

# B.SC. HONS. BIOTECHNOLOGY- 3<sup>RD</sup>

## SEMESTER

## UNIT PLANS

B.Sc. Hons Biotechnology 2021-22

Semester 3

**Subject:- Immunology**

Total units= 4

Theory marks = 67

Internal assessment= 8

Total marks =75

### UNIT-I

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
<b>1. Introduction</b>  <b>2. Cells of the immune system</b>	To discuss the overviews of immune system – Historical perspectives ii) Innate and acquired immunity iii) Clonal nature of immune response Hematopoiesis and differentiation, lymphocyte trafficking, Blymphocytes, T-lymphocytes, macrophages, dendritic cells, Natural killer cells and lymphocyte activated killer cells, eosinophils, neutrophils & mast cells	To understand general aspects of immune system like different components of the immune system,	classroom teaching with examples	Kuby Immunology (2006) by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby (W.H. Freeman).

### Question Bank

#### Long answer type questions

1. Give the history of immunology
2. Explain innate and acquired immunity
3. Describe different types of immune cells
4. Describe the clonal nature of the immune system with diagram
5. Describe lymphocyte trafficking
6. Name the different types of phagocytic cells with well labeled diagrams.
7. Explain the process of hematopoiesis.

#### Short answer type questions

1. Define immunology
2. Define hematopoiesis

3. What are dendritic cells
4. Give the function of natural killer cells
5. Give the role of mast cells
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
<b>1. Organs of the immune system</b>  <b>2. Lymphocyte Trafficking</b>  <b>3. Antigens</b>	Primary and secondary lymphoid organs, systemic function of immune system. Cell surface proteins, Cell Adhesion molecules ( Integrin, Selectin, Cadherin family and Ig Superfamily). Immunogenicity Vs. antigenicity, factors effecting immunogeneticity, nature of immunogen, epitopes, heptans and antigenicity, pattern recognition receptors.	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).

### 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	Resources and links
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			<b>/techniques</b>	
<b>1. Immunoglobulins</b>  <b>2. Major histocompatibility complex</b>	Structure of antibody, antibody effector function, antibody classes and biological activities, antigenic determinants on Immunoglobulins, Immunoglobulins superfamilies. General organization and inheritance, MHC molecules and genes, genetic map, cellular distribution, regulation of MHC expression and disease susceptibility, antigen presentation.	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).

### Question Bank

#### Long answer type questions

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

#### Short answer type questions

1. What are antibodies
2. Give full form of MHC
3. Give types of MHC
4. Give the role of IgM
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>
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### 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

**B.Sc. Hons Biotechnology 2021-22**  
**Semester 3**  
**Subject:- Animal cell culture**

Total units= 4

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

**Unit 1**

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
<p><b>1.History of development of cell cultures</b></p> <p><b>1. Biology of cultured cells</b></p>	<p>To discuss the history and natural surroundings for animal cells, simulating natural conditions for animal cells, metabolic capabilities of animal cells.</p> <p>The culture environment, cell adhesion, proliferation, differentiation, signaling, evolution of cell lines. Equipments and materials for animal cell culture technology</p>	<p><i>. The major emphasis of this course is to introduce the students to the field of Animal Cell culturing and its importance to mankind.</i></p>	<p>Lecture cum discussion</p>	<p>R. Ian Freshney, (2010) 6th Edition, Wiley-Blackwell. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications</p> <p>Butler, M (1996) Mammalian cell biotechnology. A practical approach (IRL, Oxford University Press)</p>

**Question Bank**

**Long answer type questions**

1. Explain the history of animal cell culture
2. Describe the metabolic capabilities of animal cells
3. Describe how natural conditions can be simulated for animal cell culture
4. Explain cell adhesion molecules
5. Give the detail of various equipments and materials used for animal cell culture
6. Explain cell differentiation
7. Describe evolution of cell lines

**Short answer type questions**

1. Define animal cell culture

2. Describe cell signaling
3. What are cadherins
4. What are integrins
5. Describe tight junction gaps
6. Name two cell lines

### Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
<p><b>1. Media and its components</b></p> <p><b>2. Animal cell culture Techniques:</b></p>	<p>Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements. Serum &amp; protein free defined media and their application.</p> <p>Dispersion and disruption of tissues; primary cultures, anchorage and non-anchorage dependent cells; secondary culture, transformed animal cells.</p>	<p><i>Students will learn about the nutritional requirements of animal cells and different types of media required for their growth and different animal cell culture techniques</i></p>	<p>classroom teaching with examples</p>	<p>R. Ian Freshney, (2010) 6th Edition, Wiley-Blackwell. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications</p> <p>Butler, M (1996) Mammalian cell biotechnology. A practical approach (IRL, Oxford University Press)</p>

### Question Bank

#### Long answer type questions

1. Explain the different constituents of the media and their functions
2. Give the disadvantages of serum containing media and advantages of serum free media
3. Describe BSS media
4. Describe the physical, chemical and metabolic functions of the media components
5. Give the role of carbon dioxide in animal cell culture
6. Write about primary and secondary culture
7. Describe transformed animal cells

8. Explain dispersion and disruption of tissues. Write about various physical and chemical methods
9. Explain anchorage and non-anchorage dependent cells

**Short answer type questions**

1. What is defined media
2. Give full form of BSS
3. Write about Hanks balanced salt solution
4. Describe simple growth medium
5. Which hormones are present in serum?
6. What is serum free media?
7. Why some constituents are not autoclaved?
8. Define transformed cells
9. Differentiate between primary and secondary cultures
10. Difference between dispersion and disruption

**Unit 3**

<b>Topic</b>	<b>Teaching points</b>	<b>Specific objectives</b>	<b>Methods /approaches /techniques</b>	<b>Resources and links</b>
<b>1. Cell lines</b>	Established/continuous cell lines, commonly used animal cell lines, their origin and characteristics. Maintenance and growth kinetics of cells in culture, differentiation of cells	To learn about the cell lines, their growth and viability in different environmental conditions	classroom teaching and after discussion, students will give seminars of the same topic	R. Ian Freshney, (2010) 6th Edition, Wiley-Blackwell. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications
<b>2. Measurement of growth and viability of cells in culture</b>	Measurement of growth and viability of cells in culture. Cytotoxicity assays & their applications			Butler, M (1996) Mammalian cell biotechnology. A practical approach (IRL, Oxford University Press)

**Question Bank**

### Long answer type questions

1. Explain different types of cell lines
2. Give the names of the cell lines with detail of their characteristics, origin and use.
3. Explain different methods to check the viability of the animal cells
4. Explain different types of cytotoxicity assays and their applications
5. Describe the maintenance and growth kinetics of cells in culture
6. Explain differentiation of cells

### Short answer type questions

1. Define cell lines
2. Define differentiation
3. Define viability of cells
4. What are cytotoxicity assays
5. Name two transformed cell lines

## Unit 4

<b>Topic</b>	<b>Teaching points</b>	<b>Specific objectives</b>	<b>Methods /approaches /techniques</b>	<b>Resources and links</b>
<b>1. Characterization, preservation and transformation of cell lines</b>	Characterization of Cell lines and their authentication, Cell fusion and production of monoclonal antibodies. Transformation and immortalization, cryopreservation. Bio-Safety & Bioethics.	To learn about the methods to preserve the animal cell lines for further use, and applications of animal cell culture. Students will also learn about various safety techniques of animal cell culture labs and various ethics related to it.	classroom teaching with examples	R. Ian Freshney, (2010) 6th Edition, Wiley-Blackwell. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications  Butler, M (1996) Mammalian cell biotechnology. A practical approach (IRL, Oxford University Press)

## Question Bank



**Long answer type questions**

1. What is cell fusion and describe the production of monoclonal antibodies
2. Give different methods of cell preservation
3. Write about biosafety and bioethics
4. Explain transformation and immortalization of cells
5. Explain characterization of Cell lines and their authentication

**Short answer type questions**

1. Define cryopreservation
2. Define immortalization of cells
3. Give names of immortal cell lines
4. Give four levels of biosafety in ATC labs
5. Define bioethics
6. Define cell fusion.

**Subject : plant tissue culture**

Sr. no.	Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1	Cellular totipotency  Plant Culture Media  Micropropagation	Totipotency concept, cell regenerability  Plant Culture Media and their composition.  Sterilization techniques for glassware and tissue culture media. Micropropagation: Establishment of aseptic culture, various stages, advantages and disadvantages.	To understand the detailed overview of plant tissue culture	Online Classroom teaching.  Examples from textbooks, life.  Presentation.	1. Razdan, M.K. (2007). Introduction to plant tissue culture (India Book House Pvt. Ltd) 2. Narayanaswamy, S (1994). Plant cell and tissue culture (Tata Mc-Graw Hill Publishing Co.Ltd, New Delhi). 3. Rudolf, E. (1994). Plant cell biotechnology (Spinger Verlag). 4. Bhojwani, S.S., Razdan, M.K. (1996), Plant tissue culture: Theory and practice (Elsevier Science, Netherlands). 5. Gamborg, O.L., Phillips, G.C. (1995). Plant cell, tissue and organ culture: Fundamental methods (Illustrated, Publisher Springer).  6. HS Chawla (2003). Plant biotechnology: A practical approach (Science Publishers, USA).
2	Organogenesis;  haploid and Triploid plant production	Organogenesis; somatic embryogenesis; somaclonal variation, its genetic basis and application in crop improvement. Cell/callus line selection for resistance to herbicide,	To understand the processes of plant cell transport and cell locomotion	Classroom teaching.  Examples from textbooks, life.  Presentation.	

		<p>stress and diseases. Role of tissue culture in rapid clonal propagation, production of pathogen - free plants and "synthetic seeds" haploid and Triploid plant production &amp; their application. of viruses and toxins into cells.</p>			Plant Tissue Culture and Biotechnology
3	Protoplast and somatic hybridization	<p>Protoplast and somatic hybridization: Isolation, culture and plant regeneration, protoplast fusion, identification and characterization of somatic hybrids, applications of protoplast hybridization technology.</p>	Understanding hybridization and fusion of protoplast	<p>Classroom teaching.</p> <p>Examples from textbooks, life.</p> <p>Presentation.</p>	
4	<p>Secondary metabolites</p> <p>Cryopreservation</p>	<p>Secondary metabolites: Secondary Plant products from cultured cells and their industrial applications. Cryopreservation of germplasm: Short term and long term conservation of plant genetic resources, In situ and Ex situ conservation of plants</p>	<p>Introduction to secondary metabolites</p> <p>Production of metabolites.</p> <p>Preservation of germplasm</p>	<p>Classroom teaching.</p> <p>Examples from textbooks, life.</p> <p>Presentation.</p>	

Question bank:

1. define cell biology
2. draw the structure of eukaryotic cell
3. draw the structure of prokaryotic cell
4. differentiate between prokaryotic and eukaryotic cell
5. what are stem cell?
6. Difference between pluripotent and multipotent cell
7. What are the applications of stem cells?
8. What do you understand by chromosomes?
9. What is heterochromatin and euchromatin?
10. Explain different types of cell locomotion
11. Describe cell theory
12. Explain cell doctrine
13. Draw the structures of polytene chromosomes
14. Describe telomeres.
15. Explain ATP dependent proton pumps
16. Explain the process of endocytosis and pinocytosis
17. Describe ribosomes
18. Explain different types of cell organelles with structures
19. What is symport and antiport?
20. What are microtubules . explain

**B.Sc. Hons Biotechnology 2021-22**  
**Semester 3**

**Subject:-Biochemistry**

Total units= 4

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

**Unit 1**

<b>Topic</b>	<b>Teaching points</b>	<b>Specific objectives</b>	<b>Methods /approaches /techniques</b>	<b>Resources and links</b>
<b>1. Metabolism</b>	To discuss the different metabolic pathways, biochemical reaction mechanism, energy rich metabolites. Coupled reactions, substrate level phosphorylation. Importance of ATP: Structural basis of high phosphoryl transfer potential of ATP. Sources of cellular energy, activated carriers. Regulation and evolution of metabolic pathways.	<i>To familiarize the students with the biochemical activities taking place at cellular level</i>	classroom teaching with examples	Lehninger A.L., Nelson D.L., Cox M.M. (2005). Principles of biochemistry (W. H. Freeman, USA).  Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York).  Biochemistry – J.L. Jain

**Question Bank**

**Long answer type questions**

1. What are coupled reactions. Give examples
2. Why ATP is the energy form in cell. Explain
3. Explain regulation and evolution of metabolic pathways
4. Describe substrate level phosphorylation with examples
5. Explain energy rich metabolites
6. Write about activated carriers.

**Short answer type questions**

1. What is ATP

2. Define metabolism
3. What do you understand by energy rich metabolites
4. How substrate level phosphorylation is different from oxidative phosphorylation
5. Give importance of ATP
6. Define coupled reactions
7. Give sources of cellular energy

### Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
<b>1. Carbohydrate metabolism</b>	Biosynthesis and degradation of glucose; feeder pathways of glycolysis; Krebs cycle, amphibolic nature of the Krebs cycle; regulation of Krebs cycle regulation of gluconeogenesis. Glycogen metabolism. Mitochondrial electron transport chain, oxidative phosphorylation; regulation of ATP synthesis	Students will learn about sugar metabolism in body and energy production using carbohydrates in various cell organelles	classroom teaching and practicing of the flow diagrams on black board by the students	Lehninger A.L., Nelson D.L., Cox M.M. (2005). Principles of biochemistry (W. H. Freeman, USA).  Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York).  Biochemistry – J.L. Jain

### Question Bank

#### Long answer type questions

1. How sugar is metabolized in cell?
2. Explain feeder pathways of glucose
3. Explain the energy production in tricarboxylic acid cycle
4. How glycogen is metabolized in cell
5. Explain in detail the structure and function of ATPases
6. Explain in detail the four enzyme complexes involved in electron transport chain reaction
7. How ATP synthesis is regulated?
8. What is amphibolic nature of krebs cycle?

#### Short answer type questions

1. How many ATP molecules are produced at the end of glycolysis?
2. What is the krebs cycle?

3. What is insulin and where it is produced in cell?
4. What is the location of ETC?
5. Explain feeder pathway
6. Draw the structure of ATPase
7. What are fates of pyruvate?
8. Which 3 carbon molecule is the end product of glycolysis?

### Unit 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
<b>1. Lipid Metabolism</b>	To learn about the biosynthesis and degradation of fatty acids; $\beta$ oxidation of saturated,unsaturated and polyunsaturated fatty acids. Formation of ketone bodies, their function and physiological significance. Fatty acid synthesis:multifunctional enzyme complex in eukaryotes,function of citrate. Regulation of fatty acid metabolism.	Students will learn about the metabolism , synthesis and regulation of various lipids in cell	Lecture cum discussion	Lehninger A.L., Nelson D.L., Cox M.M. (2005). Principles of biochemistry (W. H. Freeman, USA).  Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York).  Biochemistry – J.L. Jain
<b>2. Cholesterol metabolism</b>	To learn about the biosynthesis of cholesterol and its regulation			

### Question Bank

#### Long answer type questions

1. What do you know about beta oxidation of saturated and unsaturated fatty acid?
2. Explain omega oxidation in detail
3. How cholesterol is metabolised in cell? Give the location
4. How ketone bodies are formed, explain their physiological significance
5. Explain the regulation of cholesterol
6. What is the regulation of fatty acid metabolism Explain

#### Short answer type questions

1. What is cholesterol
2. What are ketone bodies
3. Give function of ketone bodies

4. What are saturated and unsaturated fatty acids?
5. What is multifunctional enzyme complex?
6. Write about fatty acid synthase complex

#### Unit 4

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
<p><b>1. Amino acid metabolism</b></p>	<p>Biosynthesis of nutritionally non-essential amino acids; catabolism of carbon skeleton of amino acids. Conversion of amino acids to specialized products; amino acids as precursors of porphyrins, bile pigments and biogenic amines.</p>	<p>Students will learn about the biosynthesis and modification of various amino acids along with the biosynthesis and catabolism of nucleic acids.</p>	<p>classroom teaching with the power point presentation of the topic nucleic acid metabolism</p>	<p>Lehninger A.L., Nelson D.L., Cox M.M. (2005). Principles of biochemistry (W. H. Freeman, USA).</p> <p>Stryer L, J. M. Berg, J.L. Tymoczko (2001). Biochemistry (W.H. Freeman and Company, New York).</p> <p>Biochemistry – J.L. Jain</p>
<p><b>2. Nucleic acid metabolism</b></p>	<p>Biosynthesis of purine and pyrimidine nucleotides; salvage reactions. Catabolism of purines and pyrimidines, urea cycle.</p>			

#### Question Bank

##### Long answer type questions

1. Explain the biosynthesis of nutritionally non essential amino acids
2. Explain the formation of heme proteins
3. Describe the salvage pathway of nucleotide synthesis
4. Describe urea cycle or krebs henseleit cycle
5. Explain the catabolism of purines and pyrimidines
6. Write about bile pigments and biogenic amines

##### Short answer type questions

1. What are essential and non essential amino acids?
2. What are porphyrins?
3. Give the importance of urea cycle



4. Difference between denovo and salvage pathway
5. Define catabolism and anabolism
6. What are bile pigments?

**B.Sc. Hons Biotechnology2021-22**

**Semester 3**

**Subject:-Genetics**

Total units= 4

Theory marks=67

Internal assessment= 8

Total marks =75

**Unit 1**

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
<b>1. Mendelian laws of inheritance</b>	<i>Pisumstavium</i> characteristics Law of independent assortment, law of segregation, genetic crosses, back cross , test cross	<i>The primary objective is to learn about the basics of genetics with the focus on the Mendelian laws, sex determination and molecular genetics</i>	classroom teaching with examples. Students will prepare the examples of various genetic crosses	Genetics by snustad and simons,  Genetics by P.K. Gupta
<b>2. Sex determination</b>	Sex determination in <i>drosophila</i> , plants and animals, sex linkage			
<b>3. Chromosomal aberrations</b>	Numerical chromosome aberration polyploidy, aneuploidy, duplications, inversions, translocations, position effects.			

**Question Bank**

**Long answer type questions**

1. Explain in detail law of independent assortment
2. Write about mendalian law of segregation
3. Explain test cross and back cross with 2 examples each
4. Write about sex linkage in animals
5. How sex determination can be done in *drosophila*
6. Write detailed note on numerical chromosomal aberration
7. Give detailed information on chromosomal aberrations

**Short answer type questions**

1. Write seven characteristics of *pisumstavium*
2. What is test cross

3. Explain back cross
4. What is aneuploidy
5. Define polyploidy

## Unit 2

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
<b>1. Gene interactions</b>	Gene interactions, sex linked inheritance	<i>This unit will familiarize students with chromosome organization, linkage, chromosome mapping.</i>	classroom teaching with examples.	Genetics by snustad and simons,  Genetics by P.K. Gupta
<b>2. Crossing over</b>	molecular mechanism and cytological proof			
<b>3. Linkage</b>	Tetrad analysis, somatic cell hybridization for gene linkage studies, Hereditary defects.			
<b>4. Recombination and genetic mapping</b>	Recombination, linkage, gene mapping, Three point testcross, interference, coincidence, recombination frequencies, Tetrad analysis			

### Question Bank

#### Long answer type questions

1. Explain gene interactions and epistasis
2. Explain three point test cross
3. Describe tetrad analysis
4. Explain gene linkage
5. Write about crossing over and its mechanism
6. Describe recombination
7. Explain gene mapping and how genes are inherited together
8. Explain the various hereditary defects
9. Give the cytological proof of crossing over

#### Short answer type questions

1. Define cross over
2. Define epistasis
3. What is interference and coincidence
4. Define linkage
5. Define recombination

### Unit 3

Topic	Teaching points	Specific objectives	Methods /approaches /techniques	Resources and links
1. <b>Population genetics</b>	Hardy-Weinberg equilibrium, gene and genotypic frequencies, Chi-square test, probability, pedigree analysis.	<i>Students will understand how genes are inherited in a population and various types of mutation</i>	Lecture cum discussion	Genetics by snustad and simons,  Genetics by P.K. Gupta
2. <b>Mutation</b>	Spontaneous versus induced mutations, types of mutations, mutagenic agents: Physical, chemical and radiation, molecular basis of mutations, mechanisms of DNA repair, mutations frequency, correlation between mutagenicity and carcinogenicity			

### Question Bank

#### Long answer type questions

1. Explain Hardy- Weinberg law
2. Describe in detail Chi square test
3. Explain the different types of mutations
4. Describe the mechanism of DNA repair
5. Explain the correlation between mutagenicity and carcinogenicity
6. Explain Ames test
7. Write about pedigree analysis

#### Short answer type questions

1. Define mutation
2. Define gene frequency
3. What do you understand by pedigree analysis
4. Name the different type of mechanisms of DNA repair
5. Define genotypic frequencies
6. Give the equation of Hardy-Weinberg law

### Unit 4

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

<p><b>1. Basic microbial genetics</b></p>	<p>Conjugation, transduction, transformation, isolation of auxotrophs, replica plating techniques, analysis of mutations in biochemical pathway, one gene – one enzyme hypothesis.</p>	<p><i>This unit will give the knowledge of inheritance of genes in microbes.</i></p>	<p>Lecture cum discussion</p>	<p>Genetics by snustad and simons,  Genetics by P.K. Gupta</p>
<p><b>2. Extra chromosomal inheritance</b></p>	<p>mitochondrial and chloroplast genetic systems.</p>			

### Question Bank

#### Long answer type questions

1. Explain the process of conjugation
2. Describe transformation
3. Write about the replica plate technique
4. Explain mitochondrial and chloroplast genetic system
5. Describe one gene-one enzyme hypothesis and experiment on *Neurosporacrassa*
6. How mutations are analysed in biochemical pathway

#### Short answer type questions

1. Define transduction and give the process
2. Define auxotrophs
3. Define prototrophs
4. Define transformation
5. Why replica plate technique is used?
6. Write about extra chromosomal DNA