

**B.Sc BIOTECHNOLOGY**  
**SEMESTER-III**  
**Under (CBCS) at Undergraduate Level**

(For the examinations to be held in the years Dec. 2017, Dec. 2018 and Dec. 2019)

**Course Title: Molecular Biology and Immunology**

**Course code: UBTTTC301**

**Duration of Examinations: 2 ½ hrs**

**Max. Marks: 100**

**Internal Examination : 20 marks**

**Credits: 4**

**External Examination: 80 marks**

**Objective:** The course is designed to give students a sound and basic exposure to Molecular biology and immunology. This course offers a very robust and forward looking programme in Biotechnology.

**Unit I: DNA Structure and Replication**

DNA and RNA as a genetic material: Bonding in macromolecules, Weak bonds and structure determination of macromolecules i.e. nucleic acids and proteins. Structural aspects – Components of DNA and RNA. Salient features of A, B & Z form of DNA; General features of DNA replication and basic rules of replication. Semiconservative mode of DNA replication: experimental basis.

**Unit II: Transcription**

Central dogma; organisation of gene: concept of promoter, enhancers, silencer; transcription factors RNA polymerase; RNA: salient features and types (mRNA, tRNA, rRNA, siRNA, miRNA); Ribozymes; Transcription in prokaryotes, Initiation, elongation and termination; Operon concept, inducible and repressible operons.

**Unit III : Translation**

Genetic code: salient features; start codon, stop codon, wobble hypothesis, degeneracy of codon, codon bias; concept of reading frame; Translation: structure and function of ribosomes; Protein synthesis in prokaryotes initiation, elongation and termination

**Unit IV: Introduction to the Immune System**

Introduction to immune system, Innate and acquired immunity. Organization and structure of lymphoid organs, Cells of the immune system: Hematopoiesis and differentiation, B-lymphocytes, T lymphocytes, Macrophages, Dendritic cells, Natural killer, Eosinophils, Neutrophils and Mast cells. Antibody structure and function, Introduction to MHC

**UNIT V: Immunobiotechnology**

Antigen-Antibody interactions and Techniques – ELISA and its variants, ELISPOT, Radio immunoassay, Immunofluorescence. Overview of Hybridoma and Monoclonal antibodies,

Technology and its application. Vaccines: History of vaccine development, introduction to the concept of vaccine, Types of vaccines; Active and passive immunization.

### **Books Recommended**

1. Watson G.D (2008). Molecular biology of the gene. Cold spring harbor Ltd Press.
2. Burton E (2008). Molecular Biology: gene to protein. Jones & Bartlett.
3. Clark & Pazdernik (2009). Biotechnology: applying the genetic revolution. Academic Press.
4. Hartwell(2004). Genetics from genes to genomes. Macgrawhill
5. Russell (2006). Genetic: molecular Approaches. Pearson Press.
6. Lewin (2011). GenesX. Jones & Bartlett.
8. Goldsby, R. A., Kindt, T.J. and Osborne, B.A. Kuby Immunology. W.H. Freeman and company, New York.
9. Coleman, R.M., Lombard, M.F. and Sicard, R.E .Fundamental Immunology. Wm.C.Brown publishers,USA.
10. Roitt, I., Brostoff, J. and Male, D. Immunology. Hartcourt Brace and Company, Asia Pte.Ltd.
11. Davies, H. (1997). Introductory Immunology. Chapman and Hall, New York edition.

### **Note for paper setters**

**External End Semester Examination (Total marks: 80) Time duration: 2 hrs 30 min**

**The question paper will have 3 sections.**

**Section I: Five (5) short answer questions representing all units i.e at least one from each unit (without detailed explanation having 70-80 words) of 3 marks each = 15 marks (All compulsory)**

**Section II: Five (5) medium answer questions (with explanation having 250-300 words) of 7 marks each = 35 marks (All compulsory)**

**Section III: Five (5) long answer questions (with detailed explanation/ of 500-600 words) covering all the units. The candidate will be required to answer only two questions of 15 marks each = 30 marks.**

**Internal Assessment (Total Marks: 20) Time duration: 1 hr.**

**The internal assessment under CBCS shall comprise of two parts**

**Part A: Total weightage to this part shall be 10 marks.** It will have eight short answer questions, selecting at least three from each of the two/three units/50% of the syllabus covered. A candidate has to attempt any five questions of two marks each.

**Part B: Total weightage to this part shall be 10 marks.** It will have two long answer questions, selecting at least each one from first two/three units/50% of the syllabus covered. A candidate has to attempt any one question of 10 marks.

**B.Sc BIOTECHNOLOGY  
SEMESTER-III**

**(For the examinations to be held in the years Dec. 2017, Dec. 2018 and Dec. 2019)**

<b>Title : Molecular Biology and Immunology (Practicals)</b>	<b>Maximum Marks : 50</b>
<b>Course Code : UBTPC302</b>	<b>External Examination : 25 Marks</b>
<b>Duration of Examination : 3 hrs</b>	<b>Internal Assessment : 25 Marks</b>
<b>Credits : 2</b>	

**Practicals**

1. Isolation of DNA from living cell
  - i) . Quantification of DNA by Spectrophotometer.
  - ii) Characterization of DNA by agarose gel electrophoresis of DNA.
  - iii) Estimation of purity of DNA by spectrophotometry
  - iv) Quantification of DNA using agarose gel by normalization
2. Total and differential Leucocyte count.
3. Total RBC count.
4. Haemagglutination assay.
5. Separation of serum from blood.
6. Blood grouping.
7. Double immunodiffusion test using specific antibody and antigen.
8. Rocket immunoelectrophoresis.
9. Demonstration of ELISA

**Note for distribution of 50 Marks in Practical Examination: (50% internal and 50% external)**

<b>I. Internal Assessment</b>	<b>(25 marks)</b>
1. Attendance :	5 Marks
2. Practical Test:	5 Marks
3. Daily performance based on practical work done:	10 Marks
4. Viva-voce	5 Marks
<b>II. External Assessment</b>	<b>(25 marks)</b>
1. External practical examination	20 Marks
2. Viva-voce	5 Marks

**B.Sc BIOTECHNOLOGY**  
**SEMESTER III**  
**(Skill Enhancement Course)**  
**Under (CBCS) at Undergraduate Level**

**Syllabus for the examinations to be held in the years Dec. 2017, Dec. 2018 and Dec. 2019)**

**Course Title : Bioprocess Technology**

**Course code: UBTTS303**

**Duration of Examinations: 2 ½ hrs**

**Internal Examination : 20 marks**

**External Examination : 80 marks**

**Max. Marks : 100**

**Credits : 4 Credits**

**Objectives:** Bioprocess Technology is an inherent and one of the most important courses in Biotechnology programme. The course aims at training the students for application of biotechnology principles for commercial production of biobased products. The course envisages new/novel process and product development, and improving the existing processes/products, enhancing bioprocess economy etc. This course may play an important role towards skill enhancement of the students.

**Unit I: Concept of Fermentation and Bioprocess technology**

- i. The fundamental concept of Fermentation and bioprocess technology
- ii. Types of bioprocesses- batch, continuous, fed batch, Microbial growth kinetics; Growth and product association
- iii. Design and formulation of Media for industrial bioprocesses
- iv. Criteria for medium design, carbon/nitrogen sources
- v. Sterilization of media and air.

**Unit II : Bioreactors-design, types and operation**

- i. Bioreactors, bioreactor design, criteria, operation and types of bioreactors
- ii. Agitation and aeration in the bioreactor, impeller and sparger design.
- iii. Concept of scale up, scale up challenges
- iv. Influence of various bioprocess parameters viz. pH, temperature, medium components on product synthesis.
- v. Bioprocess monitoring and control, automated control vs manual control of bioprocesses

### **Unit III: Bioprocess based products**

- i. Commercial production of various bioprocess based products,
- ii. Typical steps for bioprocess based product synthesis, upstream processing
- iii. Organic acids and solvents: Bioethanol, butanol, citric acid, acetic acid, gluconic acid,
- iv. Antibiotics-penicillin, streptomycin, tetracycline;
- v. Single cell protein; amino acids: glutamic acid, lysine

### **Unit IV: Downstream processing**

- i. Downstream processing: definition, cost involved in downstream processing
- ii. Typical steps involved in Downstream processing,
- iii. Criteria for downstream processing, Target application of product vs cost, separation of cells and broth,
- iv. Typical unit operation for downstream processing filtration, centrifugation, chromatography, solvent extraction, HPLC
- v. Methods for cell breakage for harvesting interacellular products

### **Unit V : Effluent treatment and disposal of wastes**

- i. Types and nature of wastes generated from bioprocesses
- ii. Characteristics of effluents/wastes: hazardous/nonhazardous
- iii. Pollution load parameters of effluents/wastes, BOD, COD.
- iv. Effluent treatment strategies, physical, chemical and biological methods, the bioreactors used for treatment of wastes, and disposal of wastes
- v. Anaerobic digestion of wastes, steps involved

### **Note for paper setters**

**External End Semester Examination (Total marks: 80) Time duration: 2 hrs 30 min**

**The question paper will have 3 sections.**

**Section I: Five (5) short answer questions representing all units i.e at least one from each unit (without detailed explanation having 70-80 words) of 3 marks each = 15 marks (All compulsory)**

**Section II: Five (5) medium answer questions (with explanation having 250-300 words) of 7 marks each = 35 marks (All compulsory)**

**Section III: Five (5) long answer questions (with detailed explanation/ of 500-600 words) covering all the units. The candidate will be required to answer only two questions of 15 marks each = 30 marks.**

**Internal Assessment (Total Marks: 20) Time duration: 1 hr.**

**The internal assessment under CBCS shall comprise of two parts**

**Part A: Total weightage to this part shall be 10 marks.** It will have eight short answer questions, selecting at least three from each of the two/three units/50% of the syllabus covered. A candidate has to attempt any five questions of two marks each.

**Part B: Total weightage to this part shall be 10 marks.** It will have two long answer questions, selecting at least each one from first two/three units/50% of the syllabus covered. A candidate has to attempt any one question of 10 marks.

#### **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.

**B. SC BIOTECHNOLOGY**  
**SEMESTER- IV**  
**Under (CBCS) at Undergraduate Level**

(For the examinations to be held in the years July 2018, July 2019 and July 2020)

**Course Title : Genetic Engineering and Plant Biotechnology**

**Course Code : UBTTC401**

**Duration of Examination : 2 ½ Hrs**

**Internal Assessments : 20**

**External Examination : 80**

**Credits : 4**

**Max. Marks : 100**

**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; Callus: Initiation and maintenance, types of callus, suspension cultures, batch cultures and continuous cultures.

**Unit II:**

Somatic embryogenesis and its application, Haploid production using anther, pollen and ovule culture, embryo rescue, Protoplast isolation and fusion and their applications, Cybrids; Production of secondary metabolites.

**Unit III:**

Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification and storage of nucleic acids, Enzymes in genetic engineering : exo & endo nucleases, Restriction nucleases, DNA polymerase I, II and III, Klenow fragment, helicases, topoisomerases, Reverse Transcriptase, Taq polymerase, Enzymes in modification- Methylases and phosphatases and their mechanism of action; RNase and their mechanism of action; Enzymes in modification- Polynucleotide kinase, Ligases; Vectors and their types, Construction of genomic and cDNA library

**Unit IV:**

Methods of nucleic acid detection, Polymerase chain reaction (PCR) and its applications, Variations in PCR and their applications, Methods of nucleic acid hybridization; Restriction mapping; DNA sequencing: Maxam and Gilbert's degradation method, Sanger's dideoxynucleotide synthetic method and Pyrosequencing, DNA fingerprinting, Molecular markers: RFLP, RAPD, AFLP, SSR and SNPs and their applications.

## Unit V:

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

### Note for paper setters

**External End Semester Examination (Total marks: 80) Time duration: 2 hrs 30 min**

**The question paper will have 3 sections.**

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**Section III: Five (5) long answer questions (with detailed explanation/ of 500-600 words) covering all the units. The candidate will be required to answer only two questions of 15 marks each = 30 marks.**

**Internal Assessment (Total Marks: 20) Time duration: 1 hr.**

**The internal assessment under CBCS shall comprise of two parts**

**Part A: Total weightage to this part shall be 10 marks.** It will have eight short answer questions, selecting at least three from each of the two/three units/50% of the syllabus covered. A candidate has to attempt any five questions of two marks each.

**Part B: Total weightage to this part shall be 10 marks.** It will have two long answer questions, selecting at least each one from first two/three units/50% of the syllabus covered. A candidate has to attempt any one question of 10 marks.

### Books recommended

1. Hammound, J., McGarvey, P. and Yusibov, V., eds (2000). Plant Biotechnology;Springer Verag.
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., Merrut, 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.

**B. SC BIOTECHNOLOGY  
SEMESTER- IV**

(For examinations to be held in the years July, 2018, July, 2019, July, 2020)

**Title : Genetic Engineering and Plant Biotechnology (Practicals)**

**Course No.: UBTPC402**

**Maximum Marks : 50**

**Duration of Examination.: 3 Hrs**

**External Examination : 25**

**Credits : 02**

**Internal Assessment : 25**

**Practicals**

1. Sterilization techniques for glassware/ plasticware. Operational use of autoclave and laminar air flow.
2. Media preparation; making of cotton plugs, plugging and sealing of culture vessels.
3. To prepare different explants for culturing.
4. To demonstrate various steps of explant inoculation.
5. Genomic DNA isolation from plants.
6. Restriction digestion of DNA.
7. Demonstration of steps of Southern blotting.
8. Demonstration of PCR amplification.
9. Demonstration of cloning.

**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.

**Note for distribution of 50 Marks in Practical Examination: (50% internal and 50% external)**

<b>II.</b>	<b>Internal Assessment</b>	<b>(25 marks)</b>
1.	Attendance :	5 Marks
2.	Practical Test:	5 Marks
3.	Daily performance based on practical work done:	10 Marks
4.	Viva-voce	5 Marks
<b>II.</b>	<b>External Assessment</b>	<b>(25 marks)</b>
1.	External practical examination	20 Marks
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**B.Sc BIOTECHNOLOGY**  
**SEMESTER-IV**  
**(Skill Enhancement Course)**  
**Under (CBCS) at Undergraduate Level**

(Syllabus for the examinations to be held in the years July, 2018, July,2019 and July, 2020)

**Course Title: Medical Microbiology**

**Course code: UBTTS403**

**Duration of Examination : 2 ½ hrs**

**Max. Marks : 100**

**Internal Examination : 20 marks**

**Credits : 4**

**External Examination : 80 marks**

**Objectives: To familiarize the student with emerging policies of biotechnology that deals with diagnosis, treatment and prevention of infectious diseases.**

**UNIT I:**

History of microbiology: Robert Koch and the golden age of bacteriology. Germ theory, Koch postulates. Advances in medical microbiology; Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels. General epidemiology: terminology, transmission, sources of infection. Principles of sterilization and Disinfection: Physical methods (Heat,Radiation and Filtration) and Chemical methods.

**UNIT II :**

Microscopy: types and usage in medical microbiology; different staining techniques; Different types of media for isolation of microorganisms: Minimal media, enriched media, defined media, complex media, selective media, differential media etc.; Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *Clostridium tetani*, *C botulinum*, *Clostridium diphtheria* *Mycobacterium tuberculosis*.

**UNIT III :**

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and prophylaxis of the diseases caused by gram negative bacteria: *Salmonella typhi*, *Yersinia pestis*, *Haemophilus influenzae*, *V. cholerae*, *Mycobacterium pneumonia*.

**UNIT IV:**

Virus: History and classification, Culturing of bacteriophages and virus, Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and prophylaxis of the diseases caused by viruses- *Rhabdoviruses*, *Pox virus*, *Herpes virus*, *Retro viruses (including HIV/AIDS)*.

## **UNIT V:**

Fungal and protozoan infections; Dermatophytoses (Trichophyton, Subcutaneous infection Cryptococcus), systemic infection (Histoplasma) and opportunistic fungal infections (Candidiasis, Aspergillosis), gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Malaria).

### **Books Readings**

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology, 4th edition. Elsevier.
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

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