Syllabus for B.Sc.(Biotechnology)
SEP-2024

SemesterI								
Sl. No	**Course Code**	**Title of the Course**	**Category of Courses**	**Teaching Hours per Week**	**SEE**	**IA**	**Total Marks**	**Credits**
1		Cell Biology and Genetics	Theory	4	80	20	100	3
2		Cell Biology and Genetics practical	Practical	4	40	10	50	2
Semester II								
3		Biochemistry and Biophysics	Theory	4	80	20	100	3
4		Biochemistry and Biophysics Practical	Practical	4	40	10	50	2
SEMESTER III								
5		Microbiology and Immunology	Theory	4	80	20	100	3
6		Microbiology and Immunology practical	Practical	4	40	10	50	2
SEMESTER IV								
7		Molecular Biology and Recombinant DNA Technology	Theory	4	80	20	100	3
8		Molecular Biology and Recombinant DNA Technology Practical	Practical	4	40	10	50	2
SEMESTER V								
9		Plant Biotechnology	Theory	3	80	20	100	3
10		Animal Biotechnology	Theory	3	80	20	100	3
11		Plant and Animal Biotechnology Practical	Practical	4	40	10	50	2
SEMESTER VI								
12		Bioprocess and Environmental Biotechnology	**Theory**	**3**	**80**	**20**	**100**	**3**
13		Biostatistics and Bioinformatics	**Theory**	**3**	**80**	**20**	**100**	**3**
14		Bioprocess, Environmental Biotechnology, Biostatistics and Bioinformatics Practical	Practical	4	40	10	50	2

MANGALORE UNIVERSITY
B.Sc. Biotechnology

Notes:

IA = Internal Assessment

Marks Allotment for skill-based practical in IV Semester:
*Continuous Internal Assessment = 10 Marks
**Preparation and Presentation (30 marks); Viva-voce (10 marks) = 40 Marks

Marks Allotment for Mini Project in V Semester / Internship in VI Semester:
#Continuous Internal Assessment = 10 Marks
##Work carried out (20 marks); Report (10 marks); Presentation and Viva-voce (10 marks) = 40 Marks

Mini Project may be carried out In-house with credits accruing to V Semester.
Internship of minimum two weeks duration to be undertaken in Industries/Labs/Institutes/ Hospitals etc., and may be carried out between IV and V Semesters with credits accruing to VI Semester.

SEMESTER IV

COMPULSORY SKILL-BASED COURSE

Program Name	**B.Sc in Biotechnology**	**Semester**	**V**
Course Title	**COMPULSORY SKILL-BASED COURSE-PROJECT WORK**		
Course Code	**BSCBTCSk504**	**No. of credits**	**02**
Contact Hours	**48 Hours project 3Hrs/week**	**Duration of EA**	**-**
Formative Assessment	**10**	**Summative assessment**	**40**

To enhance the skills of a student, a Minor project in the interested subject need to be completed and report need to be submitted for evaluation. Students Project need to be assessed and marks need to be given based by viva voce of the project work.

SEMESTER-V

BSCBTCS 501: PLANT BIOTECHNOLOGY **40 hours**

Course Outcomes:

After completing this course, the student is expected to learn the following:

CO 1. Demonstrate a comprehensive understanding of plant biology, physiology, genetics, andmolecular biology.

CO 2. Explore methods of introducing foreign genes into plants through transformation techniques.

CO 3. Gain practical skills in plant tissue culture for improvement.

CO 4. Design strategies for plant genetic manipulation against biotic and abiotic stressors.

CO 5. Hypothesize strategiesto increase plant yield and fruit/seed quality.

CO 6. Apply biotechnological tools and techniques used in plant research and agriculture, such asplant tissue culture, genetic engineering and transgenics.

CO 7. Execute plant tissue culture techniques for callus induction, somatic embryogenesis, andmicropropagation, and apply them in plant breeding and propagation.

CO 8. Perform plant transformation methods and demonstrate the ability to introduce foreign genesinto plants using different techniques.

CO 9. Apply knowledge about ethical considerations and regulatory frameworks associated with plant biotechnology and genetically modified crops.

Unit I **(10 hours)**

History of plant tissue culture, technical terms and definitions in tissue culture. Establishing sterile cultures - plant tissue culture lab set up, sterilization methods for instruments and explants. Tissue culture media, plant growth regulators. Principles, methodology and applications of clonal or micropropagation– axillary bud culture, shoot tip culture, meristem and mericlone culture. Haploid culture-principle, protocol and applications. Embryo culture – types, principle, protocol and applications. Embryo rescue.

Unit II **(10 hours)**

Callus induction, introduction to the process of embryogenesis- types and organogenesis. Synthetic seeds- principle, protocol and applications. Somaclonal variations- introduction, types, process, factors affecting process and applications. Single cell suspension cultures - types, methods, viability tests and applications. Secondary metabolites - introduction, classification, production *in-vitro* methods and applications. Cryopreservation of plant tissues-introduction, principle, types, protocol and applications.

Unit III **(10 hours)**

Protoplast-introduction, principle; isolation methods-mechanical, enzymatic. CPW medium, source of enzymes. Isolation of protoplasts from intact tissue, callus, suspension cultures and haploid cells - protocols. Testing the viability of isolated protoplasts. Markers used in the selection of hybrid cells. Somatic hybridization - introduction, principle, protocol; hybrids and cybrids. Protoplast fusion methods: chemical and electrical.

Unit IV **(10 hours)**

Structure of *Agrobacterium tumefaciens*, tumour formation in monocots and dicots. Genetic transformation – transgenic cotton, edible vaccines and transgenic brinjal: protocol and applications. GM food and ethical issues.

Diseases development in plants caused by bacteria (bacterial blight or rice), fungi (late blight of potato), virus (tobacco mosaic disease) classification, symptoms, disease cycle and control measures.

References

- Bajaj YPS series. 1986. *Biotechnology in Agriculture and forestry*. Springer Verlag Publishers.
- Bajaj YPS. 2007. *Biotechnology in Agriculture and Forestry*. Springer Verlag Publishers. Chawla HS. 2004. *Introduction to Plant Biotechnology*. Science Publications. Inc.
- Kalyankumar De. 2004. *Plant tissue culture*. New Central Book Agency (P) Limited, New Delhi.
- Mantell SH and Smith H.1983.*Plant Biotechnology*. Cambridge University Press.
- Narayana Swamy S.1994. *Plant cell and tissue culture*. Tata McGraw Publishing House, New Delhi.
- Reinert J and Yeoman MM. 1982. *Plant Cell and Tissue Culture* - A Lab manual. Springer.
- Reinert J.1982. *Plant cell and tissue culture*- A Lab manual. Narosa Publications, New Delhi.
- Russell, G.E.1988.*Biotechnology of Higher Plants*. Intercept Publications.
- Srivatsava P.S. *Plant tissue culture and Molecular Biology*: Applications and prospects. Narosa Publishing House, New Delhi.

BSCBTCS 502: ANIMAL BIOTECHNOLOGY **40 hours**

Course Outcomes:

After completing this course, the student is expected to learn the following:

CO 1. To learn the fundamental aspects of animal biotechnology.

CO 2. Discuss about biotechnological tools and techniques used in animal research.

CO 3. Understand the biology and characterization of cultured cells, including their adhesion, proliferation, differentiation, morphology, and identification.

CO 4. Gain practical skills in basic mammalian cell culture techniques, measuring growth parameters, assessing cell viability, and understanding cytotoxicity.

CO 5. Learn about germplasm conservation techniques and the establishment of gene banks, along with large-scale culture methods for cell lines.

CO 6. Explore methods of introducing foreign genes into animals through transformation techniques.

CO 7. Explore organ and histotypic culture techniques, biotransformation, 3D cultures, whole embryo culture, somatic cell cloning, and the ethical considerations surrounding stem cells and their applications

CO 8. Apply knowledge to real-world challenges in veterinary medicine, conservation, and

biomedical research

CO 9. Understand the need for animal biotechnology for human welfare.

Unit I **(10 hours)**

History of the development of cell culture: Contributions of R.G.Harrison, Alexis Carrel. Hanging drop technique, watch glass technique. Equipments and materials for animal cell culture. Essential, beneficial and useful equipments. Substrates (glass, plastic, treated surface, feeder layer).

Animal cell culture media: Media for immediate survival of cells (BSS). Media for prolonged survival of cells (natural and artificial). Natural media - embryo extract, lymph serum; artificial (defined) media- media with serum and media without serum. Importance of serum in culture media.

Basic techniques of mammalian cell culture *in vitro*: primary explants culture - technique, advantages and disadvantages; primary cell culture - technique. Disaggregation of tissue: trypsinization - cold and warm, collagenase treatment, mechanical methods. Measurement of cells - cell count and cell viability. Cell counting - hemocytometer, electronic cell counter; cell viability - trypan blue, MTT assay.

Cell separation techniques - density gradient centrifugation, MACS, FACS.

Maintenance of cell culture: medium change-need, method; sub culturing – factors affecting, methods - monolayer and suspension culture.

Unit II **(10 hours)**

Cell lines: types (finite and continuous), characteristics, examples for commonly used cell lines - BHK 21 - C13, HeLa. Routine maintenance – medium change, sub culturing.

Growth kinetics of cells in culture: growth curve–lag, log, stationary and plateau phase; PDT, multiplication rate, generation number.

Measurement of cell proliferation- MTT assay, ^{3}[H]:thymidine incorporation. Somatic cell fusion techniques: chemical/virus mediated, electrofusion, Production of MAbs by hybridoma technology: technique, applications of MAbs. Selection of hybrids: HAT selection; cell cloning- types: dilution and suspension (agar gel and methocel). Stem cell cultures: types- totipotent, pluripotent, multipotent, unipotent; embryonic and adult. Cryopreservation - technique (freezing and thawing) and applications.

Unit III **(10 hours)**

Animal cloning- reproductive cloning (somatic cell nuclear transfer), therapeutic cloning (xenotransplantation**). Gene transfer methods** (transfection): chemical methods- $CaPO_4$ co-precipitation, DEAE dextran mediated, lipofection; physical - microinjection, electroporation; biological method – retroviral infection. Reporter genes - GFP, antibiotic resistance markers (neomycin phosphotransferase). DNA microarray - method, applications. **Gene therapy** - somatic and germline. Somatic (SCID), gene therapy in cancer treatment (TNF gene, p53 gene replacement).

Unit IV **(10 hours)**

Genetic engineering - Factor VIII, tissue plasminogen activator (tPA), hormones (growth hormone, insulin), hepatitis B vaccine. Organ culture (3 dimensional cultures): methods-watch glass technique, raft method, agar gel method, grid method cyclic exposure to light and gas phase. Tissue engineering (artificial skin): methods-collagen method and mesh scaffolding method. Transgenic animals:transgenic cattle - tPA, AAT production; Animals as bioreactors (biopharming): mammary glands asbioreactors- production of regulatory proteins (alpha -1- antitrypsin[AAT], tPA).

References

- Butler M. 2004. *Animal Cell Culture and Technology* 2nd edition. BIOS Scientific Publishers.
- Cibelli JB,Lanza RP,Campbell K andWestMD. 2002 .*Principles of Cloning.* Academic Press.
- Davis JM.2002. *Basic Cell Culture: A Practical Approach* (Practical Approach Series) 2nd edition. Oxford University Press, Oxford.
- Houdebine LM.2003. *Animal Transgenesis and Cloning*. John Wiley &Sons.
- Ian Freshney R. 2000.*Culture of Animal Cells*: A Manual of Basic Technique 4th edition. Wiley-Liss.
- Panno J. 2005. *Animal Cloning*: The Science of Nuclear Transfer. Facts on File Inc.

BSCBTPS 503: PLANT AND ANIMAL BIOTECHNOLOGY PRACTICAL

1. Plant tissue culture laboratory set up
2. Different plant tissue culture media
3. Methods of sterilization of glass ware, media and explants
4. Establishment of callus culture, seed, embryo culture
5. Anther and pollen culture
6. Clonal propagation-shoot tip and axillary bud culture
7. Somatic embryogenesis and artificial seeds
8. Preparation and filtration of animal tissue culture media
9. Primary explants culture
10. Chick embryo culture (Spratt culture)
11. Isolation of bone marrow cells by flushing and primary culture
12. Determination of viability of cells
13. Mammalian cell counting by Hemocytometer
14. Estimation of viability of cells by trypan blue dye exclusion
15. Cryopreservation

COMPULSORY SKILL-BASED COURSE

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Course Code	BSCBTCSk504	No. of credits	02
Contact Hours	48 Hours project 3Hrs/week	Duration of EA	-
Formative Assessment	10	Summative assessment	40

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SEMESTER-VI

BSCBTCS 601:BIOPROCESS AND ENVIRONMENTAL BIOTECHNOLOGY

40 hours

Course outcomes:

After completing this course, the student is expected to learn the following:

CO 1. Exploitation of microorganisms for industrial use and their improvement, and formulation of media for efficient growth and production of microbial or cell-based products.

CO 2. The design, operation, and specific applications of various bioreactors.

CO 3. Demonstrate a comprehensive understanding of the fundamental concepts and principles of environmental biotechnology.

CO 4. Apply knowledge of biotechnological techniques to address environmental challenges,such as pollution control and waste management.

CO 5. Analyze and evaluate environmental biotechnology case studies, research findings, andreal-world applications.

CO 6. Design and implement biotechnological approaches for environmental remediation,utilizing microbial processes and biodegradation principles.

CO 7. Evaluate the ethical and sustainable aspects of environmental biotechnology practices and make informed decisions regarding their application in environmental conservation.

CO 8. Communicate scientific concepts and research findings related to environmentalbiotechnology effectively, both in written and oral forms, to diverse audiences

Unit I **(10 hours)**

Basic principle components of fermentation technology. Strain improvement of industrially important microorganisms. Types of microbial culture and its growth kinetics– Batch, Fed-batch, and Continuous culture. Principles of upstream processing – Media preparation, Inocula development, and sterilization.

Unit II **(10 hours)**

Bioreactors- Significance of Impeller, Baffles, Sparger; Specialized bioreactors- design and their functions: airlift bioreactor, membrane bioreactors, fluidized bed reactor, packed bed reactors Downstream processing- cell disruption, precipitation methods, solid-liquid separation, liquid-liquid extraction, filtration, centrifugation, chromatography, drying devices (Lyophilization and spray dry technology), crystallization, Microbial production of amylase and Single Cell Proteins.

Unit III **(10 hours)**

Basic principles of environmental biotechnology and its relevance to environmental protection: definition, its role in waste management, manufacturing process and pollution control. Microbiological treatment solid wastes: composting, vermicomposting, Biological treatment of liquid wastes (sewage): primary treatment, secondary treatment (activated sludge system, trickling filters), sludge digestion, septic tanks, oxidation ponds. Tertiary treatments. Bioremediation: Importance of bioremediation in environmental cleanup. Microorganisms used in bioremediation. *In-situ* Bioremediation Methods. – Bioaugmentation. Biostimulation. Bioventing. Phytoremediation. *Ex-situ* Bioremediation Methods – Composting, Land farming, Biopile and bioslurry systems.

Unit IV **(10 hours)**

Conventional and non-conventional sources of energy. Methanogenic bacteria and biogas, microbial H2 production, bioethanol production. solar energy and solar energy converters, wind and tidal energy and its utilization. Coastal regulatory zone (CRZ). Energy gardens – *Pongamia* and *Jatropha.* Microbial degradation of xenobiotics: pesticides, detergents, plastics. Degradation of organic compounds: hydrocarbon. Eutrophication, biomagnifications. Biomining (e.g. copper and gold).Biocontrol agents: Bacterial, viral, fungal of plants as Biopesticides. Biofertilizers: utilization of *Rhizobia*, *Cyanobacteria*, *Arbuscular mycorrhizae*.

References

1. Casida LE. (1991). *Industrial Microbiology*. 1st ed., Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). *Biotechnology: A textbook of Industrial Microbiology*. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). *Industrial Microbiology*. 1st ed., Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). *Principles of Fermentation Technology*. 2nd ed., Elsevier Science Ltd.
5. Colin Ratledge and Bjorn Kristiansen, Basic Biotechnology (3rd Ed.).2022, Cambridge University Press. 2002.
6. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
7. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, (2nd Ed). Taylor &Francis Ltd, UK, 2007.
8. Jogdand SN. 2010. *Environmental Biotechnology.* Himalaya Publishing House, Bangalore, New Delhi.

9. Odum EP. *Ecology* 1983.W B. Saunders Co., Philadelphia and London.
10. Odum EP. and Barrett GW. 2004. Fundamentals of Ecology WB. Saunders Co., Philadelphia and London.
11. Subba Rao N.S. 1974. *Soil Microbiology*, 4th ed., Oxford & IBH Publishers, New Delhi
12. Wang LK, Ivanov V, Tay JH and Hung YT. 2010. *Environmental Biotechnology.* Sringer publishers.

BSCBTCS 602: BIOSTATISTICS AND BIOINFORMATICS 40 hours

Course Outcomes: After successful completion of this Course, students will be able to:

CO 1: Describe the scope and importance of biostatistics and explain types of data their presentation in easily understandable way.

CO 2: Demonstrate analysis of data using different statistical methods which helps to draw inference from the data

CO3: Explain the organization and working of computers and illustrate the use of computers in biological science especially in automated control of fermenters

CO 4: Describe the scope and importance of bioinformatics and demonstrate the use of basic bioinformatics tools for analysis of biological data

CO 5: Discuss biological databases, their types and importance and discuss the applications of bioinformatics in biology

Unit I (10 hours)

Biostatistics: Definition and Importance; Data: Definition, Types: Qualitative Data and Quantitative Data, Categories of Data: Primary Data, Secondary Data; Classification and Tabulation of Data; Frequency Distribution: Discrete Frequency Distribution, Continues Frequency Distribution Presentation of Data: Bar Diagram, Histogram, Line diagram, Pie chart Measures of central tendencies: definitions with examples- mean, mode, median, Geometric mean, Harmonic mean

Unit II (10 hours)

Measures of dispersion: definitions with examples - range, quartile deviation, mean deviation, standard deviation. Probability: definition, sample space, event, complement of an event, subevent, union of events. Introduction of events, equally likely events, mutually exclusive and exhaustive events with illustrations. Correlation: definition, types of correlation, Karl Pearson's coefficient of correlation, Spearman's rank correlation. Regression: definition, regression equations, properties of regression

Unit III (10 hours)

Bioinformatics – An Overview: Definition, Scope, Importance of Bioinformatics in Biological Research, History of Bioinformatics. Bioinformatics and its relation with molecular biology Examples of related tools (FASTA, BLAST, RASMOL). Biological Databases: Definition, Types: Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary) Database Management System (DBMS).

Unit IV **(10 hours)**

Multiple sequence analysis: Parameters of CLUSTAL-W and CLUSTALX for multiple sequence alignment, interpretation; Phylogenetic analysis: methods and tools. Biological Data visualization: PyMol, Cn3D. Application of bioinformatics in drug designing: molecular docking and pharmacogenomics. AI in bioinformatics: Gene prediction and genome annotation, Protein structure prediction.

References

Arnold E. 1979. Introductory statistics for Biology 2nd ed., London.

Attwood T and Parry-Smith D. 1999. Introduction to Bioinformatics. Prentice Hall Publ.

Lewis AE. 2010. Biostatistics. Prentice Hall. New Jersey.

Parker RE. 1979. Introductory Statistics for Biology. Hodder Arnold Publications

Zar J. H. 1974. Biostatistical analysis. Prentice Hall, New Jersey

BSCBTPS 603: BIOPROCESS, ENVIRONMENTAL BIOTECHNOLOGY, BIOSTATISTICS AND BIOINFORMATICS PRACTICAL

1. Estimation of alkalinity and salinity from water, soil or sewage
2. Determination of BOD and COD
3. Estimation of hardness of water
4. Estimation of total solids, dissolved and suspended solids
5. Estimation of dissolves oxygen and carbon dioxide
6. Estimation of organic carbon.
7. Study of fermenter- Demonstration.
8. Production of wine
9. Estimation of the percentage of alcohol, total acidity & volatile acidity in wine.
10. Production and analysis of amylase.
11. Production and analysis of lactic acid.
12. Problems in biostatistics
13. Problems in bioinformatics

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