

**B.Sc Life Sciences: Biotechnology(132 credits)** [ 1 –Chemistry, 2-Botany / Zoology & 3-Biotechnology ]

<b>Sem</b>	<b>Core subjects 12*6=72</b>	<b>AECC 2*4=8</b>	<b>SEC 4*4=16</b>	<b>DSE 6*6=36</b>
I	DSC-1A	English Communication		
	DSC-2A			
	DSC-3A General Microbiology			
II	DSC-1B	EVS		
	DSC-2B			
	DSC-3B Plant Biotechnology			
III	DSC-1C		SEC- A Analytical techniques in Biotechnology	
	DSC-2C			
	DSC-3C Immunology and Animal Biotechnology			
IV	DSC-1D		SEC- B Molecular Diagnostics	
	DSC-2D			
	DSC-3D Fundamentals of recombinant dna technology			
V			SEC- C Microbial Diagnosis in Health Clinics	DSE-1A DSE-2A DSE-3A Industrial Microbiology
VI			SEC-D Bioethics, Biosafety and IPR	DSE-1B DSE-2B DSE-3B Environmental Biotechnology



## **B.Sc Biotechnology (Pass Course)**

### **Semester-I**

#### **BTP 111: GENERAL MICROBIOLOGY**

**Credits 6:4 Th/T+2 Pr(Total hours- 60)**

##### **UNIT I (12 periods)**

Introduction to microbial world. Definition and history of Microbiology, contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming. Importance of Scope of Microbiology as a modern science Branches of Microbiology. Concepts of Microbial species and strains, Classification of bacteria based on Morphology (Shape and flagella), Staining reaction, nutrition and extreme environment

##### **UNIT II (12 periods)**

Ultra structure of a bacterial cell, LPS and its role in pathogenicity, endospore , capsule, flagella and pili. Bacterial Photosynthesis . Bacterial genome and plasmids. Plasmids: properties and types. Principles of genetical recombination in bacteria. Economic importance of bacteria.

Microbial Growth and Control : Physical parameters (Temperature, pH, Osmotic Pressure), Chemical parameters (Carbon, Nitrogen, Phosphorous, Sulphur, Trace elements, oxygen), Growth factors, Culture Media, Phases of Growth, Growth Measurements.

##### **UNIT III (12 periods)**

Fungi - General characters of fungi and its classification. Substrate relationship in fungi, cell ultrastructure, cell wall composition, haustoria, nutrition, reproduction , heterothallism, heterokaryosis and physiological specialization in fungi. Economic importance of Fungi.

Mushroom Production Technology - Pure culture and spawn production and their maintenance. Preparation and Pasteurization of different substrates. Filling the beds / containers for growing Mushroom. Sterilization/ disinfections of substrates. Mushroom house equipments. Post harvest handling of Mushroom. Chemical composition and nutraceutical applications of mushroom.

##### **UNIT IV (12 periods)**

Virus: General characters and structural organization, LHT system of classification, multiplication (Lytic and lysogenic life cycle) and transmission. General account of Virioids , Prions ,Rickettsias and L-forms. Mycoplasma, Spiroplasma and Phytoplasma: General characters, reproduction, transmission and pathogenesis. Important diseases caused by viruses, mycoplasma, spiroplasma and phytoplasma.

**UNIT V (12 periods)**

Methods in Microbiology: Pure culture techniques; different methods of sterilization (Physical, chemical and radiation methods); principles of microbial nutrition; Preparation of culture media. Biochemical characterization of pure culture. Stains and staining techniques in microbiology. Test for viability and toxicity.

**PRACTICALS**

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.
6. Morphological study of Mushrooms
7. Study of parasitic and saprophytic fungal species.
8. Study of Mycoplasmal disease

**SUGGESTED READING**

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). *Introductory Mycology*. 4 th edition, John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7th edition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). *Introductory Phycology*. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12<sup>th</sup> edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology*. 5th edition. McGraw Hill Book Company.

## **B.Sc Biotechnology (Pass Course)**

### **Semester-II**

#### **BTP 121: Plant Biotechnology**

**Credits 6 :4 Th/T+2 Pr(Total hours- 60)**

##### **UNIT I** (12 periods)

Fundamentals of plant tissue architecture- Meristematic tissue, permanent tissues, simple and complex tissue. Concept of cell totipotency, pluripotency, polarity and *in vitro* differentiation, dedifferentiation and redifferentiation.

##### **UNIT II** (12 periods)

Basic tools and techniques of plant tissue culture, Concept of asepsis and methods of sterilization (physical and chemical methods). Nutrient media, their composition and methods of preparation. Role of plant growth regulators, vitamins and other adjuvants in tissue culture.

##### **UNIT III** (12 periods)

Explant types, initiation of cultures, maintenance of cultures, callus and liquid culture and single cell culture. Somaclonal and gametoclonal variation. Meristem tip culture for elimination of viruses in plants.

Somatic embryogenesis – induction of embryogeny *in vitro*, indirect and direct somatic embryogenesis, stages of embryogenesis, factors influencing embryogenesis. Artificial seeds

##### **UNIT IV** (12 periods)

Anther and pollen culture – production of haploids. *In vitro* fertilization, embryo, endosperm, ovary and ovule culture. Embryo rescue. Protoplast isolation, purification, culture and regeneration. Steps of micropropagation-management of donor plants, culture establishment, shoot multiplication, rooting and hardening and acclimatization.

##### **UNIT V** (12 periods)

Cell culture and *in vitro* production of secondary metabolites. Important alkaloids and factors affecting their production. Hairy root culture, elicitation and biotransformation, Bioreactors – their types, construction and use in secondary metabolite production.

**PRACTICALS:**

1. Methods of sterilization - chemical and physical (Demonstration Experiment)
2. Preparation of different nutritive media for PTC - (Demonstration Experiment)
3. Determination of pH of the media (Individual Experiment)
4. Callus culture - (Demonstration Experiment)
5. Protocol for Pollen culture - (Demonstration Experiment)

**SUGGESTED READINGS**

1. Brown C. W and Thorpe T. A 1984 Cell culture and Somatic Cell Genetics of plants, Academic Press Orlando
2. Chu, C 1978 Plant Tissue Culture, Peking Science Press, Peking
3. Gamborg O. L and Phillips. G.G. 1975 Plant Cell, Tissue culture and Organ culture Fundamental Methods. Narosa Publishing House, New Delhi
4. Narayanaswamy, S 1994. Plant Cell and Tissue, Tata –Mc Graw Hill Publishing Co., Ltd., New Delhi.
5. Reinert J and Bajaj Y. B. S 1977 (Ed) Applied and Fundamental Aspects of Plant cell, Tissue and Organ culture , Springer Verlag, Berlin Ronald Press, New York.

**B.Sc Biotechnology (Pass Course)**  
**Semester-III**  
**BTP 211: IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY**  
**Credits 6:4 Th/T+2 Pr(Total hours- 60)**

**UNIT I** (12 periods)

History and scope of Immunology. Types of Immunity Passive, Active and Acquired immunity, Humoral, Cell Mediated Immunity / Cell and organs of immune responses and their functions . Antigens Types, hastens, epitomes and Factors influencing antigenicity.

**UNIT II** (12 periods)

Antibodies Structure, types, properties and functions of immunoglobulin, Production of antibodies. Antigen-Antibody reaction Investor tests-Precipitation, Immunoelectro -phoresis, Hemagglutination Labeled antibody (RIA, ELISA and Immuno-fluro scent techniques) . Hypersensitivity and Allergic reactions . Blood cell components, ABO blood grouping Rh typing .

**UNIT III** (12 periods)

Scope of Animal Tissue Culture. Culture media simulating natural conditions for growth of animal cells: 1. Natural media-Plasma Clot, biological fluids tissue extract, embryo extract, Importance of Serum in media. 2. Chemical defined media. Primary Culture:- Cell lines, and cloning desegregation of tissue, isolation of tissue, enzyme desegregation, and mechanical desegregation and Secondary Culture:- Transformed animal cells and continuous cell lines.

**UNIT IV** (12 periods)

Transfection of animal cell lines, HAT selection Selectable Markers and Transplantations of Cultural Cells. Expression of cloned proteins in animal cell-Expression vector, over production and down stream processing of the expressed proteins. Production and applications of monoclonal antibodies

**UNIT V** (12 periods)

Stem cell cultures, embryonic stem cells and their applications, cell culture based vaccines. Transgenic animals and production of useful products in transgenic animals. *In vitro* fertilization, embryo transfer, cloning: methodology and its applications, ethics in cloning.

**Practical:**

1. Blood grouping
2. Differential Count of WBC
3. Widal Test and VDRL Test
4. Dot Elisa

5. ELISA-Demonstration
6. Ouchterlony Double diffusion (ODL0 1 )
7. Rocket Electrophoresis
8. Separation of Serum from blood & precipitation of immunoglobulin.
9. Sterilization techniques: Glass ware sterilization, Media sterilization, Laboratory sterilization
10. Sources of contamination and decontamination measures.
11. Preparation of Hanks Balanced salt solution
12. Preparation of Minimal Essential Growth medium

### **Suggested Readings**

1. Masters, J. Animal Cell Culture. Panima.
2. Freshney, I. Culture of Animal Cell. John Wiley.
3. Martin, C. (Ed). Animal Cell Culture Techniques. Springer.
4. Mather and Barnes. (Ed). Methods in Cell Biology. Vol. 5-7, Animal Cell Culture Method. Academic Press.
5. Paul, J. Animal Tissue Culture.
6. Butler, M. and Dawson, M. Lab Fax : Cell Culture. Bios Scientific Publications.
7. Jenkins, N. Animal Cell Biotechnology. Panima Books Distributors.



**B.Sc Biotechnology (Pass Course)**  
**Semester-III**  
**BTP 212: ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY**  
**Credits 4 :2 Th/T+2 Pr(Total hours- 30)**

**UNIT I** (6 periods)

Microscopy- Light Microscope, Dark-field, Phase contrast, Fluorescence, Confocal and Polarization microscopy; Electron microscopy: TEM & SEM.

**UNIT II** (6 periods)

Principles and applications of gel filtration- ion exchange chromatography-thin layer chromatography-affinity chromatography- gas chromatography, high performance liquid chromatography (HPLC).

**UNIT III** (6 periods)

Basic principles of Centrifugation and Filtration and their application. Types of centrifuge. Analytical centrifugation. Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

**UNIT IV** (6 periods)

Electrophoresis : Theory and application of Polyacrylamide gel electrophoresis and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis, SDS PAGE.

**UNIT V** (6 periods)

Spectrophotometer: UV, Visible and Raman Spectroscopy; Theory and application of Circular Dichroism; Fluorescence; NMR, PMR, ESR and Plasma Emission spectroscopy; Mass spectrometry.

**Practicals**

1. Study of fluorescent micrographs to visualize bacterial cells.
2. Ray diagrams of phase contrast microscopy and Electron microscopy.
3. Separation of mixtures by paper / thin layer chromatography.
4. Demonstration of column packing in any form of column chromatography.
5. Separation of protein mixtures by any form of chromatography.
6. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
7. Determination of  $\lambda_{\text{max}}$  for an unknown sample and calculation of extinction coefficient.
8. Separation of components of a given mixture using a laboratory scale centrifuge.
9. Understanding density gradient centrifugation with the help of pictures.

**Suggested Reading :**

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry, 4<sup>th</sup> edition Pub WH Freeman Co.
2. Jack kite. (1995). Mechanisms in protein chemistry, Garland publishers.
3. Upadhyay and Nath (2003). Biophysical chemistry, principles and techniques, Himalaya publishing house.

## **B.Sc Biotechnology (Pass Course)**

### **Semester-IV**

#### **BTP 221: FUNDAMENTALS OF RECOMBINANT DNA TECHNOLOGY**

**Credits 6:4 Th/T+2 Pr(Total hours- 60)**

##### **UNIT I (12 periods)**

History and scope of Immunology. Types of Immunity Passive, Active and Acquired immunity, Humoral, Cell Mediated Immunity / Cell and organs of immune responses and their functions . Antigens Types, hastens, epitomes and Factors influencing antigenicity.

##### **UNIT II (12 periods)**

Antibodies Structure, types, properties and functions of immunoglobulin, Production of antibodies. Antigen-Antibody reaction Investor tests-Precipitation, Immunoelectro -phoresis, Hemagglutination Labeled antibody (RIA, ELISA and Immuno-fluro scent techniques) . Hypersensitivity and Allergic reactions . Blood cell components, ABO blood grouping Rh typing .

##### **UNIT III (12 periods)**

Scope of Animal Tissue Culture. Culture media simulating natural conditions for growth of animal cells: 1. Natural media-Plasma Clot, biological fluids tissue extract, embryo extract, Importance of Serum in media. 2. Chemical defined media. Primary Culture:- Cell lines, and cloning desegregation of tissue, isolation of tissue, enzyme desegregation, and mechanical desegregation and Secondary Culture:- Transformed animal cells and continuous cell lines.

##### **UNIT IV (12 periods)**

Transfection of animal cell lines, HAT selection Selectable Markers and Transplantations of Cultural Cells. Expression of cloned proteins in animal cell-Expression vector, over production and down stream processing of the expressed proteins. Production and applications of monoclonal antibodies

##### **UNIT V (12 periods)**

Stem cell cultures, embryonic stem cells and their applications, cell culture based vaccines. Transgenic animals and production of useful products in transgenic animals. *In vitro* fertilization, embryo transfer, cloning: methodology and its applications, ethics in cloning.

**PRACTICALS:**

1. Blood grouping
2. Differential Count of WBC
3. Widal Test and VDRL Test
4. Dot Elisa
5. ELISA-Demonstration
6. Ouchterlony Double diffusion (ODL0 1 )
7. Rocket Electrophoresis
8. Separation of Serum from blood & precipitation of immunoglobulin.
9. Sterilization techniques: Glass ware sterilization, Media sterilization, Laboratory sterilization
10. Sources of contamination and decontamination measures.
11. Preparation of Hanks Balanced salt solution
12. Preparation of Minimal Essential Growth medium

**Suggested Readings**

1. Masters, J. Animal Cell Culture. Panima.
2. Freshney, I. Culture of Animal Cell. John Wiley.
3. Martin, C. (Ed). Animal Cell Culture Techniques. Springer.
4. Mather and Barnes. (Ed). Methods in Cell Biology. Vol. 5-7, Animal Cell Culture Method. Academic Press.
5. Paul, J. Animal Tissue Culture.
6. Butler, M. and Dawson, M. Lab Fax : Cell Culture. Bios Scientific Publications.
7. Jenkins, N. Animal Cell Biotechnology. Panima Books Distributors.

**B.Sc Biotechnology (Pass Course)**  
**Semester-III**  
**BTP 222: MOLECULAR DIAGNOSTICS**  
**Credits 4 :2 Th/T+2 Pr(Total hours- 30)**

**UNIT I (06 Periods)**

Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting.

**UNIT II (06 Periods)**

Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology. Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

**UNIT III (06 Periods)**

Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

**UNIT IV (06 Periods)**

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

**UNIT V (06 Periods)**

GLC, HPLC, Electron microscopy, flowcytometry and cell sorting. Transgenic animals.

**PRACTICALS**

*(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)*

1. Perform/demonstrate RFLP and its analysis
2. Kirby-Bauer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture
3. A kit-based detection of a microbial infection (Widal test)
4. Study of Electron micrographs (any four).
5. Perform any one immuno diagnostic test (Typhoid, Malaria, and Dengue)

**SUGGESTED READING**

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker.
2. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
3. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's
4. Medical Microbiology. 24th edition. McGraw Hill Publication.
5. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
6. Microscopic Techniques in Biotechnology, Michael Hoppert

**B.Sc Biotechnology (Pass Course)**  
**Semester-V**  
**BTP 311: INDUSTRIAL MICROBIOLOGY**  
**Credits 6 :4 Th/T+2 Pr(Total hours- 60)**

**UNIT I** (12 periods)

Introduction to industrial microbiology -Brief history and developments in industrial microbiology. Isolation of industrially important microbial strains and fermentation media- Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, cornsteep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates

**UNIT II** (12 periods)

Types of fermentation processes, bio-reactors and measurement of fermentation-Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations. Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot-scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration

**UNIT III** (12 periods)

Down-stream processing-Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying.

Enzyme immobilization -Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase)

**UNIT IV** (12 periods)

Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses) -Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12 Enzymes (amylase, protease, lipase) Wine, beer

**UNIT V** (12 periods)

Fermented foods-Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

**PRACTICALS**

1. Study different parts of fermenter
2. Microbial fermentations for the production and estimation (qualitative and quantitative) of:
  - (a) Enzymes: Amylase and Protease
  - (b) Amino acid: Glutamic acid
  - (c) Organic acid: Citric acid
  - (d) Alcohol: Ethanol
3. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.
4. Preparation of Yogurt/Dahi.

**SUGGESTED READINGS**

1. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
2. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1st edition. Bios Scientific Publishers Limited. USA
3. Waites M.J., Morgan N.L., Rockey J.S. and Highton G. (2001). Industrial Microbiology: An Introduction. 1st edition. Wiley – Blackwell
4. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company
5. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2<sup>nd</sup> edition. Panima Publishing Co. New Delhi.
7. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.



**B.Sc Biotechnology (Pass Course)**  
**Semester-V**  
**BTP 312: MICROBIAL DIAGNOSIS IN HEALTH CLINICS**  
**Credits 4:2 Th/T+2 Pr(Total hours- 30)**

**Unit 1**(6 periods)

Importance of Diagnosis of Diseases -Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

**Unit II** (6 periods)

Methods of collection of Clinical Samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport to laboratory and storage.

**Unit III** (6 periods)

Direct Microscopic Examination and Culture-Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria. Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, Mac Conkey agar, Distinct colony properties of various bacterial pathogens.

**Unit IV** (6 periods)

Serological and Molecular Methods - Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes. Kits for Rapid Detection of Pathogens

**Unit V** (6 periods)

Testing for Antibiotic Sensitivity in Bacteria -Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method.

**PRACTICALS**

1. Collection of blood samples and separation of plasma.
2. Microscopic study of permanent thin film mount of tuberculosis and malaria.
3. Gram staining.
4. Demonstration of Elisa test.
5. Determination of minimum inhibitory concentration.
6. Clinical analysis of urine and blood.

**SUGGESTED READING**

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26<sup>th</sup> edition. McGraw Hill Publication
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2<sup>nd</sup> edition, Elsevier India Pvt Ltd
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby
5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14th edition, Elsevier.

**B.Sc Biotechnology (Pass Course)**  
**Semester-VI**  
**BTP 321: ENVIRONMENTAL BIOTECHNOLOGY**  
**Credits 6:4 Th/T+2 Pr (Total hours- 60)**

**UNIT I (12 Periods)**

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact on environment. Methanogenic bacteria and their ecophysiology.

**UNIT II (12 Periods)**

Bioremediation of soil & water contaminated with oil spills, heavy metals , detergents and dyes. Degradation of lignin and cellulose using microbes. Superbug

**UNIT III (12 Periods)**

Phyto-remediation- Degradation of pesticides, aromatic and chlorinated hydrocarbons, petroleum products and other toxic chemicals by micro-organisms

**UNIT IV (12 Periods)**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers: Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

**UNIT V (12 Periods)**

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).Use of microbes for the treatment of hazardous clinical disposal.

**PRACTICALS**

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. Bacterial Examination of Water by MPN Method.

**SUGGESTED READING**

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jeseff Winter
4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
5. Agricultural Biotechnology, S.S. Purohit
6. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
7. Introduction to Environmental Biotechnology, Milton Wainwright
8. Principles of Environmental Engineering, Gilbert Masters
9. Wastewater Engineering – Metcalf & Eddy\*

**B.Sc Biotechnology (Pass Course)**  
**Semester-VI**  
**BTP 322: BIOETHICS, BIOSAFETY AND IPR**  
**Credits 4 :2 Th/T+2 Pr(Total hours- 30)**

**UNIT-I (12 Periods)**

Foundation of Bioethics-Definition, historic evolution, codes and guidelines, universal principles Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International.

Ethical issues against the molecular technologies. Codes, Covenants, Declarations and Guidelines

**UNIT-II (12 Periods)**

Biosafety guidelines- Government of India definition of genetic modified organism (GMOs) and living modified organisms (LMOs), roles of institutional biosafety committee, review committee on genetic manipulation (RCGM), genetic engineering approval committee (GEAC) for GMO applications in food and agriculture, environmental release of GMOs. Biosafety assessment of pharmaceutical products such as drugs/vaccines etc. AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions.

**UNIT-III (12 Periods)**

Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables, patenting life – legal protection of biotechnological inventions. World Intellectual Property Rights Organization (WIPO).

**UNIT-IV (12 Periods)**

Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.

**UNIT-V (12 Periods)**

Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent amendments.

**PRACTICALS**

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste

**SUGGESTED READING**

1. Entrepreneurship: New Venture Creation : David H. Holt
2. Patterns of Entrepreneurship : Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers