

Department of Biotechnology

Discipline Specific Core Course: Biotechnology

Sem	Theory/ Practical	Course Title	Teaching/ Practical Instruction hour/week	Total Hours/ Sem	Duration of Exam in hours	Assessment Marks			Credits	
						Summative	Formative	Total		
V	Theory	Plant and Animal Biotechnology	4	60	3	80	20	100	4	
	Practical	Plant and Animal Biotechnology	4	60	3	40	10	50	2	
	OR									
	Theory	Genetic Engineering	4	60	3	80	20	100	4	
	Practical	Genetic Engineering	4	60	3	40	10	50	2	
	Elective	Biotechnology for human welfare	4	60	3	80	20	100	3	

B.Sc. Semester–V
Discipline Specific Course (DSC)

Student shall select DSC 9A & 10 A or 9B & 10 B for 06 credits only

Course Title: - Plant and Animal Biotechnology

Course Code:C5BIT2T1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-9A	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

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

- CO1: Gain knowledge of history and development of plant biotechnology
- CO2: Know the composition and preparation of different plant growth media
- CO3: Study and learn the of techniques in Micropropagation,
- CO4: Understand the skill and technique of animal cell and tissue culture.
- CO5: Understand the of scope of animal biotechnology
- CO6: Attain knowledge of transgenic animals and IPR

Unit	Title: Plant and Animal Biotechnology (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit 1	<p>1.1: Plant Biotechnology - History and development of plant biotechnology. <i>In vitro</i> culture methods and laboratory facilities.</p> <p>1.2: Growth medium composition - Use of growth regulators and their effect on cell growth, Study of M.S., B5 and Nitsch media.</p> <p>1.3: Plant Tissue Culture - Callus differentiation: Regeneration of shoots and root. Organogenesis, Embryogenesis, Embryo culture, ovary and endosperm culture. Cell suspension and single cell clones.</p> <p>Micro propagation: Clonal propagation of elite species, auxillary bud. Shoot tip and meristem culture. Applications of micro propagation.</p> <p>Plant Tissue culture Applications: In Agriculture, Horticulture and Cryopreservation</p>	15 hrs

Unit 2	<p>2.2: Animal Biotechnology: Historical perspectives, development and scope.</p> <p>Basic techniques of animal cell culture: Preparation and sterilization of glasswares and apparatus, preparation and sterilization of reagents and media, preparation of animal material and applications.</p> <p>Animal tissue culture media: Culture media containing naturally occurring ingredients. Blood plasma, blood serum, serum free media, tissue extracts, complex natural media, chemically defined media.</p> <p>Primary culture, cell lines and cloning : Primary and established cell lines, somatic cell fusion, tissue cultures, whole embryo culture example chick embryo.</p>	15 hrs
Unit 3	<p>3.1: Genetic engineering : Introduction, Tools of genetic engineering. Enzymes: Restriction endonucleases: Classification, nomenclature, types and their application in recombinant DNA technology. Ligases: DNA ligases and their application, enzymes to modify ends of DNA molecules.</p> <p>Vectors/Vehicle DNA: Plasmid and their features, some common plasmid vectors pBR 332, pUC 18.</p>	15 hrs
Unit 4	<p>4.1: Gene cloning: Methods of introducing gene in prokaryotes and eukaryotes (<i>E.coli</i> and yeast cells as cloning host). Detection of the right clone, Direct screening, direct selection, indirect screening technique, nucleic acid probes, hybridization technique. immunodiagnostic probe. Cells for cloning: <i>E.coli</i>, strains used for cloning, expression of cloned DNA in <i>E.coli</i></p> <p>4.2: Genetically Modified Technology for nutrition and food security: Tomato, strawberry, pumpkin, Sweet Paper, veterinary products, chocolates, cheese, Transgenic animals- Transgenic mice and sheep.</p>	15 hrs

Recommended books:

1. Bhan 1998. 'Tissue culture', Mittal publication. New Delhi.
2. Chatwal.G.R.1995: Text Book of Biotechnology, Anmol Publ. Pvt. Ltd.
3. Crueger. W. and Crueger. A.: Biotechnology A text book of Industrial Microbiology. 2nd Ed.
4. Gamborg and Phillips. 1996 Plant Cell, Tissue and Organ Culture: Fundamental methods. Narosa Publ,
5. Gupta P.K. 1996: Elements of biotechnology; Rastogi and Company.
6. Harrison, Maureen, A., Rac. Ian. F. 1997: General Technique of cell culture Cambridge University Press.
7. Ignacimuthu, S. 1996: Applied Plant Biotechnology.
8. Lyeliane Kyte and Jhon Kleyn, 1996. Plants from test tubes - An Introduction to Micro propagation III edition, Timber press Portland.
9. Narayanaswamy, S. 1994: Plant Cell and tissue Culture. New Delhi. Tata McGraw Hill Publishing Company.
10. Prakash.M. and Arora, G. K. 1998: Cell and Tissue Culture, New Delhi, Anmol Publication.
11. Razdan.M.K. 1993: An introduction to Plant Biotechnology.
12. Shrivastava P.S. "Plant Tissue culture and molecular Biology; applications and prospects, Narosa publishing house, New Delhi.
13. Cartwanzht, T. 1994: Animal Cells as Bioreactors, Cambridge University Press, New York.

14. Freshney, R. L. 1987: Culture of animal cells: A manual of basic techniques. 15. Ian, R.. Freshney: Wiley-Liss (3rd edn.) Culture of Animal Cells.
16. John. R. W.: Animal Cell culture - Practical approach Marters, Oxford.
17. Puhler. A. 1993: Genetic Engineering of Animals. VCH Publishers, Weinheim FRG
18. Ravi Shankar, G.A. and Venkataram, L.V. 1997: Recent Advances in Biotechnology. Application of Plant Tissue and Cell Culture. New Delhi, Oxford and IBH Publishing Company.
19. Sateesh M.K. 2003. Biotechnology-5. New age international publishers.
20. Spier, R.E. and Griffith, T.B. 1987: Modern approaches to Animal Cell Technology, Somerset, Butterworth and Company Ltd.

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	20Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester–V
Discipline Specific Course (DSC)

Course Title: - Plant and Animal Biotechnology
Course Code: C5BIT2P1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-10A	Practical	02	04	56hrs.	3hrs.	10	40	50

Course Outcomes (COs):

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

- CO1: Understand of preparation of plant tissue culture media.
- CO2: Gain knowledge of callus induction, seed culture and demonstration.
- CO3: Understand protoplast isolation and fusion
- CO4: Learn preparation of synthetic seeds
- CO5: Understand of extraction of mammalian and chicken serum
- CO6: Gain the knowledge of culturing the chick embryonic cells
- CO7: Understanding of Genetic Engineering tools.

List of the Experiments, each will have 04Hrs / Week

1. Preparation of plant tissue culture media. a) MS. b) B5) LS
 2. Callus induction using plant explants (Carrot, Nicotine and sugarcane).
 3. Seed Culture.
 4. Demonstration of Organogenesis
 5. Demonstration of Micropropagation.
 6. Demonstration of Anther culture
 7. Protoplast isolation from mesophyll cells.
 8. Suspension cultures: Initiation of suspension culture from callus.
 9. Preparation of Synthetic seeds.
 10. Cell viability test using Trypan blue exclusion method.
 11. Preparation of Balanced salt solutions:(Hank and Earl).
 12. Extraction of serum (Chicken/mammalian).
 13. Study of instruments for animal cell culture – inverted microscope, biosafety cabinet, CO₂ incubator
 14. Enumeration of RBC and WBC using haemocytometer from human blood sample.
 15. Photographic demonstration of transgenic crop plants/animals in Biotechnology innovations.
 16. Isolation of RNA from different sources.
- (Minimum of ten experiments to be performed)

B.Sc. Semester–V
Discipline Specific Course (DSC)

Student shall select DSC 9B & 10 B or DSC 9A & 10 A for 06 credits only

Course Title: - Genetic Engineering

Course Code:C5BIT2T2

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-9B	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs):

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

CO1: Understanding of fundamental principles and techniques of Genetic Engineering

CO2: Understanding of genetic engineering in agriculture, medicine and environmental studies

CO3: Understanding and developing practical skills in genetic engineering

CO4: Understanding and implying ethical, social and legal implications of genetic engineering

CO5: Understanding of importance of human genome project

CO6: Understanding of rules and regulation of handling genetically modified organisms

Unit	Title: Genetic Engineering (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit 1	<p>1.1: Genetic engineering: Introduction, Tools of genetic engineering.</p> <p>1.2: Enzymes- Restriction endonucleases: Classification, nomenclature, types and their application in recombinant DNA technology. Ligases : DNA ligases and their application, enzymes to modify ends of DNA molecules.</p> <p>1.3: Vectors/Vehicle DNA: Plasmid and their features, some common plasmid vectors-PBR 322, pUC 18.</p>	15 hrs

Unit 2	<p>2.1: Gene cloning: Methods of introducing gene in prokaryotes and eukaryotes (<i>E.coli</i> and yeast cells as cloning host).</p> <p>2.2: Detection of the right clone, Direct screening, direct selection, indirect screening technique, nucleic acid probes, hybridization technique. immunodiagnostic probe.</p> <p>2.3: Cells for cloning: <i>E.coli</i>, strains used for cloning, expression of cloned DNA in <i>E.coli</i>.</p>	15 hrs
Unit 3	<p>3.1: Gene libraries - Genomic library and cDNA library.</p> <p>3.2: DNA Mapping - Restriction mapping and its applications.</p> <p>3.3: DNA sequencing - Outline of Maxam-Gilbert's method and Sanger's dideoxy method, Next Generation Sequencing, CRISPR-9</p> <p>3.4: Bioinformatics – Introduction, Role of Bioinformatics tools in genetic engineering.</p>	15 hrs
Unit 4	<p>4.1: Applications of rDNA technology in human health - Production of recombinant vaccines - Hepatitis B. Production of insulin. Human genome project and its implication.</p> <p>4.2: Biosafety - Rules and regulations of handling genetically modified organisms</p> <p>4.3: Biotechnology and intellectual property rights (IPR) - Patents, trade secrets, copy right and choice of IPR.</p>	15hrs

Recommended books:

1. Benjamin Lewin, "Genes I, Wiley Eastern Ltd., Delhi.
2. Benjamin Lewin, "Genes-II, Genes III, Wiley and sons publications.
3. Benjamin Lewin, Genes-V &VI Oxford University press.
4. Brown, T.A.1998: Genetics: A molecular approach3rdedn. Stanley Thornes (Publishers) Ltd. United Kingdom.
5. Christopher H. 1995"Gene cloning and Manipulation",Cambridge University Press.
6. Davis, R.W. Boterin, D.and Roth, J.R. 1980: A manual for genetic engineering, cold spring harbor laboratory. Cold Spring Harbor. New York.
7. Gardner. Simmons. Snustad1991: Principles of genetics.8thedn. John Wiley and Sons. Inc.
8. Mitchell, D.S.T.1994: An introduction to genetic Engineering. Cambridge University Press.
9. Old and Primrose, "Principles of gene Manipulation", Blackwell Scientific publications.
10. Peters.P.1993: A guide to genetic engineering. Dubuque, Iowa. WMC Brown. 11. Rigbu ,P. W. J.1987:Genetic Engineering 6, Academic Press Inc .Florida, USA.

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	20Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester– V
Discipline Specific Course (DSC)

Course Title: - Genetic Engineering
Course Code: C5BIT2P2

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Durati on of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-10B	Practical	02	04	56hrs.	3hrs.	10	40	50

Course Outcomes (COs):

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

- CO1: Acquire knowledge on instruments used for genetic engineering
- CO2: learn and practice laboratory skills for genetic engineering
- CO3: learn skill and techniques related to Nucleic acid extraction
- CO4: learn the skill and techniques of gel electrophoresis and PCR
- CO5: Understand DNA fingerprinting, Gene cloning

List of the Experiments, each will have 04Hrs / Week

1. Isolation/Extraction of genomic DNA from bacteria and yeast.
2. Isolation /Extraction of genomic DNA from plant and animal tissues.
3. Study of denaturation and renaturation of DNA.
4. Quantification of extracted DNA by Spectrophotometer.
5. Agarose gel electrophoresis of DNA.
6. Isolation of RNA from plant.
7. Isolation of RNA from animal tissues.
8. Isolation of protoplast from bacteria/plants/ animals
9. DNA fingerprinting: Comparison of two plates of monomorphic and dimorphic hands (Demonstration).
10. Study of gene cloning using charts.
11. Study of principles of genetic engineering equipments.
12. Demonstration of designing of probes using softwares
13. Demonstration of Restriction digestion of DNA and ligation (minimum ten experiments to be performed)

B.Sc. Semester– V
Elective Course (EC-1)
It is for other combination students

Course Title: - Biotechnology for human welfare
Course Code: C5BIT5T1

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
EC-1	Theory	04	04	60hrs.	3hrs.	20	80	100

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understand the role of Biotechnology in production of fermented foods and other products.

CO2: Understand the application of Biotechnology techniques in forensic science.

CO3: Understand the importance of Biotechnology in human health management.

CO4: Attain knowledge and significance of reproductive Biotechnology.

Title: Biotechnology for human welfare

Unit 1

15hrs

1.1 Overview and definition of Biotechnology, History, Development and scope of Biotechnology.

1.2 In industry - Industrial production of fermented foods (yoghurt, cheese, dosa, butter milk, tempeh), alcohol, enzyme, organic acids, pigments, dyes, SCP, antibiotics. Wine production

Unit 2

15hrs

2.1 In environment - Biogas production, Vermicompost, Biofertilizers, mushroom cultivation, floriculture, Apiculture, Seri biotechnology.

2.2 Degradation of organic pollutants- chlorinated and non-chlorinated compounds. PHB production and its applications. 2.3 Waste management - Treatment of municipal waste and industrial effluents.

2.4 Bioremediation - Bioremediation of xenobiotic compounds.

Unit 3

15hrs

3.1 Biotechnology in forensic science -DNA finger printing, solving crimes such as murder and rape; solving claims of paternity and theft etc. using various methods.

3.2 Health- Biopharmaceuticals, development of non-toxic therapeutic agents, recombinant vaccines, insulin, gene therapy,

3.3 Molecular diagnostics using ELISA, PCR- real time PCR, reverse transcription PCR for detecting viral / bacterial DNA and RNA, monoclonal antibodies and their use in diagnostics and therapy

3.4 Electrochemical biosensors, human genome project

Unit 4.

15hrs

4.1 Reproductive Biotechnology - Endocrine control of estrous cycle and gestation, Folliculogenesis, Oogenesis and spermatogenesis.

4.2 Artificial insemination, In vitro fertilization, IUI, nuclear transfer, embryo Transfer

Books recommended:

1. H.K. Dass (2018) Text of Biotechnology., Wiley India publication

2. B.D. Singh (2017) Biotechnology new horizon., Kalyani publishers

3. R.C. Dubey (2015) Text of Biotechnology, S. Chand and company

4. U. Satyanarayana (2005) Biotechnology. Books & Allied (P) LTD.-Kolkata

5. W.T. Godbey (2014) An Introduction to Biotechnology, 1st Edition Academic press.

6. K. Pranav, V. Praveen, M. Usha (2017). Biotechnolgy A Problem Approach, Fifth edition Pathfinder Publications

7. Rup Lal (2020). An Introduction to Biotechnology- A Genetic Manipulation Perspective, First Edition Dreamtech Press

Formative Assessment for Theory	
Assessment Occasion/type	Marks
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	20Marks
<i>Formative Assessment as per guidelines.</i>	