

**B.SC. HONS. BIOTECHNOLOGY- 4<sup>TH</sup>**  
**SEMESTER**  
**UNIT PLANS**  
**PLANT BIOTECHNOLOGY**

Sr. No.	Teaching Points	Specific Objectives	Methods / Approaches / Techniques	Resources
1	plant molecular biotechnology and techniques for plant genetic manipulations.	Genetic material of plant cells with an introduction to chloroplast and mitochondrial DNA. Plant Promoter, Plant Selection markers and reporter genes. Transformation of plant cells; different type of vectors including viral vectors and their benefits.	Classroom Lectures.  Text notes.  Presentation	Reference Books: 1. Draper, J.R., Scott. P., Armitage, R. Walden (1988). Plant Genetic Transformation and Gene Expression – A Laboratory Manual. BlackaScientific Publications, Oxford. 2. Ashihara et al. (2011) Plant Metabolism and Biotechnology, John Wiley & Sons, Ltd. ISBN: 978-0-470-74703-2 3. Old, R.W., and Primrose, S.B. (2004). Principles of Gene Manipulation: An Introduction to Genetic Engineering. Blackwell Scientific Publications, Oxford. 4. Peter J. Lea and Richard C. Leegood, Plant Biochemistry and Molecular Biology, Wiley Publishing. 5. Singh R.P. & Jaiwal P.K. (2003) Plant Genetic Engineering Vol. 1 – 4. SCI Tech Publishing LLC, U.S.A. 6. Gupta, P.K. (1990). An Introduction to Biotechnology, Rastogi Publications, Meerut.
2	Modes of gene delivery in plants	Particle bombardment, electroporation, microinjection; Advantages and disadvantages Agrobacterium mediated gene transfer, natural pathogen mode of infection, vir gene functions, Ti / Ri plasmids, Screening and selection of transformants, PCR and hybridization methods; Transgene selection and silencing; Generation and maintenance of transgenic plants.	Classroom Lectures.  Text notes.  Presentation	
3	Transgenic plants	Genetic modification of plants for herbicide resistance, Pest resistance, virus resistance Bacterial and fungal resistance. : Delayed fruit ripening, improved protein composition. Bt cotton, golden rice and some others as examples.	Classroom Lectures.  Text notes.  Presentation	
4	Products and applications	Plant cell as factories for production of industrial enzymes, biodegradable plastics, antibodies, edible vaccines; manipulation of metabolic pathways for production of fatty acids, industrial oils, terpenoids, flavonoids.	Classroom Lectures.  Text notes.  Presentation	

(i) Printed Pages : 3]

Roll No. ....

(ii) Questions : 9]

Sub. Code : 

0	9	5	8
---	---	---	---

Exam. Code : 

0	0	3	6
---	---	---	---

**B.Sc. (Hons.) 4th Semester Examination**

**1047**

**BIOTECHNOLOGY**

**(Plant Biotechnology)**

**Paper : BIOT-Sem-IV-III-T**

**Time : 3 Hours]**

**[Max. Marks : 67**

*Note :-* Attempt *five* questions in all by selecting *one* question from each Unit. Question No. 1 is compulsory. All questions carry equal marks except question No. 1.

**Compulsory Question**

- I. (a) What is selectable marker ?
- (b) What is the source of 35s promoter and its role ?

**N-455**

( 1 )

Turn Over

- (c) Role of right and left borders in Ti plasmid ?
- (d) What is double selection of transformants ?
- (e) What is gene gun method of gene delivery ?
- (f) Name two industrial enzymes which can be produced in plants ?
- (g) Round up Maize ? 2,2,2,2,2,2,3

#### Unit-I

- 2. (a) What are Promoters ? Discuss the various types of promoters used for gene expression in plant ?
- (b) Give a detail account of various viral vectors used for plant transformation. 6,7
- 3. (a) How are chloroplast and mitochondrial DNA structurally vary ?
- (b) Describe, how are Binary and Co-integrate vectors designed ? 6,7

#### Unit-II

- 4. (a) Discuss the direct gene delivery systems used to transform monocot plants.
- (b) Discuss the role of *vir* genes in transfer of *t*-DNA in plants. 8,5

5. (a) How is gene silencing technique applied to develop better quality transgenic crops ?  
(b) Mention the PCR based methods for selection of transformants ? 8,5

### Unit-III

6. (a) How are herbicide resistant plants developed ? Explain with the help of Glufosinate resistant plants.  
(b) Give an account of developing transgenic golden rice and the genes involved in the same. 7,6
7. (a) Give a detailed account of how is Bt cotton crops developed.  
(b) How is plant genetically modified to improve its protein composition ? 7,6

### Unit-IV

8. How can we enhance production of secondary metabolites using plant cells as biological factories ? Explain with various examples. 13
9. What kind of manipulation is required in the metabolic pathways of terpenoids to enhance their production ? 13

(i) Printed Pages: 3

Roll No. ....

(ii) Questions : 9

Sub. Code : 

0	9	7	9
---	---	---	---

Exam. Code : 

0	0	3	6
---	---	---	---

B.Sc. (Hons.) Biotechnology 4<sup>th</sup> Semester

1048

**PLANT BIOTECHNOLOGY**

**Paper-BIOT-Sem-IV-III-T**

Time Allowed : Three Hours]

[Maximum Marks : 67

**Note** :— Attempt FIVE questions in all, selecting ONE question compulsorily from each unit. Q. No. 1 is compulsory.

1. Discuss the following in brief :—

- (a) Co-integrated vector.
- (b) Infection pattern of *A. tumefaciens*.
- (c) PCR based genetic transformation of plants.
- (d) Caulimo-virus based vectors..
- (e) Golden rice.

5×3

**UNIT—I**

- 2. (a) Describe the method of chloroplast transformation, giving its advantages and disadvantages.
- (b) Discuss the role of suitable plant promoters in genetic transformation.

9,4

3. (a) What are reporter genes ? Discuss some important reporter genes used in selection and transformation of plants.
- (b) Discuss the salient features of mitochondrial genome. 9,4

#### UNIT—II

4. (a) Explain the various Cloning strategies by using Ti Plasmid.
- (b) Write a brief note on Ri plasmid. 9,4
5. (a) Discuss the techniques of Particle bombardment for DNA transformation in plants. What are its advantages over other methods used for direct DNA delivery ?
- (b) Briefly discuss Gene silencing in plants. 9,4

#### UNIT—III

6. (a) Describe the techniques by which you can improve the storage proteins in plants.
- (b) How can shelf life of fruits and flowers be increased ? 9,4
7. (a) How can herbicide resistant plants be raised for Triazine and Phosphinothricin ?
- (b) What are *cry* proteins ? Discuss their significance in brief. 9,4



#### UNIT—IV

8. (a) Explain giving suitable examples the production of industrially important products in plants.
- (b) Discuss the importance of edible vaccines over conventional vaccines. 9,4
9. (a) What are biodegradable plastics ? Discuss the manipulation of their metabolic pathways for enhancing and modifying their production in plants.
- (b) What are Plantibodies ? How are these obtained ? 9,4

SESSION 2021-22

THEORY: 67 MARKS

B. Sc. HONS. BIOTECHNOLOGY- 4 SEM

ASSESSMENT: 08 MARKS

**Paper: Agro & Industrial Biotechnology**

Sr. no.	Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1	Basic concept of agriculture as industry:	Industrially important microbes, its screening, selection and identification. Maintenance and preservation of industrially important microbial cultures. Differences between microbial industrial process and chemical industrial process.	Objective: This course will introduce students to the concepts of agriculture as industry. This course will help students to understand the application of fundamental concepts like transgenic approaches to improve crop plants, microbial culture maintenance, and metabolite purification at industrial level.	Classroom teaching.  Examples from textbooks, life.  Presentation.	1. Marwaha, S.S., Arora, J.K. (2003). Biotechnological strategies in agro-Processing (Asiatech publishers Inc. New Delhi, India).  2. Stanbury, P.F., Whitaker A. (2011) 2nd edition. Principles of fermentation technology. 3. 3. Singh, BD. (2008). Biotechnology: Expanding horizons (Kalyani Publishers, India). 4. 4. Patel A.H. (2007). Industrial microbiology



2	Improvement programme of industrial microbes	, mutational programme of penicillin producing microorganisms, selection pressure in maintaining the hyper producer, lowering of production due to reversal of mutations, media formulation and process optimization of industrial and agro industrial microbes.		Classroom teaching.  Examples from textbooks, life.  Presentation.	(New Age International Publishers). 5. Loessner, J. 5. M, Jay J.M, D.A. Golden (2005). Modern food microbiology (Golden Springer). 6. 6. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory manual (Pearson Benjamin Cummings).
3	Microbes in agro industries and industrial biotechnology:	<ul style="list-style-type: none"> <li>• : Introduction of primary and secondary metabolites, production of vitamin B12, alcohol, wine, beer, cheese, bread, citric acid, gluconic acid, antibiotics (penicillin), enzymes (amylases, cellulases, lipases and proteases) and their industrial applications..</li> </ul>		Classroom teaching.  Examples from textbooks, life.  Presentation.	
4	Emerging energy technologies in agro industries:	<ul style="list-style-type: none"> <li>• production of vermiculture, composting, herbicides and biopesticides, production of</li> </ul>		Classroom teaching.  Examples from textbooks,	

		biofertilizers: Blue green algae, azolla, fungi, mycorrhiza (VAM), bacteria – Azospirillum, microbial biotransformati ons, single cell proteins (bacterial, fungal and algal).		life.  Presentation.	
--	--	--	--	----------------------------	--

Question bank:

1. Explain in detail the traditional and modern biotechnology outlook with suitable examples. 2. Comment on Historical overview of Industrial Fermentation Process some few methods and their respective advantages and disadvantages.
2. Write in detail about upstream and downstream processing for obtaining product of your interest through modern biotechnology. Present the above process in the form of flow chart/block diagram or pictorial representation.
3. Write in detail about downstream processing for obtaining product of your interest through modern biotechnology.
4. What are the main utilities of Fermentor? Describe functions of main components of the fermentor.
5. What is the main role of microorganism in fermentation? Explain in detail the design and selection of a strain for the fermentation process.
6. . Comment on Process flow sheeting –Elaborate the block diagrams, draw a pictorial representation for any one product of your interest.
7. Write a detailed note on the Biochemistry of Fermentation by the microbes. .
8. .Write short note on the different types of Batch fermentation & Fed Batch Fermentation

**B.Sc. Hons Biotechnology 2021-22**  
**Semester 4**

**Subject:- Immunology**

Total units= 4  
Theory marks = 67  
Internal assessment= 8  
Total marks =75

**UNIT-I**

<b>Topic</b>	<b>Teaching points</b>	<b>Specific objectives</b>	<b>Methods /approaches /techniques</b>	<b>Resources and links</b>
Complement system	Function, Components- Classic, Alternative, Mannose binding proteins, activation, Regulation of the Complement System, Biological Consequences of Complement Activation.	To understand general aspects of immune system like different components of the immune system, and complement system	classroom teaching with examples	Kuby Immunology (2006) by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby (W.H. Freeman).
<b>Lymphocyte Trafficking</b>	Cell surface proteins, Cell Adhesion molecules (Integrin, Selectin, Cadherin family and Ig Superfamily)			

**Question Bank**

**Long answer type questions**

1. Give the history of immunology
2. Explain Mannose binding proteins,
3. Describe different types of Cell surface proteins
4. Describe the Cell Adhesion molecules
5. Describe lymphocyte trafficking
6. Name the different types of phagocytic cells with well labeled diagrams.
7. Explain the process of Classic.

**Short answer type questions**

1. Define immunology
2. Define Cadherin family
3. What are dendritic cells
4. Give the function of Complement System
5. Give the Biological Consequences of Complement Activation.
6. Differentiate between innate and adaptive immunity

7. Differentiate between B and T lymphocytes.

### Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. Hypersensitivity	Type I, Type II, Type III and Type IV Hypersensitivity reactions and their implications.	To understand the Generation and functions of these components, the antigen and its characteristics to cause the disease.	Lecture cum discussion	Kuby Immunology (2006) by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby (W.H. Freeman).
2. Autoimmunity	Organ specific autoimmune diseases: Hashimoto's Thyroiditis, Insulin-dependent Diabetes Mellitus, Grave's disease, Myasthenia Gravis. Systemic Autoimmune Disease: Systemic lupus Erythmatosus (SLE)			

### Question Bank

#### Long answer type questions

1. Describe the primary lymphoid organs
2. Describe the secondary lymphoid organs
3. Give the factors affecting the antigenicity of the antigens
4. Explain the cross reactivity of the antigen
5. Give the immunoglobulin superfamily
6. Describe pattern recognition receptors
7. What are cell adhesion molecules

#### Short answer type questions

1. Define antigen
2. Define immunogen
3. Difference between antigen and immunogen
4. What are haptens
5. Define epitopes
6. What are cell adhesion molecules
7. What are cell surface proteins

### Unit- 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links

Transplantation immunology	Immunologic Basis of Graft Rejection, Clinical Manifestations of Graft Rejection, General Immunosuppressive Therapy, Specific Immunosuppressive Therapy, Immune Tolerance to Allografts, Clinical Transplantation	To understand the working of antibodies to kill the pathogen and in immune system. To understand the role of MHC in recognition of self and non self cells.	classroom teaching with the use of blackboard	Kuby Immunology (2006) by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby (W.H. Freeman).
Vaccines and Vaccination	principles of vaccination, passive & active immunization, immunization programs, adjuvants, bacterial vaccines, viral vaccines, polysaccharide vaccines, DNA vaccines, recombinant vaccines, vaccines to other infectious agents, tumor vaccines.			

### Question Bank

#### Long answer type questions

1. Give the different types of vaccines
2. What are MHC and give its types
3. Explain the processing of antigens in different types of grafts
4. Give the functioning of antibodies and their structures
5. Explain the general organization and inheritance of MHC genes
6. Explain the types of vaccines

#### Short answer type questions

1. What are antibodies
2. Give full form of MHC
3. Give types of MHC
4. Give the role of recombinant vaccines
5. Which antibody can cross the placenta and give its role
6. Which antibodies are involved in inflammatory responses

### Unit 4

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
-------	-----------------	---------------------	---------------------------------	---------------------

<p><b>1. Hybridoma Technology</b></p> <p><b>2. Antigen–Antibody interactions</b></p>	<p>Production of Monoclonal Antibodies, applications of polyclonal and monoclonal antibodies. Strength of interaction, cross reactivity, antibody affinity, avidity. Antigen-antibody interactions as tools for research and diagnosis: precipitation and agglutination reactions, immunodiffusion, immunoelectrophoresis, immunoassays, Enzyme linked immunosorbent assay (ELISA), Radioimmunoassay (RIA), western blot, Immunofluorescence.</p>	<p>The students will gain the knowledge of basic immunological techniques.</p>	<p>classroom teaching with power point presentation of the topic hybridoma technology</p>	<p>Kuby Immunology (2006) by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby (W.H. Freeman). Delves PJ, Martin SJ, Burton DR, Roitt IM. Roitt's essential immunology. Wiley Blackwell; 2011.</p>
--	---	--	---	--

### Question Bank

#### Long answer type questions

1. Explain the production of monoclonal antibodies
2. Give various functions of monoclonal antibodies
3. Describe the types of ELISA with well labeled diagrams
4. Give difference between immunodiffusion and immunoprecipitation
5. Explain western blot
6. Give the various types of immunodiagnostic techniques
7. Give applications of polyclonal antibodies

#### Short answer type questions

1. Define monoclonal
2. Give full form of ELISA and RIA
3. What are immunodiagnostic techniques
4. Explain cross reactivity
5. Define avidity and affinity



## **Biophysical and BIO-ANALYTICAL TOOLS**

BIO-ANALYTICAL TOOLS					
UNIT	TOPIC: TEACHING POINTS	OBJECTIVES	METHODS APPROACHES TECHNIQUES	RESORURCES & LINKS	
I	Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy	Apprising students with tools and techniques used in study of biotechnology.	Classroom teaching with relevant examples from textbooks recommended and presentations	<p>1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley&amp; Sons. Inc.</p>	
II	Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.				
III	Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.				<p>2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.</p>
IV	Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.				<p>3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press &amp; Sunderland, Washington, D.C.; Sinauer Associates, MA.</p> <p>4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.</p>

## ANIMAL BIOTECHNOLOGY

UNIT	TOPIC: TEACHING POINTS	OBJECTIVES	METHODS APPROACHES TECHNIQUES	RESORURCES & LINKS
I	<p>Organotypic and histotypic cultures: Organotypic culture: Gas and nutrient exchange, structure integrity, growth, differentiation, advantages and applications. Methods, advantages and applications of histotypic culture. Three dimensional culture and tissue engineering: Concept of tissue engineering, components of tissue engineering, cells imaging in 3D construct.</p>	<p>Apprising students with tools and techniques used in study of biotechnology.</p>	<p>Classroom teaching with relevant examples from textbooks recommended and presentations</p>	<p>Culture of animal cells (2009). RI Freshney, Sixth ed. John Willey &amp; Sons.</p> <p>3. Culture of animal cells: A manual of basic technique and specialized applications. John Wiley &amp; Sons, (2011).</p> <p>4. Animal cell culture and technology by Michaelis Butler. BIOS Scientific Publisher (2003).</p>
II	<p>In vitro fertilization (IVF) in Humans and Embryo Transfer in Livestock. Cell culture based vaccines: Cells as virus host/cell culture based vaccines, cells as protein factory/cell expression system and cells as antigen presenter/personalized vaccine. Scaling up of the</p>			<p>5. Animal cell biotechnology XVI 2nd Edition (2007) by Ralf Partner Humana Press.</p> <p>6. Textbook of animal biotechnology (2012) by B Singh, S K Gautam, and M S Chauhan..</p>

	animal cell culture: different methods of scale up at laboratory and industrial level.			
III	Transgenic animals and their applications: Concept of transgenics, Methods of gene transfer, selection of clone containing DNA insert and application of transgenic animals (Food, environment, recombinant proteins, drugs etc.). Safety and ethical issues of transgenic animals.			7. 7. Principles of tissue engineering by Robert Lanza, Robert Langer, Joseph P. Vacanti. Academic Press, (2011) - Science - 1344 pages.
IV	Production of various products of human use using animal cell culture: Antibiotics production Human Growth factors Insulin and other Hormones			