VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Biotechnology

V Semester Syllabus

Bachelor of Science

With effect from 2021-22 and onwards

Chairman
BOS in Biotechonology (PG/UG)
Department of PG. Studies and
Research in Biotechnology
Vijayanagara Sri Krishnadevaraya
University, BALLARI - 583105.

Dr. Ashajyothi. C, M.Sc., Ph.D
Assistant Professor
Department of Biotechnology
V.S.K. University, BALLARI-583105

B.Sc. (Biotechnology) Programme with effect from 2021-22

THIRDYEAR; SEMESTER-5										
Objective: Real time Learning & Ability to solve complex problems that are ill-structured										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC5	**21BSC5C5BTL**	**Plant Biotechnology**	40	60	100	4	-	-	4	3
	21BSC5C5BTP	**Plant Biotechnology Lab**	25	25	50	-	-	4	2	3
DSC6	**21BSC5C6BTL**	**Animal Biotechnology**	40	60	100	4	-	-	4	3
	21BSC5C6BTP	**Animal Biotechnology Lab**	25	25	50	-	-	4	2	3
Another Department course (Theory+Practical)	Another Department code	Another Department Course Title **(Theory)**	40	60	100	4	-	-	4	3
	Another Department code	Another Department Course Title **(Lab)**	25	25	50	-	-	4	2	3
Another Department course (Theory+Practical)	Another Department code	Another Department Course Title **(Theory)**	40	60	100	4	-	-	4	3
	Another Department code	Another Department Course Title **(Lab)**	25	25	50	-	-	4	2	3
SEC4	**--**	**Employability Skills/Cyber Security**	-	-	-	2	-	2	3	3
		Semester Total							**27**	

Department of Biotechnology

Semester-V

DSC5: 21BSC5C5BTL: Plant Biotechnology

Course Title: Plant Biotechnology	**Course code: 21BSC5C5BTL**
Total Contact Hours: 56 Hrs.	**Course Credits: 04**
Internal Assessment Marks: 40	**Duration of SEE: 03 Hrs.**
Semester End Examination Marks: 60	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Demonstrate a comprehensive understanding of plant biology, physiology, genetics, and molecular biology.
2. Apply biotechnological tools and techniques used in plant research and agriculture, such as plant tissue culture, genetic engineering and transgenics.
3. Utilize molecular markers and genomic approaches for genetic mapping, marker-assisted selection, and plant breeding programs.
4. Apply molecular biology techniques, including PCR, DNA sequencing, and gene expression analysis, to investigate and analyze plant genetic information.
5. Utilize bioinformatics tools and databases to analyze and interpret plant genomic and transcriptomic data.
6. Apply knowledge about ethical considerations and regulatory frameworks associated with plant biotechnology and genetically modified crops.
7. Apply acquired knowledge and problem-solving skills to address real-world challenges in agriculture, food security, and environmental sustainability using plant biotechnology approaches.

DSC5: 21BSC5C5BTL: Plant Biotechnology

Unit	Description	Hours
1	**Plant Tissue culture:** Introduction, history, definition, hypothesis, and concept of totipotency. Principles of plant tissue culture, types of culture, morphogenesis, differentiation, callus, direct and indirect organogenesis. In vitro propagation and micropropagation, Seed culture, embryo culture, bud culture, limitations, applications in horticulture, agriculture, and forestry. Meristem culture, Somaclonal variation. Commercial micropropagation of Banana and Sugarcane. Haploid Production, Anther culture, Pollen culture, Ovary culture, Ovule culture - technique, limitations, and applications. Protoplast culture, Somatic hybridization, cybrids.	11
2	***In vitro* secondary metabolite production:** Introduction to secondary metabolites, major secondary metabolites, and applications. In vitro secondary metabolite production, Suspension cultures, cell cultures, root cultures, hairy root cultures, growth Vs secondary metabolite production, yield enhancement, elicitation, biotransformation, bioreactors and scaling up of secondary metabolite production, limitations,	12

	and applications. Case studies of Shikonin and root cultures of Panax ginseng.	
3	**Transgenic Plants-I:** Introduction to Transgenic Plants. Overview of transgenic plants and their significance in agriculture. Historical background and development of plant genetic engineering. Benefits and controversies associated with transgenic plants. Transgenic Plant Technology - Techniques for introducing foreign genes into plants: Agrobacterium-mediated transformation, biolistics, and other methods. Selection and screening of transformed plants.	**11**
4	**Transgenic Plants-II:** Molecular markers and reporter genes used in transgenic plant research. Transgene Integration and Expression. Mechanisms of transgene integration into plant genomes. Factors influencing transgene expression: promoters, enhancers, and regulatory elements. Methods for analyzing and verifying transgene expression. Applications of Transgenic Plants - Improved crop traits through genetic engineering: pest resistance, herbicide tolerance, disease resistance, and abiotic stress tolerance. Case studies of commercially important transgenic crops.	**11**
5	**Biosafety and Regulatory Considerations:** Safety assessment of transgenic plants: potential risks and benefits. International regulatory frameworks for releasing and commercializing genetically modified organisms (GMOs). Public perception and consumer acceptance of transgenic plants. Ethical considerations of genetic engineering in plants. Socio-economic impacts of transgenic crops on farmers and agricultural systems. Intellectual property rights and access to transgenic technologies. Emerging trends and technologies in plant biotechnology - genome editing (CRISPR-Cas9) and RNA interference (RNAi)	**11**

References:

1. Bhojwani, S.S., and Razdan, M.K. (2004). Plant Tissue Culture: Theory and Practice. Amsterdam: Elsevier Science.
2. Brown, T.A. (2010). Gene Cloning and DNA Analysis: An Introduction. 7th edition. Oxford: Wiley-Blackwell.
3. Gardner, E.J., Simmons, M.J., and Snustad, D.P. (2008). Principles of Genetics. 10th edition. Hoboken, NJ: John Wiley & Sons.
4. Glick, B.R., and Pasternak, J.J. (2018). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5th edition. Washington, DC: ASM Press.
5. Raven, P.H., Johnson, G.B., Losos, J.B., and Singer, S.R. (2013). Biology. 10th edition. New York, NY: McGraw-Hill Education.
6. Reinert, J., and Bajaj, Y.P.S. (1997). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Berlin: Springer.
7. Russell, P.J. (2013). iGenetics: A Molecular Approach. 3rd edition. Boston, MA: Benjamin Cummings.

Date Course Coordinator Subject Committee Chairperson

Department of Biotechnology

Semester-V

DSC5: 21BSC5C5BTP: Plant Biotechnology Lab

Course Title: Plant Biotechnology Lab	**Course code: 21BSC5C5BTP**
Total Contact Hours: 60Hrs	**Course Credits: 02**
Internal Assessment Marks: 25	**Duration of SEE: 03 Hrs.**
Semester End Examination Marks: 25	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Execute plant tissue culture techniques for callus induction, somatic embryogenesis, and micropropagation, and apply them in plant breeding and propagation.
2. Perform plant transformation methods and demonstrate the ability to introduce foreign genes into plants using different techniques.

DSC5: 21BSC5C5BTP: Plant Biotechnology Lab

List of Experiments

1. Laboratory organization of basic and commercial plant tissue culture
2. Media preparation (MS, B5), solid media preparation, and Liquid media preparation
3. Explant preparation – Leaf, bud, rhizome, and meristem
4. Callus culture- Initiation and establishment of different types of callus cultures
5. Micropropagation – Stage 0. 1, 2, 3, and 4
6. Acclimatization and hardening techniques
7. Anther culture and pollen culture
8. Ovary and Ovule culture
9. Isolation and culture of Protoplast
10. Staining, cell viability, and cell count of cell cultures
11. Hairy root culture by Agrobacterium rhizogenic transformation

References:

1. Sambrook, J., Fritsch, E.F., and Maniatis, T. (1989). Molecular Cloning: A Laboratory Manual. 2nd edition. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
2. Slater, A., Scott, N.W., and Fowler, M.R. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford: Oxford University Press.
3. Smith, R. (2012). Plant Tissue Culture: Techniques and Experiments. 3rd edition. San Diego, CA: Academic Press.
4. Taiz, L., and Zeiger, E. (2014). Plant Physiology. 5th edition. Sunderland, MA:

Sinauer Associates.
5. Vasil, I.K., and Vasil, V. (2007). Molecular Improvement of Cereal Crops. Dordrecht: Springer

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Department of Biotechnology

Semester-V

DSC6: 21BSC5C6BTL: Animal Biotechnology

Course Title: Animal Biotechnology	**Course code: 21BSC5C6BTL**
Total Contact Hours: 56 Hrs.	**Course Credits: 04**
Internal Assessment Marks: 40	**Duration of SEE: 03 Hrs.**
Semester End Examination Marks: 60	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the biology and characterization of cultured cells, including their adhesion, proliferation, differentiation, morphology, and identification.
2. Develop knowledge of the manipulation of animal reproduction, including artificial insemination, embryo transfer, in vitro fertilization, and somatic cell cloning. Understand ethical issues and applications like recombinant vaccines and probiotics for disease control.
3. Understand gene transfer techniques in animals, including vectors, gene constructs, selectable markers, transfection methods, production of transgenic animals, integration and identification of transgenes, and ethical considerations in transgenesis. Stay updated on recent advances and applications.

DSC6: 21BSC5C6BTL: Animal Biotechnology

Unit	Description	Hours
1	**History and terminology:** Pluripotency, Differentiation, Reprogramming, Embryonic stem cells (ESCs), Induced pluripotent stem cells (iPSCs), Multipotency, Trans differentiation, Chimera, and gene knockout. Biology and characterization of cultured cells- cell adhesion, proliferation, differentiation, morphology of cells, and identification. The basic technique of mammalian cell culture in vitro, Measuring parameters of growth in cultured cells, cell viability, and cytotoxicity. Germplasm conservation and establishment of gene banks. Large-scale culture of cell lines- monolayer, suspension, and immobilized cultures.	12
2	**Organ and histotypic culture:** Technique, advantages, limitations, applications. Biotransformation - Induction of cell line mutants and mutations. 3D cultures. Whole embryo culture. Somatic cell hybridization. Stem cells: types (embryonic, adult), isolation, identification, expansion, differentiation and uses, stem cell engineering, ethical issues. Commercial applications of animal tissue culture. Hazards and safety aspects of tissue culture.	11
3	**Manipulation of reproduction in animals:** Manipulation of animal reproduction and characterization of animal genes, Manipulation of reproduction in animals. Artificial insemination, embryo	11

	transfer, and in vitro fertilization. Embryo transfer in cattle and applications. Somatic cell cloning - cloning of Dolly. Ethical issues. Production of recombinant vaccines. Probiotics for disease control.	
4	**Vectors for gene transfer in animals:** Retrovirus, Gene constructs promoter/ enhancer sequences for transgene expression in animals. Selectable markers for animal cells- thymidine kinase, dihydrofolate reductase, CAT. Transfection of animal cells- calcium phosphate coprecipitation, electroporation, lipofection, peptides, direct DNA transfer, viral vectors,	**11**
5	**Methods for producing transgenic animals:** microinjection. - retroviral, microinjection, engineered stem cell. Targeted gene transfer. Transgene integration and identification methods. Transgenic and genome-edited animals. Ethical issues in transgenesis. Recent advances and applications in the field.	**11**

References:

1. Wilson, K., & Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge University Press. ISBN: 978-1316614761.
2. Gahlawat, S.K., Duhan, J.S., Salar, R.K., Siwach, P., Kumar, S., & Kaur, P. (2018). Advances in Animal Biotechnology and its Applications. Springer. ISBN: 978-981-10-4701-5.
3. Primrose, S.B., & Twyman, R.M. (2016). Principles of Gene Manipulation (8th ed.). Blackwell Science. ISBN: 978-1405135442.
4. Verma, A., & Singh, A. (2013). Animal Biotechnology. Elsevier. ISBN: 978-0124160026.
5. Glick, B.R., & Pasternak, J.J. (2009). Molecular Biotechnology (4th ed.). ASM Press. ISBN: 978-1555814984.
6. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
7. Watson, J.D., Meyers, R.M., AC, A., & AW, J. (2006). Recombinant DNA (3rd ed.). Cold Spring Harbor Laboratory Press. ISBN: 978-0716728665.
8. Singh, B.D. (2006). Biotechnology: Expanding Horizons (3rd ed.). Kalyani Publishers.
9. Srivastava A.K. Animal Biotechnology. (2018). Oxford & IBH Publishing Co Pvt. Ltd,458pp.

Date Course Coordinator Subject Committee Chairperson

Department of Biotechnology

Semester-V

DSC6: 21BSC5C6BTP: Animal Biotechnology Lab

Course Title: Animal Biotechnology Lab	**Course code: 21BSC5C6BTP**
Total Contact Hours: 60Hrs	**Course Credits: 02**
Internal Assessment Marks: 25	**Duration of SEE: 03 Hrs.**
Semester End Examination Marks: 25	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Gain practical skills in basic mammalian cell culture techniques, measuring growth parameters, assessing cell viability, and understanding cytotoxicity.
2. Learn about germplasm conservation techniques and the establishment of gene banks, along with large-scale culture methods for cell lines.
3. 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.

DSC6: 21BSC5C6BTP: Animal Biotechnology Lab

List of Experiments

1. Preparation of cell culture media: Preparation of basic cell culture media, such as Dulbecco's Modified Eagle Medium (DMEM), supplemented with fetal bovine serum (FBS), antibiotics, and other required additives.
2. Aseptic techniques and sterile handling: Practicing aseptic techniques, including properly handling tools and equipment, working in a laminar flow hood, and maintaining sterility throughout the cell culture process.
3. Filter sterilization: Practice filter sterilization for sensitive media ingredients.
4. Cell counting and viability assessment: Count cells using a hemocytometer or automated cell counter, and perform viability assays (e.g., trypan blue exclusion) to determine the percentage of viable cells.
5. Cell passaging and subculturing: Practicing subculturing cells by passaging them from one culture vessel to another, following proper techniques for detachment, trypsinization, and seeding at appropriate densities.
6. Cell freezing and thawing: Learn or demo the cryopreservation process by freezing and thawing cells using cryoprotective agents and controlled cooling and thawing rates.
7. Cell staining and microscopy: Staining the cultured cells using dyes such as hematoxylin and eosin (H&E), and observe them under a light microscope to study cell morphology and structure.
8. Contamination identification and troubleshooting: Learn to identify and troubleshoot common issues in cell culture, such as contamination by bacteria, fungi, or mycoplasma, and implement appropriate corrective measures.
9. Cytotoxicity assays: Students can assess the cytotoxic effects of substances (e.g.,

drugs, chemicals) on cultured cells using assays like the MTT or LDH assay.

10. Experimental design and data analysis: Students can design and execute simple experiments, record and analyze data, and interpret the results based on their observations and measurements.

References:

1. Clynes, M. (Ed.). (1998). Animal Cell Culture Techniques. Springer.
2. Masters, J.R.W. (Ed.). (2000). Animal Cell Culture - Practical Approach. Oxford University Press.
3. Freshney, I. (2016). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (8th ed.). Wiley-Blackwell.
4. Pörtner, R. (Ed.). (2007). Animal Cell Biotechnology: Methods and Protocols. Humana Press.
5. Singh, B., & Gautam, S.K. (2013). Textbook of Animal Biotechnology. The Energy and Resources Institute (TERI).
6. Gupta, P.K. (2018). Animal Biotechnology. Rastogi Publications.
7. Mather, J.P., & Barnes, D. (Eds.). (Year N/A). Animal Cell Culture Methods. In Methods in Cell Biology, Vol. 57. Academic Press.

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