

# BIOTECHNOLOGY

## SEMESTER III

### Syllabi for the examinations to be held in the years 2015, 2016 and 2017

Course No.: **BP-301(Theory)**

Duration of Exam: 3 Hrs

Course Title : **Cell and Molecular Biology**

Credits : 4

Total Marks : 100

Examination : 80

Internal Assessment : 20

#### **Unit – I**

Cell theory, Structure of pro-and eukaryotic cells; cell wall in plants and microbes; structure and function, Plasma membrane; transport through membrane, Cell organelles; Nucleus, Mitochondria, Chloroplast and endoplasmic reticulum. Basic concept of cell signaling. Chromosome structure and function.

#### **Unit – II**

Mendelian Genetics, interaction of genes, Recombination, Bacterial genetic system; transformation, transduction and conjugation, Mutations; molecular basis of mutations, Overview of transposable elements in bacteria and plants. Structural and numerical alterations of chromosomes.

#### **Unit – III**

Central dogma, Model organisms to study Molecular biology. Nucleic acids; DNA and RNA as a genetic material, experimental basis. DNA structure: Methods of analysis of DNA. Direct method; X-ray crystallography, autoradiography and electron microscopy. Indirect methods; Spectroscopy and Agarose gel electrophoresis. Factors determining structure of DNA, Hydrogen bonding in DNA, Hydrophobic interactions in DNA, base stacking, different forms of DNA: A, B, Z, Satellite DNA, Shapes of DNA; Linear and Circular DNA.

#### **Unit – IV**

General features of DNA replication and basic rules of replication. Semiconservative mode of DNA replication. Experimental basis, Replication in prokaryotes, initiation, elongation and termination. Replication in eukaryotes Initiation, elongation and termination. Transcription in prokaryotes, Initiation, elongation and termination. Transcription in eukaryotes initiation, elongation and termination.

## Unit – V

Regulation of gene expression in prokaryotes operon concept , inducible and repressible operons, Translation: structure and function of ribosomes, mRNA, tRNA, rRNA; Protein synthesis in prokaryotes; initiation, elongation and termination. Translation in eukaryotes; initiation, elongation and termination.

### NOTE FOR PAPER SETTING

The question paper will have 2 sections. Section ‘1’ will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit

### Internal Assessment (Total Marks : 20)

20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under :-

|     |                                             |   |                       |
|-----|---------------------------------------------|---|-----------------------|
| i)  | Class test                                  | - | 10 marks              |
| ii) | Two written Assignments/<br>Project reports | - | 10<br>(05 marks each) |

### Books recommended

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts K., and Watson J.D (2008). Molecular Biology of Cell (5<sup>th</sup> edition), Garland Publishing Inc., New York.
2. Weaver, R.F., 2005, Molecular Biology, 3rd edition, New York, NY, McGraw-Hill.
3. Lodish, H. *et al.*, 2004, Molecular Cell Biology, 5th edition, New York, NY, W.H. Freeman and Company.
4. Alberts, B., Bray, D., Hopkin, K., and Johnson, A.D., ( 2009). Essential Cell Biology (3<sup>rd</sup> edition), Garland Publishing Inc., New York.
5. Wilson, K. and Walker, J. (2005). Principle and Techniques of Biochemistry and Molecular Biology (6<sup>th</sup> edition), John Wiley. Cambridge University Press, New York.
6. Karp, Gerald, and Nancy L (2009). Pruitt. Cell and molecular biology: concepts and experiments (6<sup>th</sup> edition). New York: John Wiley & Sons.
7. Das, H.K (2007.). Textbook of Biotechnology (4<sup>th</sup> edition), Wiley Dreamteck India Pvt. Ltd, India.
8. Singh, B. D. "Text book of Biotechnology." Kalyani publishers Ludhiana 2 (2005): 239-40.
9. Gardner, E.J., Simmons, M.E., Snustad DP. (2012) Principle of Genetics (8<sup>th</sup> Edition) Wiley India Pvt. Ltd., New Delhi

Course No.: **BP-301(Practical)**

Duration of Exam.: 3 Hrs

**Course Title : Cell and Molecular Biology**

Total Marks : 50

External Examination : 25

Internal Assessment : 25

1. Different type of cells; prokaryotes , eukaryotes
2. Isolation of DNA from living cell
3. Quantification of DNA by Spectrophotometer.
4. Characterization of DNA by agarose gel electrophoresis of DNA.
5. Estimation of purity of DNA by spectrophotometry
6. Quantification of DNA using agarose gel by normalization
7. To measure the length and breadth of the given cell sample by using micrometer
8. Counting cells using Haemocytometer
9. Preparation of permanent slides.
10. Study of Meiosis and Mitosis in cells.

**Internal Assessment (Total Marks : 25)**

- (1) 1<sup>st</sup> Internal assessment on the basis of day to day performance in the Laboratory / field : 06 marks
- (2) 2<sup>nd</sup> assessment on the basis of day to day performance in the laboratory / field : 06 marks
- (3) Internal Practical Test : 08 marks
- (4) Regularity of attendance : 05 marks

**Books recommended**

1. Sambrook J, Fritsch, E.F . and Maniatis, T. (2001). Molecular cloning. A Laboratory Manual 3<sup>rd</sup> ed., Cold Spring Harbor Laboratory Press.
2. Dabre P.D. (1998) Introduction to Practical Molecular Biology, John Wiley & Sons Ltd., New York.
3. Plummer D.T. (1990) An Introduction of Practical Biochemistry. 3<sup>rd</sup> Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
4. Singh R. and Sawhney, S.K. (2002) Introduction to Practical Biochemistry. Narosa Publications, New Delhi.

# BIOTECHNOLOGY

## SEMESTER IV

### Syllabi for the examinations to be held in the years 2016, 2017 and 2018

Course No.: **BP-401(Theory)**

Duration of Exam: 3 Hrs

Course Title : **Enzymology and Bioprocess Technology**

Credits : 4

Total Marks : 100

Examination : 80

Internal Assessment : 20

#### Unit – I

Biophysical and biochemical techniques: Principle, theory and applications of centrifugation, chromatography, types of chromatography; column, paper, TLC, ion exchange chromatography and affinity chromatography. Theory, principle and applications of Spectrophotometry (UV - VIS) and electrophoresis.

#### Unit – II

History of Enzymology, Enzyme vs chemical catalysts, general characteristics of enzymes, enzyme specificity, Nomenclature and classification of enzymes and their significance, Holoenzyme, apoenzyme, coenzymes, prosthetic group; Enzyme activity units, IU, katal, specific activity, enzyme assay methods, structure of enzyme proteins, Nature of active site, general mechanisms of enzyme action,

#### Unit – III

Enzyme kinetics, Michaelis-Menten equation,  $K_m$ ,  $V_{max}$ , equilibrium and steady state approaches for enzyme kinetics study, Lineweaver-Burk plots, enzyme inhibition reversible. Irreversible forms of inhibitions, Competitive, non-competitive, uncompetitive and mixed inhibition; Approaches for Isolation and purification of enzymes, Applications of enzymes in industries- food processing, dairy, textile, brewery, leather, detergent.

#### Unit – IV

Introduction to Bioprocess technology, Concept of Fermentation vs bioprocess, Microbial growth kinetics; types of fermentation processes: batch, continuous, fed batch; media for industrial processes, sterilization of media and air, Bioreactors, design and types of bioreactors; Agitation and aeration, impeller and sparger. Bioprocess monitoring and control, scale up, various bioprocess parameters, Effect of pH, temperature medium components on product synthesis.

#### Unit – V

Bioprocess based products-antibiotics-penicillin, streptomycin, tetracycline; ethanol, organic acids-citric acid, acetic acid, gluconic acid, butanol, single cell protein; Down stream processing, steps involved in down stream processing, separation of cells and broth, filtration, centrifugation, chromatography, solvent extraction, effluent treatment and disposal, BOD, COD.

## **NOTE FOR PAPER SETTING**

The question paper will have 2 sections. Section '1' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit

### **Internal Assessment (Total Marks : 20)**

20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under :-

|     |                                             |   |                       |
|-----|---------------------------------------------|---|-----------------------|
| i)  | Class test                                  | - | 10 marks              |
| ii) | Two written Assignments/<br>Project reports | - | 10<br>(05 marks each) |

### **Books recommended**

1. Shuler, M.L. and Kargi, G. (2003). Bioprocess Engineering: Basic Concepts, Prentice Hall, Englewood Cliffs.
2. Stanbury, P.F. and Whitaker, A. (1997). Principles of Fermentation Technology, Pergamon Press, Oxford.
3. Doran, P.M. (1999). Bioprocess Engineering Principles. Academic Press, New York.
4. Tripathi, G. (1999). Enzyme Biotechnology. Technoscience Publications, Jaipur, India.
5. Palmer, T. (2001). Enzymes Biochemistry, Biotechnology, Clinical Chemistry, Horwood Publishing Chichester, England.
6. Nicholas, P, Stevans, L. Fundamental of Enzymology (1999). Oxford University Press, New York.

Course No.: **BP-401(Practical)**

Duration of Exam.: 3 Hrs

Title : **Enzymology and Bioprocess Technology**

Total Marks : 50

External Examination : 25

Internal Assessment : 25

1. Estimation of  $\alpha$ -amylase activity from saliva.
2. Effect of temperature and pH on enzyme activity.
3. Study of enzyme kinetics.
4. Enzyme purification by salt precipitation.
5. Enzyme purification by chromatography.
6. Enzyme purification by electrophoresis.
7. Isolation of yeast from fruits.
8. Study of microbial growth kinetics.
9. Determination of thermal death point and thermal death time.
10. Ethanol production by fermentation in shake flask.

#### **Internal Assessment (Total Marks : 25)**

- |                                                                                                          |            |
|----------------------------------------------------------------------------------------------------------|------------|
| (1) 1 <sup>st</sup> Internal assessment on the basis of day to day performance in the laboratory / field | : 06 marks |
| (2) 2 <sup>nd</sup> assessment on the basis of day to day performance in the laboratory / field          | : 06 marks |
| (3) Internal Practical Test                                                                              | : 08 marks |
| (4) Regularity of attendance                                                                             | : 05 marks |

#### **Books recommended**

1. Plummer D.T. (1990). An Introduction of Practical Biochemistry. 3<sup>rd</sup> Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Singh R. and Sawhney, S.K. (2002). Introduction to Practical Biochemistry. Narosa Publications, New Delhi.
3. Wilson, K. and Walker, J. (2004), Practical Biochemistry, Principles and techniques (4<sup>th</sup> edition), Cambridge University Press.

## **BIOTECHNOLOGY**

### **SEMESTER V**

|                                   |                                                                   |
|-----------------------------------|-------------------------------------------------------------------|
| Course No.: <b>BP-501(Theory)</b> | Course Title : <b>Plant Biotechnology and Genetic Engineering</b> |
| Duration of Exam : 3 Hrs          | Credits : 4                                                       |
|                                   | Total Marks : 100                                                 |
|                                   | Examination : 80                                                  |
|                                   | Internal Assessment : 20                                          |

### **Syllabi for the examinations to be held in the years 2016, 2017 and 2018**

#### **Unit – I**

Plant tissue culture, Micropropagation, stages of propagation, advantages and applications, culture media (White's and Murashige and Skoog's); Plant growth regulators (Auxins, Cytokinins and Gibberlins) and their use in plant tissue culture; Initiation and maintenance of callus, types of callus and suspension cultures, batch cultures and continuous cultures; Somatic embryogenesis, Virus free plants, shoot tip culture, meristem isolation and culture, thermotherapy, applications and limitations; vitrification.

#### **Unit – II**

Haploid production by anther, pollen and ovule culture, embryo rescue, homozygous lines; Somatic cell hybridization; Protoplast isolation and culture, protoplast fusion and their applications, cybrids; Cryopreservation, types of cryoprotectants, freezing and storage, thawing and germplasm conservation, freeze preservation and slow growth cultures; Production of secondary metabolites.

#### **Unit – III**

Isolation of DNA and RNA from viruses, bacteria, plants and animals, Analysis and characterization of DNA by spectrophotometry and agarose gel electrophoresis. Tools in genetic engineering; Restriction enzymes: types and properties; Polymerases, DNA pol I, Klenow fragment, Reverse Transcriptase, Taq polymerase, ligases, exonucleases, DNase, RNase and Proteinases; Cloning vectors; plasmids pUC18, Genomic DNA library construction in prokaryotes, Construction of cDNA library.

#### **Unit – IV**

Polymerase chain reaction, types and procedure, applications; restriction mapping, nucleic acid hybridization; DNA sequencing, Maxam and Gilbert's degradation method and Sanger's dideoxynucleotide synthetic method, DNA fingerprinting, molecular markers, RFLP, RAPD, AFLP, SSR, their applications.

#### **Unit – V**

Gene transfer in plants using *Agrobacterium tumefaciens*, vectorless gene transfer, selectable markers, scorable markers; Major genes transferred through genetic engineering; advantages and application of Genetic engineering, production of transgenic plants with resistance against herbicides and insects; Golden Rice, Bt cotton.

### **NOTE FOR PAPER SETTING**

The question paper will have 2 sections. Section '1' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit

### **Internal Assessment (Total Marks : 20)**

20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under :-

|     |                                             |   |                       |
|-----|---------------------------------------------|---|-----------------------|
| i)  | Class test                                  | - | 10 marks              |
| ii) | Two written Assignments/<br>Project reports | - | 10<br>(05 marks each) |

### **Books recommended**

1. Hammound, J., McGarvey, P. and Yusibov, V., eds (2000). Plant Biotechnology;Springer Verlag.
2. Fu, T-J. Singh, G. and Curitis, W.R., eds (1999). Plant Cell and Tissue Culture for the Production of Food Ingredients, Kluwer Academic/ Plenum Press.
3. Gupta, P.K. (2010). Elements of Biotechnology (3<sup>rd</sup> edition), Rastogi and Co., Meerut, India.
4. Bhojwani, S.S and Razdan, M.K. (2010). Plant Tissue Culture: Theory and Practice Elsevier Science.
5. Chawla, H. S. (2009). Introduction to Plant Biotechnology. 3rd edition C RC Press.
6. Das, H.K. (2010). Text Book of Biotechnology. 4<sup>th</sup> edition, Wiley India Pvt. Limited
7. Gupta, P.K. (2011). Plant Biotechnology, Rastogi Publishers, Meerut, India.
8. Kour, H., Tandon, V., and Kou H. (2009). Plant Biotechnology and Genetic Engineering. Anmol Publications Pvt Ltd. ,Bangalore
9. Kumar, A and Sopory, S K. (2010). Applications of Plant Biotechnology: In vitro Propagation, Plant Transformations and Secondary Metabolite Production. I K International Publishing House, New Delhi.



Course No.: **BP-501(Practical)**

Duration of Exam.: 3 Hrs

Title : **Plant Biotechnology and Genetic Engineering**

Total Marks : 50

External Examination : 25

Internal Assessment : 25

1. Sterilization techniques for glassware/ plasticware. Operational use of autoclave and laminar air flow.
2. Lab design and requirements of a standard plant tissue culture lab (It includes a visit to an established PTC lab).
3. Media preparation; making of cotton plugs, plugging and sealing of culture vessels.
4. To prepare different explants for culturing.
5. To demonstrate various steps of explant inoculation.
6. Genomic DNA isolation from plants.
7. Restriction digestion of DNA.
8. Demonstration of steps of Southern blotting.
9. Demonstration of PCR amplification.
10. Demonstration of cloning.

**Internal Assessment (Total Marks : 25)**

- (1) 1<sup>st</sup> Internal assessment on the basis of day to day performance in the laboratory / field : 06 marks
- (2) 2<sup>nd</sup> assessment on the basis of day to day performance in the laboratory / field : 06 marks
- (3) Internal Practical Test : 08 marks
- (4) Regularity of attendance : 05 marks

**Books recommended**

1. Chawla, H.S. (1998) Biotechnology in Crop improvement. International Book Distribution Company.
2. Gupta, P.K. (1996) Elements of Biotechnology. Rastogi and Co., Meerut.
3. Henry, R.J. (1997) Practical Applications of Plant Molecular Biology. Chapman and Hall.
4. Razdan, M.K. (1996). Plant Tissue Culture, Elsevier.
5. Sambrook, J. Fritsch, E.F. and Maniatis, T. (2001). Molecular Cloning. A Laboratory Manual 2<sup>nd</sup> ed., Cold Spring Harbor Laboratory Press.

# **BIOTECHNOLOGY**

## **SEMESTER VI**

|                                   |                                                           |
|-----------------------------------|-----------------------------------------------------------|
| Course No.: <b>BP-601(Theory)</b> | Course Title : <b>Immunology and Animal Biotechnology</b> |
| Duration of Exam: 3 Hrs           | Credits : 4                                               |
|                                   | Total Marks : 100                                         |
|                                   | Examination : 80                                          |
|                                   | Internal Assessment : 20                                  |

### **Syllabi for the examinations to be held in the years 2017, 2018 and 2019**

#### **Unit – I**

Introduction to the immune system – Innate and adaptive, Recognition of self and non self, Hematopoiesis and its regulation, Cells of immune system: Lymphoid cells, T cells, B cells, NK cells, Antigen Presenting Cells (dendritic cells and macrophages), Primary and Secondary lymphoid organs, Lymphatic system.

#### **Unit – II**

Antigen, properties of antigens, antigen-antibody interactions, affinity and avidity, Immunoglobulins – classes, basic structure and biological activity, T-cell subsets and their properties, introduction to MHC and types of MHCs, Recognition of antigen by T-cells and role of MHC, Structure of T and B cell receptors.

#### **Unit – III**

Structure and organization of animal cell, Primary and established cell line cultures, mono-layer and suspension culture, transformed / continuous cell lines, commonly used cell lines. Basic techniques of cell culture in vitro; equipment and aseptic conditions, Disaggregation of tissue; cold and warm trypsinization, maintenance of cell culture, cell separation.

#### **Unit – IV**

Biology and characterization of cultured cells: Cell morphology, cell adhesion, cell proliferation, cell differentiation, energy metabolism, Measurement of growth and viability of cell in culture, Growth kinetics of cells in culture, Measurement of cytotoxicity, Organ and histotypic cultures, Cell transformations.

#### **Unit – V**

Immuno-diffusion and Immuno-electrophoresis, Immuno-blot, ELISA and variants of ELISA, RIA, Monoclonal antibodies and hybridoma technology, Vaccines and its types, DNA transfer technology, production of useful products in transgenic animals, introduction to stem cells and its medical applications.

## **NOTE FOR PAPER SETTING**

The question paper will have 2 sections. Section '1' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit

### **Internal Assessment (Total Marks : 20)**

20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under :-

|     |                                             |   |                       |
|-----|---------------------------------------------|---|-----------------------|
| i)  | Class test                                  | - | 10 marks              |
| ii) | Two written Assignments/<br>Project reports | - | 10<br>(05 marks each) |

### **Books recommended**

1. Roitt, I.M., Brostoff, J. and Male, D.K. (2001), Immunology, 6<sup>th</sup> Edition. Grower Medical Publishing, New York.
2. Kuby, J. (2002), Immunology. 5<sup>th</sup> Edition. W.H. Freeman and company, New York.
3. Satyanarayana, U. (2005). Biotechnology. Books and Allied (P) Ltd, (Kolkatta) India.
- 5 Freshney, Ian R. (2005). Culture of Animal Cells 3<sup>rd</sup> Edition. Wiley- Liss.
- 6 Singh, B. D. (2005). "Text book of Biotechnology." Kalyani publishers Ludhiana .

Course No.: **BP-601(Practical)**

Duration of Exam.: 3 Hrs

Title : **Immunology and Animal Biotechnology**

Total Marks : 50

External Examination : 25

Internal Assessment : 25

1. Total and differential Leucocyte count.
2. Total RBC count.
3. Haemagglutination assay.
4. Separation of serum from blood.
5. Blood grouping.
6. Double immunodiffusion test using specific antibody and antigen.
7. Rocket immunoelectrophoresis.
8. Demonstration of ELISA
9. Demonstration of sterilization techniques.
10. Preparation of tissue culture medium.
11. Preparation single cell suspension from the animal tissue.
12. Trypsinization of tissue and establishment of a monolayer and subculturing.

**Internal Assessment (Total Marks : 25)**

- (1) 1<sup>st</sup> Internal assessment on the basis of day to day performance in the laboratory / field : 06 marks
- (2) 2<sup>nd</sup> assessment on the basis of day to day performance in the laboratory / field : 06 marks
- (3) Internal Practical Test : 08 marks
- (4) Regularity of attendance : 05 marks

**Books recommended**

1. Masters, John R.W. (2000). Animal Cell Culture – Practical approach, Oxford, Univeristy Press, Oxford.
2. Freshney R.I. (2005). Culture of Animal Cells, 5<sup>th</sup> Edition, Wiley – Liss.
3. Srivastava, A. K., Singh, R.K., Yadav, M.P. (2009). Animal Biotechnology, Oxford and IBH publishing company, New Delhi.
4. Sateesh, M.K.(2005). Biotechnology-5: Animal Cells, Immunology & Plant Biotechnology. New Age International (L),Pvt., New Delhi.
5. Talwar, G.P. and Gupta S.K. (1992). A Handbook of Practical and Clinical Immunology, CBS Publishers and Distributors, New Delhi.
6. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt (2011). Essential Immunology. Wiley-Blackwell; 12th edition

7. Abul K. Abbas, Andrew H. Lichtman (2011). Cellular and Molecular Immunology.  
Publisher: Saunders 7<sup>th</sup> edition.