlighting their advantages and limitations in terms of resolution, sensitivity, and sample compatibility. Applications of AFM.

Unit IV: Emerging Microscopy

Principle and application of Stimulated Emission Depletion (STED) Microscopy (Super resolution microscopy), Near-field Scanning Optical Microscope (NSOM) and Two-Photon Microscopy.

Reference Books:

- Jens Rietdorf, Microscopy Techniques, © Springer-Verlag Berlin Heidelberg 2005.
- Peter W. Hawkes , John C.H. Spence, Science of Microscopy2007 Springer Science Business Media, LLC
- Anwar Ul-Hamid, A Beginners' Guide to Scanning Electron Microscopy. Springer Nature Switzerland AG 2018.
- *A Practical Guide to Transmission Electron Microscopy, Volume II: Advanced Microscopy* Copyright © Momentum Press®, LLC, 2016.
- Jian Min Zuo • John C.H. Spence, Advanced Transmission Electron Microscopy Springer Science Business Media New York 2017.
- Keith Wilson and John Walker, principles And Techniques Of Biochemistry And Molecular Biology seventh Edition.
- Pier Carlo Braga Davide Ricci ,Atomic Force Microscopy Biomedical Methods and Applications.
- Jan Slavik, Fluorescence Microscopy and Fluorescent Probes Springer Science+Business Media, LLC.
- C. Barry Carter · David B. Williams (Eds.) Transmission Electron Microscopy Diffraction, Imaging, and Spectrometry, Springer International Publishing Switzerland 2016.
- Joseph I. Goldstein Dale E. Newbury Joseph R. Michael Nicholas W.M. Ritchie John Henry J. Scott David C. Joy, Scanning Electron Microscopy and X-Ray Microanalysis 4th edition. Springer Science+Business Media LLC 2018.

- https://www.e3sconferences.org/articles/e3sconf/pdf/2021/66/e3sconf_icgec2021_01031.pdf
- https://cw.fel.cvut.cz/b172/_media/courses/a6m33zsl/microscopic_techniques.pdf
- file:///D:/Downloads/AdvancesinMicroscopyTechniques.pdf
- file:///D:/Downloads/69723-MundoNano.pdf

Course Code	BIOT-641
Course Title	SEC-4, H - Fermented Foods
Marks	50
Credit	02
Total Periods	45 (3/wk)

Fermented Foods: Past, Present and Future Introduction;, History of Fermented Foods;, Microorganisms Involved in Food Fermentations - Bacteria, Yeasts, Moulds;, Advantages of Food Fermentation;, Production of Anti-Microbial Compounds (Organic acids, acetaldehyde and ethanol, Hydrogen peroxide, Carbon dioxide, Diacetyl, Reuterin, Bacteriocins)

Oriental Fermented Functional (Probiotic) Foods: Introduction, Functional Foods-Definition, Criteria of Functional Foods, Probiotic Foods as Functional Foods, Probiotics and Gut Microflora, Oriental Fermented, Foods as Sources for Probiotics Fermented Functional Foods of Korea, China, Japan, Indonesia, Nepal, Bhutan, Thailand and Philippines Biogenic Microbial Metabolites Derived from Fermentation Traditional Fermented Products of India: Introduction, Grain based fermented food products/ beverages, Fermented plant sources (fruit, vegetables, whole plant part) food product, Fermented plant beverage, Fermented milk and milk products, Fermented meat and sea products

Cultured Dairy Products: Introduction, Consumption of Cultured Dairy Products, Fermentation Principles, Yogurt Manufacture (Milk treatment, Yogurt styles, Yogurt cultures, Culture metabolism, Post-fermentation), Yogurt Flavor and Texture –role of EPS, Nutritional Benefits of Yogurt Cultured Buttermilk Manufacture;, Sour Cream Manufacture; Kefir Manufacture; Other cultured dairy products from around the world.

Cheese: Introduction, Manufacturing Principles, General Steps in Cheese Making, (selection of milk, Starter cultures, Coagulation, Cutting and cooking, Curd handling, Salting, Aging)

References:

1. Robert W. Hutkins: Microbiology and Technology of Fermented Foods First edition, (2006) IFT Press and Blackwell Publishing

2. Ramesh C. Ray, Aly F. El Sheikha and R. Sasi Kumar (eds): Microorganisms and Fermentation of Traditional Foods" (2014) 1st Edition ISBN 9781482223088 CRC Press

3. K. Rawat *, A. Kumari, S. Kumar, R. Kumar and R. Gehlot: Traditional Fermented Products of India (2018) International Journal of Current Microbiology and Applied Sciences, Volume 7 Number 04 https://doi.org/10.20546/ijcmas.2018.704.214

4. Didier Montet, Ramesh C. Ray (Ed): Fermented Foods, Part I Biochemistry and Biotechnology (2020) ISBN 9780367737450 CRC Press

5. Ravinder A: Hand Book Of Fermented Foods And Beverages Technology (2013) ISBN-10: 9350978873 Himalaya Pub. House-New Delhi