

Credits	5	Hours/Week	6	Sub Code	S1BT1	Semester	I
Medium of Instruction : English						Core Course : 1	

GENERAL MICROBIOLOGY

Objectives:

1. To offer a sense of the history of microbial science, its methodology and its many contributions to humanity
2. To impart the knowledge on microbiology and microbial diseases.

Unit I: History of Microbiology, classification, and nomenclature of microorganisms. Microscopy: Light and Electron microscopy. Microscopic examination of microorganisms-morphology and fine structure of bacteria.

Unit II: Sterilization Methods - Principles and applications - Physical and chemical methods. Staining techniques - Principle and types; Negative and Differential Staining.

Unit III: Culture medium, growth cycle, impact of environmental factors on growth of microbes, nutritional classification of microbes, Energy production; oxidation and reduction reactions, aerobic and anaerobic processes.

Unit IV: Sources of microbial infection: Portals of entry and exit of pathogenic microbes. Bacterial diseases of man- tetanus, tuberculosis, pneumonia and cholera. Viral Disease- AIDS (HIV).

Unit V: Applications of microbes in medicine- antibiotics; penicillin and streptomycin. In Agriculture - Biofertilizer –bacteria and cyanobacteria. In food and dairy industries. Microbial bio-products (SCP, Bio-pigments, yeast –products and enzymes)

Text Books:

1. Michael J. Pelczar, Chan, E.C.S and Noel R. Kreig, (2011). Microbiology, 7th edition, McGraw Hill.
2. Joanne Wille, Linda Sherwood and Christopher Woolverton, (2011). Prescott Microbiology, 11th edition, Mc Graw Hill.

Reference Books:

1. Jawetz, Melnick and Adelbergs Geo F. Brooks, (2012). Medical Microbiology, 26th edition, Lange Med.
2. Roger Stainer, (1986). General Microbiology, 5th edition, Prentice Hall.
3. Hans Zinnser, Wolfgang K. Joklik, (2010). Zinsser's Microbiology, 11th edition, McGraw-Hill Professional.
4. Michael T. Madigan, John M. Martinko, Paul V. Dunlap, David. P clark, (2009) Brock Biology of microorganisms, 12th edition, Prentice Hall.

Question Paper Pattern

(Time: 3 Hours)

(Marks: 75)

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|--|--------------------|
| Part - A: Two Questions from each Unit (No choice) | (10x 2 = 20 Marks) |
| Part - B: Either or Questions (One pair from each Unit) | (5 x 5 = 25 Marks) |
| Part - C: Three out of Five Questions (One from each Unit) | (3x10 = 30 Marks) |

Credits	4	Hours/Week	3	Sub Code	S1BTP1	Semester	I
Medium of Instruction : English						Core Course : 2	

MAJOR PRACTICAL – I

GENERAL MICROBIOLOGY

1. Laboratory rules and regulations of Microbiology.
2. Staining Techniques - simple, Gram's, spore and capsule.
3. Fungal staining - Wet Mount technique
4. Microscope and its functions.
5. Media preparation and sterilization (Bacteria and Fungi).
6. Enumeration of microorganism from soil, water and air - serial dilution technique.
7. Pure culture technique - Pour plate, Spread plate and Streak plate methods.
8. Biochemical characterization of selected bacteria.

Credits	5	Hours/Week	6	Sub Code	S2BT2	Semester	II
Medium of Instruction : English						Core Course : 3	

CELL BIOLOGY AND GENETICS

Objectives:

1. To understand the concept of cell, their organelles and functions.
2. To know the basics of genetics and mutation.

Unit I: Cell as a basic Unit. Cell theory. Classification of cell types, specialized cells such as motile, nerve and muscle cells. Ultrastructure of prokaryotic and eukaryotic cells. Comparison of microbial, plant and animal cell.

Unit II: Cellular organization - plasma membrane, cell wall, their structural organization, transport of nutrients, ions and macromolecules across the membranes. Cellular energy transactions - Role of mitochondria and chloroplast. Cellular organelles (Cytosol, nucleus, endoplasmic reticulum, golgi bodies, cytoskeleton, ribosomes, vacuoles, peroxisomes and lysosome).

Unit III: Cell division (Eukaryotic and Prokaryotic) - Cell cycle, Mitosis and Meiosis. Specialized chromosomes – Salivary gland and Lampbrush chromosomes.

Unit IV: Mendelism – Mendels work, laws of heredity, Test cross, incomplete dominance. Genome organization – Solenoid model. DNA replication - chromosomal theory of inheritance.

Unit V: Mutation – Types. Spontaneous and induced. Mutagens - Physical and chemical. Transposable elements in prokaryotes and eukaryotes.

Text Books:

1. E. D. P. De Robertis and E. M. F. De Robertis, Jr, (2006) Cell Biology and Molecular Biology, 8th edition. Lippincott Williams and Wilkins.
2. Verma and Agarwal, 1991, Cytology, S. Chand and company.

Reference Books:

1. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Kreiger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, Kelsey C. Martin, (2018). Molecular cell biology, 8th edition. W. H. Freeman publishers
2. E. J. Gardener, M. J. Simmons and D. P. Snustad, (2006) Principles of Genetics, 8th edition, John Wiley & Sons Publications.
3. S.C. Rastogi, (2006) Cell and Molecular Biology, 3rd edition, New Age International Publishers, New Delhi.

Question Paper Pattern

(Time: 3 Hours)

(Marks: 75)

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| Part - A: Two Questions from each Unit (No choice) | (10x 2 = 20 Marks) |
| Part - B: Either or Questions (One pair from each Unit) | (5 x 5 = 25 Marks) |
| Part - C: Three out of Five Questions (One from each Unit) | (3x10 = 30 Marks) |

Credits	4	Hours/Week	3	Sub Code	S2BTP2	Semester	II
Medium of Instruction : English						Core Course : 4	

MAJOR PRACTICAL – II

CELL BIOLOGY AND GENETICS

1. Measurement of cells - Micrometry
2. Structure observation – Prokaryotic & Eukaryotic cell
3. Motility determination - Hanging drop method
4. Identification of Polytene chromosome in Chironomous larvae.
5. Identification of Barr body in buccal cells.
6. Identification of various stages of mitosis in Onion root tip.
7. Identification of various stages of meiosis in Grasshopper testis.

Credits	5	Hours/Week	6	Sub Code	S3BT3	Semester	III
Medium of Instruction : English						Core Course : 5	

MOLECULAR BIOLOGY

Objectives:

1. To learn about the nucleic acid structures and functions.
2. To understand the DNA repair mechanisms, promoter functions and its importance.
3. To study gene expression in prokaryotes and eukaryotes and gene organization.

Unit I: Nucleic Acids Structure and functions (DNA and RNA). Watson and Crick model of DNA and other forms of DNA (A and Z). Functions of DNA and RNA. DNA Replication in Prokaryotic and Eukaryotic.

Unit II: DNA Repair mechanisms; photo-reactivation, excision repair, mismatch repair, SOS repair. Recombination in prokaryotes Transformation, Conjugation and Transduction.

Unit III: Transcription in Prokaryotes and Eukaryotes. Mechanism of Promoters and RNA polymerase and transcription factors.

Unit IV: Translation. Mechanism of translation in Prokaryotes and Eukaryotes. Post translational modifications of proteins. Regulation of Gene expression in Prokaryotes - Operon concept (Lac and Tryp) and in Eukaryotes (galactose metabolism in yeast).

Unit V: Gene organization and expression in Mitochondria and Chloroplasts. Transposable elements in maize and *Drosophila*.

Text Book:

1. David Freifelder, (1986). Molecular biology, 2nd edition, Jones and Bartlett learning.

Reference Books:

1. Benjamin Lewin, (2007). Gene IX, 9th edition, Jones and Bartlett publishers.
2. Rigby, P.W.J. (1987). Genetic Engineering, Academic Press Inc. Florida, USA.
3. T.A. Brown, (2011). Introduction to Genetics -A Molecular approach, 3rd edition, Garland Science.

Question Paper Pattern

(Time: 3 Hours)

(Marks: 75)

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|--|--------------------|
| Part - A: Two Questions from each Unit (No choice) | (10x 2 = 20 Marks) |
| Part - B: Either or Questions (One pair from each Unit) | (5 x 5 = 25 Marks) |
| Part - C: Three out of Five Questions (One from each Unit) | (3x10 = 30 Marks) |

Credits	4	Hours/Week	3	Sub Code	S3BTP3	Semester	III
Medium of Instruction : English						Core Course : 6	

MAJOR PRACTICAL – III

MOLECULAR BIOLOGY

1. Isolation of DNA from bacteria, plant and animal tissue
2. Separation of DNA by Agarose gel electrophoresis.
3. Bacterial Conjugation - Demonstration
4. Estimation of DNA by DPA method.
5. Estimation of RNA by Orcinol method.
6. Extraction and estimation of protein from plant and animal tissues.
7. Separation of protein by SDS- PAGE

Credits	2	Hours/Week	2	Sub Code	S3SB1D	Semester	III
Medium of Instruction : English						Skill Based : 1	

AQUACULTURE

Objectives:

1. To learn the history and scope of aquaculture.
2. To understand the different culture and breeding techniques used in aquaculture.

Unit I: Introduction and scope of aquaculture, aquaculture practices in India- Cultivable organisms Feed in intensive aquaculture – feed development, feed ingredients. Feed types and uses - wet feeds wet and moist formulated feeds, dry feeds and commercial feed types. Feed handling and storage.

Unit II: Preparation of fish pond- selection of site- construction of fish farm- liming irrigation-fertilization- water quality management-

Unit III: Types of culture- Monoculture, composite fish culture, monosex culture, Pen culture, cage culture. Culture of carp, milk fish and sea bass. Culture of fresh water prawn *Macrobrachium* spp, lobsters and crabs.

Unit IV: Production and economics of aquaculture in extensive and semi-intensive systems. Natural seed resources- seed production –seed grounds –methods of collection of seed for culture practices – quarantining – acclimatization of seeds.

Unit V: Collection and transportation of brood stock. Breeding under controlled conditions, brood stock management. Integrated fish farming – Paddy cum fish culture- fish cum poultry farming- fish cum dairy farming – fish cum pig farming

Text Book:

1. Reddy S. M. (2004). A text Book of Aquaculture, Discovery Publishing Pvt. Ltd.

Reference Books:

1. Pillay. T. V. R., 1972. Coastal Aquaculture in the indo-pacific Region, Fishing News Book Ltd., London.
2. Pillay, T.V.R., 1990. Aquaculture principles and practices. Fishing News (Book) Ltd., London
3. Shigueno, K., 1976. Shrimp culture in Japan. Association for international technical promotion, Tokyo.
4. Bardach, J.E., J.H.Ryther and W.O.McLarney, 1972. Aquaculture: Farming and Husbandry of Freshwater and Marine Organisms. Wiley interscience, New York.

Question Paper Pattern

(Time: 3 Hours)

(Marks: 75)

- Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3x10 = 30 Marks)

Credits	5	Hours/Week	6	Sub Code	S4BT4	Semester	IV
Medium of Instruction : English						Core Course : 7	

INDUSTRIAL BIOTECHNOLOGY

Objectives:

1. To understand the utility of microbes in industries for the production commercially important products.
2. To learn about strain improvement, metabolic products and media formulations.
3. To study about different types of fermentation process and sterilization process.

Unit I: Isolation, screening and maintenance of industrially important microbes. Strain improvement for increased yield and other desirable characteristics. Microbial metabolic products – Primary and secondary metabolites.

Unit II: Media preparation for fermentation. Sterilization methods – Batch and continuous sterilization. Sterilization of air. Basic modes of fermentation (Batch, fed batch and continuous fermentation). Microbial growth kinetics.

Unit III: Basic design, parts of a typical fermentor/bioreactor. Types of fermentor -Air - lift, stirred tank, tower, fluidized bed, packed bed, pulsed and photo bioreactors. Different stages of fermentation process.

Unit IV: Measurement and control of bioprocess parameters - temperature, pressure, agitation and aeration, agitation, pH, computers in biocontrol. Downstream processing.

Unit V: Production of primary and secondary metabolites - Alcohol (Ethanol), Acids (Citric) Antibiotics (Penicillin), Amino acids (Lysine), Single Cell Protein (Algae / Fungi) and their applications. Biofertilizers. Mushroom cultivation.

Text Books:

1. Patel, A.H, (2007). Industrial Microbiology, Macmillan India Limited, New Delhi.
2. U. Satyanarayana, 2005, Biotechnology, Books and allied (P) Ltd, Kolkata

Reference Books:

1. Stanbury, P.F., Whitaker, A., and Stephen H., (Eds), (1995). Principles of Fermentation Technology, 2nd edition, Pergamon Press, Oxford.
2. Frazier, W.C. and Dennis C. Westhoff, (1995). Food Microbiology, Tata McGraw Hill Publishing Company, New Delhi.
3. Casida, L.E, (2003). Industrial Microbiology, New Age International (P) Ltd., New Delhi.
4. Michael Shuler and Fikret Kargi, (2002). Bioprocess Engineering: Basic Concepts, 2nd edition, Prentice Hall, Englewood Cliffs, NJ.

Question Paper Pattern

(Time: 3 Hours)

(Marks: 75)

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| Part - A: Two Questions from each Unit (No choice) | (10x 2 = 20 Marks) |
| Part - B: Either or Questions (One pair from each Unit) | (5 x 5 = 25 Marks) |
| Part - C: Three out of Five Questions (One from each Unit) | (3x10 = 30 Marks) |

Credits	4	Hours/Week	3	Sub Code	S4BTP4	Semester	IV
Medium of Instruction : English						Core Course : 8	

MAJOR PRACTICAL – IV

INDUSTRIAL BIOTECHNOLOGY

1. Isolation of industrially important organisms for the production of amylase enzyme - *E. coli* on EMB Agar.
2. Amylase production test – Demonstration of starch hydrolysis
3. Cellulose production test – Degradation of cellulose.
4. Production of alcohol from grape juice.
5. Determination of quality of raw milk by methylene blue reductase test.
6. Determination of population growth by turbidometry (Spectrophotometric method)
7. Immobilization of Yeast cells.
8. Cultivation of paddy straw mushroom.
9. Process Control of Fermentor – Demonstration. (pH, Temp, Foam and Dissolved O₂).

Credits	2	Hours/Week	2	Sub Code	S4SB2B	Semester	IV
Medium of Instruction : English						Skill Based : 2	

BIOFERTILIZER

Objectives:

1. To learn the basics of biofertilizers and the valuable organisms involved.
2. To study the role of bacteria, Mycorrhiza in enriching the soil as biofertilizers.

Unit-I: Biofertilizers - Introduction, scope. A general account of Biofertilizers organisms - Cyanobacteria (BGA), Bacteria and Mycorrhizae – Cyanobacteria (BGA) as biofertilizers - *Anabaena*, *Cylindrospermum*, *Gloeocapsa*, *Lyngbya*, *Nostoc*, *Plectonema* and *Tolypothrix*. Algalization, *Azolla* - *Anabaena* as biofertilizers.

Unit II: Isolation of cyanobacteria. Formation of Fogg's medium – Mass cultivation of *Azolla* - Cyanobacterial biofertilizers - Symbiotic association of Cyanobacteria - Field application of Cyanobacterial inoculants.

Unit-III: Isolation - *Azotobacter* - Ashby's mannitol agar. *Azospirillum* - Semisolid medium (Bulow and Dobreiner, 1975). *Rhizobium* - Yeast Extract Mannitol Agar medium - Culture characteristics. Mass production of *Azospirillum*, *Azotobacter* and *Phosphobacteria*.

Unit IV: Bacterial biofertilizers - Introduction, scope. Bacterial biofertilizers organisms - *Azospirillum*, *Azotobacter*, *Frankia*, *Phosphobacteria* and *Rhizobium*. Vermicompost.

Unit V: Mycorrhizal fungi as biofertilizers - Introduction, scope. A general account of Ecto, Endo and Arbuscular mycorrhizae (AM). Legume - AM interactions - National and Regional Biofertilizers Production and Development Centres.

Text Book:

1. Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi.

Reference Books:

1. Subba Rao, N. S. (2002). Soil Microbiology. 4th ed. Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Verma, A. (1999). Mycorrhiza. Springer Verlag, Berlin.
3. Wallanda, T. *et al.* (1997). Mycorrhizae. Backley's Publishers, The Netherlands.

Question Paper Pattern

(Time: 3 Hours)

(Marks: 75)

- Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3x10 = 30 Marks)

Credits	5	Hours/Week	6	Sub Code	S5BT5	Semester	V
Medium of Instruction : English						Core Course : 9	

rDNA TECHNOLOGY

Objectives:

1. To learn about the molecular tools for gene cloning, gene manipulation techniques.
2. To give an insight into vectors for cloning and construction of gene libraries.

Unit I: Molecular tools for gene cloning: Nucleases: exonucleases and endonucleases, restriction enzymes (Type I, II, III, IV & V). Polymerases: DNA pol I, Klenow fragments, reverse transcriptase, Taq & pfu polymerases. Ligases: *E. coli* DNA ligase, T4 RNA ligase. Topoisomerases: Type I (A, B) & Type II (A, B). End modifying enzymes: Terminal transferases, T4 polynucleotide kinase, alkaline phosphatases.

Unit II: Vectors: Introduction and properties - plasmids, bacteriophage, phagemids, cosmids, Ti plasmids, BAC, YAC, shuttle vectors and expression vectors, viral vectors.

Unit III: Transfer of DNA into Cells - transformation, CaCl₂ mediated, Ultra-sonication, Electroporation, Micro-injection, Macro-injection, Particle bombardment system and Liposome mediated gene transfer.

Unit IV: Cloning methods: Cloning in *E. coli*, Selection and screening of recombinants. DNA amplification- PCR. Blotting techniques - Southern, Western and Northern blot.

Unit V: Construction of genomic libraries and cDNA library, DNA sequencing methods - chemical degradation, chain termination. Application of rDNA Technology in animals - Production of Vaccine, Insulin, gene therapy.

Text Book :

1. Brown T.A. (2010). Gene Cloning and DNA Analysis: An Introduction, 6th Edition, Wiley Blackwell.

Reference Books :

1. Old, R.W and S.B. Primrose. (1996). Principles of Gene Manipulation: An Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.
2. Glover, DM. and B.D. Hames. (1995). DNA Cloning: A Practical Approach, IRL Press, Oxford, Innis,
3. Persing, D.H., K T.F Smith, F.C. Teower and T.J. While. (1993). Diagnostic Molecular Microbiology, ASM Press, Washington, D.C.

Question Paper Pattern

(Marks: 75)

(Time: 3 Hours)

- Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	4	Hours/Week	6	Sub Code	S5BTP5	Semester	V
Medium of Instruction : English						Core Course :10	

MAJOR PRACTICAL – V

rDNA TECHNOLOGY, ENZYMOLOGY & ENZYME TECHNOLOGY AND IMMUNOLOGY & IMMUNOTECHNOLOGY

I. rDNA TECHNOLOGY

1. Isolation of Genomic DNA—Bacteria, Plant and Animal.
2. Isolation of Plasmid DNA.
3. Agarose gel Electrophoresis
4. Isolation of RNA.
5. Restriction Digestion.
6. Transformation.
7. Southern blotting --- Demonstration.
8. PCR - Demonstration.

II. I. ENZYMOLOGY AND ENZYME TECHNOLOGY

1. Isolation, fractionation and purification of enzymes - ALP.
2. Effect of pH, temperature and enzyme substrate concentration on the activity of enzymes ALP.
3. Gel filtration chromatography.
4. Ion Exchange Chromatography.

III. IMMUNOLOGY AND IMMUNOTECHNOLOGY

1. Haem agglutination – ABO blood grouping – Slide Method.
2. Bacterial agglutination – WIDAL – Slide and tube method
3. Latex agglutination – ASO and pregnancy test – Slide method

Credits	4	Hours/Week	6	Sub Code	S5BTEL1A	Semester	V
Medium of Instruction : English					Major Elective Course :1		

ENZYMOLGY AND ENZYME TECHNOLOGY

Objectives:

1. To understand the basics of enzyme technology which includes structure, function and importance of enzymes and its wide industrial applications.
2. To obtain knowledge on enzyme kinetics and enzyme regulation

Unit I: Enzymes - history and general characteristics, definition and IUB enzyme classification. Properties of enzymes. Isozymes, abzymes, synzymes, holoenzyme, apoenzyme, coenzyme, cofactors, activators, inhibitors, active site, metallo enzymes.

Unit II: Enzyme kinetics - effect of pH, temperature, activator, enzyme and substrate concentration - Michaelis Menten plot and inhibitor kinetics (competitive, uncompetitive and non- competitive). Lineweaver Burk plot, Eadie-Hofstee plot and Hanes Woolf equation. Significance of Km and Vmax, Kcat, turnover number.

Unit III: Enzyme regulation - allosteric modification of enzymes, reversible covalent modification and proteolytic activation, enzymes in membranes, feedback inhibition and forward simulation. Irreversible inhibition- suicide inhibition.

Unit IV: Mode of enzyme action - lock and key hypothesis and induced fit hypothesis. Enzyme catalysis - acid base catalysis, bond catalysis, strain, proximity and orientation effects. Mechanism of action of lysozyme, chymotrypsin, enzyme substrate complex formation - bisubstrate (random and ping pong mechanism).

Unit V: Applications of enzyme technology- industrial enzymes- thermophilic enzymes, amylases, lipases, proteolytic enzymes. Clinical enzymes - thrombolytic agents, anti-inflammatory agents. immobilization of enzymes- advantages and disadvantages of immobilization techniques

Text Books:

1. Nooralabetu and Krishna Prasad, (2011). Enzyme technology. Eastern economy edition.
2. Palmer T. (2004). Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, West Press Edition.

Reference Books:

1. Geoffrey L. Zubey., William. W. Parson and Dennis E. Vance. (1995). Principles of Biochemistry, W.M.C. Brown Publisher.
2. Stanbury, P.F., A. Whitaker and S.J. Hall. (1997). Principles of Fermentation Technology, Aditya Books Pvt. Ltd., India.

Question Paper Pattern

(Marks: 75)

(Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)

Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)

Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	4	Hours/Week	6	Sub Code	S5BTEL1B	Semester	V
Medium of Instruction : English					Major Elective Course :1		

BIOINSTRUMENTATION

Objectives:

1. To study the basics of analytical, physical chemistry for understanding instrumentation.
2. To understand the principles and applications of various analytical tools and techniques used in the field of Biotechnology.

Unit I: pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator.

Unit II: Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy

Unit III: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch, Gel, AGE, PAGE.

Unit IV: Immunological Methods: Precipitation reaction based assays. Radial Immuno Diffusion, Immunoelectrophoresis, Counter Current.

Unit V: Complement Fixation Test, Radio Immuno Assay, ELISA, PCR, Immunoblotting and Hybridization, Autoradiography.

Text Books:

1. Keith Wilson, John Walker, (2000). Practical Biochemistry, Cambridge university press
2. Kuby, J. (1997). Immunology, 3rd Edition, W.H. Freeman and Co.

Reference Books:

1. S. K. Sawhney and Randhir Singh, (2009). Introductory Practical Biochemistry, Narosa Publishing House.
2. Gedder A and L. E. Balsar, (1991). Principles of Applied Biomedical Instrumentation, 3rd edition, John Wiley and Sons.
3. Boyer, Rodney F. Benjamin and Cummins, (2000). Modern Experimental Biochemistry, 3rd edition, Pearson publisher.

Question Paper Pattern

(Marks: 75)

(Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)

Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)

Part - C: Three out of Five Questions (One from each Unit) (3 x 10 = 30 Marks)

Credits	4	Hours/Week	6	Sub Code	S5BTEL1C	Semester	V
Medium of Instruction : English					Major Elective Course :1		

DEVELOPMENTAL BIOLOGY

Objectives:

1. To learn the reproductive cycles in mammals.
2. To study and gain insight in the developmental stages observed in plants and animals.

Unit I: Reproductive cycle in mammals, their hormonal control, gametogenesis – spermatogenesis and oogenesis. Fertilization, Artificial insemination, *in vitro* fertilization and Embryo Transfer.

Unit II: Types of eggs and patterns of cleavage, Blastulation, Gastrulation, Fate of germ layers, metamorphosis – retrogressive and progressive changes in insects and amphibians.

Unit III: Microsporogenesis, megasporogenesis, Pollen development, Gametophytic amphimixis; Polyploidy; methods and application; Seeds – types, germination, Organogenesis.

Unit IV: Plant embryogenesis – techniques to study embryology, Embryo sacs in Anther Leptomenia, Calotis; Hyacinthus, Unusual embryological features – Loranthaceae, Endospermal embryos; Gynospermic characters in angiosperms, Types of embryos.

Unit V: Genetic control of development – Early experiments, Pattern determination, Bithorax Complex, Genes Controlling – Flower development and development of *Drosophila*.

Text Book:

1. B.I Balansky, (1981). An introduction to Embryology, 5th edition, W.B Saunders and co, Philadelphia.

Reference Books:

1. Bhojwani S. S., Bhatnagar S. P and Dantu P. K, (2014).The embryology of Angiosperms, 6th edition. Vikas publishing House.
2. Werner A. Mueller, (2008). Developmental Biology, Springer.
3. Verlec and Jhori B.M., (1982). The embryology of Angiosperms, Springer
4. Maheswari. P, (1981). Introduction to the embryology of Angiosperms, McGraw Hill.

Question Paper Pattern

(Marks: 75)

(Time: 3 Hours)

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| Part - A: Two Questions from each Unit (No choice) | (10x 2 = 20 Marks) |
| Part - B: Either or Questions (One pair from each Unit) | (5 x 5 = 25 Marks) |
| Part - C: Three out of Five Questions (One from each Unit) | (3 x10 = 30 Marks) |

Credits	4	Hours/Week	6	Sub Code	S5BTEL2A	Semester	V
Medium of Instruction : English					Major Elective Course :2		

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Objectives :

1. To study the organs of the immune system, types of immunity, hypersensitivity.
2. To impart knowledge into Immunodiagnostic techniques.
3. To learn about the auto immunity and cancer.

Unit I: Introduction - History and scope of Immunology. Haematopoiesis. Organs of the immune system: bone marrow, thymus, spleen, lymph nodes, MALT, peyer's patches, tonsils.

Unit II: Types of immunity - innate, acquired immunity, cells involved in innate and acquired immunity. Structure and functions of cytokines. Antigen - types, immunoglobulins - types, distribution and functions. T & B Cells - receptors, activation and function.

Unit III: Cellular interactions in immune response, hypersensitivity reactions- Type I, II, III and IV. HLA Tissue typing, transplantation immunity, monoclonal antibody production.

Unit IV: Autoimmune disorders and immunology of infectious diseases including AIDS. Introduction to tumor immunology - Immune evasion - Immune suppression. Cancer genetics- oncogenes, tumour suppressor genes, cancer and cell cycle, metastasis

Unit V: Immunodiagnostics - precipitation, agglutination, Widal test, pregnancy test. Immunoblotting techniques - ELISA and FISH.

Text Books:

1. Kuby, J., (1997). Immunology, 3rd Edition, W.H. Freeman and Co.
2. Nandhini Shetty, (2017). Immunology - An introductory textbook, Rev 2nd edition, New age international publishers

Reference Books:

1. Male, D., Brostoff, J., Roth D, and Roitt, I (2006). Immunology, 7th edition, Elsevier.
2. Richard Coico and Geoffrey Sunshine, (2015). Immunology - A Short Course, 7th edition, Willey - Blackwell
3. Gabriel Virella. (1993). Introduction to Medical Immunology, Marcel Dekker Inc.
4. Donald M. Weir and John Steward, (1993). Immunology, 7th Edition. ELBS, London.

Question Paper Pattern

(Marks: 75)

(Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)

Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)

Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	4	Hours/Week	6	Sub Code	S5BTEL2B	Semester	V
Medium of Instruction : English					Major Elective Course :2		

MOLECULAR DIAGNOSTICS

Objectives:

1. To make a study on principles and applications of various techniques used for diagnosis of diseases.
2. To learn about the techniques in prenatal diagnosis.

Unit I: Blood examination – anticoagulant, hemoglobin, RBC, Packed cell volume, ESR, WBC total, differential normal and abnormal hematopathies – anemia, bone marrow smear, leukemia and myelodysplastic syndromes, diagnostic significance of PB smear, hemorrhagic disorder, L.E. cell phenomenon.

Unit II: Urine analysis – collection – physical, chemical and microscopic examination of urine – CSF Parasite analysis.

Unit III: Biochemical analysis of Blood, Blood banking, Transplantation, AIDS, ELISA, RIA, Computers in lab. Quality control.

Unit IV: Lab safety – Biosafety levels I, II, III,IV , FACS, PCR- types of PCR, quantitative and semi-quantitative PCR.

Unit V: Artificial blood, detecting chromosomal abnormalities using molecular techniques, amniocentesis, immunodiffusion techniques.

Text Book:

1. Talib, V.H, (2012). Handbook of medical lab technology, 2nd edition, CBS publication.

Reference Books:

1. William J. Marshall., Marta Lapsley, Andrew Day (2016). Clinical Chemistry, 8th edition, Elsevier.
2. Allen Gaw, Robert A.Cowan (1999). An Illustrated color text of Clinical Biochemistry, illustrated by Robert Britton, second edition, Churchill Living stone press.
3. Allan D. Marks., Colleen M. Smith, Dawn B. Marks, and Michael A. Lieberman, (2006). Marks' Basic Medical Biochemistry: A Clinical Approach, 2nd Edition), Lippincott Williams and Wilkins.

Question Paper Pattern

(Marks: 75)

(Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)

Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)

Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	4	Hours/Week	6	Sub Code	S5BTEL2C	Semester	V
Medium of Instruction : English					Major Elective Course :2		

NANOBIOTECHNOLOGY

Objectives:

1. To study the basics of nanobiotechnology and different types of nanomaterials.
2. To gain knowledge on the techniques used in analysis of nanomaterials.

Unit I: Biological Inspired Concepts: Biological Networks – Biological Neurons – The Function of Neuronal Cell – Biological neuronal cells on silicon – Modelling of Neuronal cells by VLSI circuits.

Unit II: Biological and Quantum Mechanical Computers: DNA Computer – Information Processing with Chemical reaction – Nanomachines – Parallel Processing – Quantum Computer.

Unit III: Nanobiometrics: Introduction – lipids as nano-bricks and mortar- Self assembled nanolayers - the bits that do things - proteins – DNA Computer

Unit IV: Natural nanocomposites: Introduction – natural nanocomposite materials – biologically synthesized nanostructures – protein based nanostructure formation – Nanotechnology in Agriculture.

Unit V: Nanoanalytics: Quantum dot Biolabelling – Nanoparticle Molecular labels – Analysis of Biomolecular Structure by AFM.

Text Book:

1. Baldav Raj, Budaraju srinivasa murty, James Murday and P. Shankar (2012). Textbook of Nanoscience and Nanotechnology, Springer.

Reference Books:

1. Goser, K., Glosekotter, P, and J. Dienstuhl, (2004). Nanoelectronics and Nanosystems: From transistors to molecular devices, Springer.
2. Mick Wilson, Kamali Kannagara, Geoff Smith and Michelle Simmons, Burkhard Raguse, (2005). Nanotechnology: Basic science and emerging technologies, First Indian Edition, Overseas Press.

Question Paper Pattern

(Marks: 75)

(Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)

Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)

Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	2	Hours/Week	1	Sub Code	S5SB3C	Semester	V
Medium of Instruction : English						Skill Based : 3	

MUSHROOM CULTIVATION AND VALUE ADDITION

Objectives:

1. To acquire knowledge in differentiating edible and poisonous mushrooms.
2. To teach cultivation, harvesting and storage methods.
3. To learn the nutritional and beneficial aspects of mushroom in food and pharma industry.

Unit I: Mushroom Technology - Introduction, History and Scope - Edible and Poisonous Mushrooms. Vegetative characters - Formation and development of Basidiocarp, structure of basidiocarp - *Agaricus*. Importance and nutritive value of edible mushrooms. Mushroom research centres in India.

Unit II: Morphological and Microscopical identification of mushrooms. Nutrient Profile of Mushroom: Protein, aminoacids, calorific values, carbohydrates, fats, vitamins & minerals.

Unit III: Cultivation of button mushroom (*Agaricus bisporus*), milky mushroom (*Calocybe indica*), oyster mushroom (*Pleurotus sajorcaju*) and paddy straw mushroom (*Volvariella volvcea*). Isolation and culture of spores, culture media preparation. Production of mother spawn, multiplication of spawn.

Unit IV: Inoculation Technique - Cultivation technology - Substrates, composting technology, bed, polythene bag preparation, spawning - casing - Cropping – Mushroom production - Harvest - Storage methods and marketing.

Unit V: Nature, Medicinal and nutritional value, Health benefits: Microbicidal effects. Therapeutic Aspects: Antitumour effect. Identification of Mushroom compounds: Antimicrobial, Flavonoids, Pharmaceutical compounds. Separation and Purification of Compounds.

Text Books:

1. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
2. Kannaiyan, S. Ramasamy, K. (1980). A hand book of edible mushroom, Today & Tomorrows Printers & Publishers, New Delhi.

Reference Books:

1. Pandey, B. P. 1996. A textbook of fungi. Chand and Company New Delhi.
2. Tripathi, D.P.(2005). Mushroom Cultivation, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
3. PathakYadav Gour (2010). Mushroom Production and Processing Technology, Published by Agrobios (India).

Question Paper Pattern (Marks: 75) (Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	5	Hours/Week	6	Sub Code	S6BT6	Semester	VI
Medium of Instruction : English					Core Course :11		

PLANT & ANIMAL BIOTECHNOLOGY

Objectives:

1. To understand the different types of culturing techniques used in plant and animal biotechnology.
2. To learn about the media formulations, establishment of cell lines, transformation techniques
3. To give an insight into Stem cells culture and hybridoma technology for MAB production.

Unit I: Introduction to plant cell and tissue culture. Concept of cellular totipotency. Laboratory organization. Sterilization techniques. Plant tissue culture media (Composition, types and preparation). Role of plant growth hormones (auxin, cytokinins, gibberlins) in tissue culture.

Unit II: Establishment and maintenance of callus culture. Micropropagation. Organogenesis and somatic embryogenesis. Protoplast isolation and fusion. Production of somatic hybrids and cybrids. Synthetic seed technology. Somoclonal variation.

Unit III: Plant transformation techniques. *Agrobacterium* mediated gene transfer. General features of Ti plasmid. Organization of Vir genes. Mechanism of T-DNA transfer. Ti plasmid as vectors – Binary and Co-integrative vectors. *Agrobacterium rhizogenes* and Ri plasmid. Production of transgenic plants. Delay of fruit ripening.

Unit IV: Animal cell culture: Structure and organization of animal cells. Animal cell culture: media formulations. Types of cell culture - primary cell culture, secondary cell culture, cell transformation, cell lines, Stem cell types and culture. Tests: cell viability and cytotoxicity, Cryopreservation.

Unit V: Embryology - Gametogenesis and fertilization in animals. Artificial fertilization- IVF and embryo collection, preservation and transfer. GMO- (Genetically Modified Organisms) transfection methods animal vectors - SV40, Adenovirus, Baculovirus. Transgenic animals production and application.

Text Books:

1. Chawla, H.S. (2009). Introduction to Plant Biotechnology, 3rd Edition. New Delhi.
2. Ignachimuthu, S. (1995). Basic Biotechnology, Tata McGraw Hill Publishers, New Delhi.

Reference Books :

1. Grierson, D. and S.N. Covey. (1988). Plant Molecular Biology, Blackie & Sons. Ltd.
2. Ramadas, P. (2008). Animal Biotechnology, MJP Publishers, Chennai.
3. Ranga M.M. (2004). Animal Biotechnology, 2nd Edition, Agrobios, India.

Question Paper Pattern (Marks: 75) (Time: 3 Hours)

- Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	5	Hours/Week	6	Sub Code	S6BT7	Semester	VI
Medium of Instruction : English					Core Course :12		

ENVIRONMENTAL BIOTECHNOLOGY

Objectives :

1. To give an insight into ecology, environmental pollution and microbial processes in the environment.
2. To provide knowledge on the use of microbes for a safe environment and in the treatment of hazardous waste using biotechnological processes.

Unit I: Ecology - ecological principles, structural concepts, ecological factors - physical, chemical, biotic and edaphic factors. Ecosystem concepts - types, structure and function - productivity and energy flow, food chains, food web and ecological pyramids.

Unit II: Environment Pollution and its causes: Air pollution, water pollution (heavy metal pollution and thermal pollution) soil pollution (pesticide pollution). Nonconventional energy resources- biogas production, methane and hydrogen production - Recycling of waste products- composting and silaging.

Unit III: Introduction to bioremediation – types, factors influencing bioremediation. Bioremediation techniques: ex situ and in situ bioremediation, Phytoremediation - Types of reactors used in bioremediation.

Unit IV: Characteristics of sewage and objectives in sewage treatment. Biological treatment: attached growth system, biofilm kinetics, trickling filters, rotating biological contactors. Suspended growth system: activated sludge process, anaerobic digestion. Tertiary treatment: nitrogen and phosphorus removal, disinfection, removal of heavy metals and pesticides by biosorption. Removal of oil spills by microbes.

Unit V: Introduction to xenobiotics, degradation of xenobiotics- pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation. Pollution by radionuclides - uptake of radionuclides from polluted sites. Purification of polluted air using biofilters - Future prospects.

Text Book:

1. Rana, S.V.S., (2010). Environmental Biotechnology, Rastogi Publications, Meerut, India.

Reference Books:

1. Raina, M. Maier, Ian L. Pepper and Charles P. Gerba, (2000). Environmental Microbiology. Academic Press. UK.
2. Alan Scragg, (1999). Environmental Biotechnology, Pearson Education Limited.
3. Dubey, R.C. (2004). A text book of Biotechnology. S. Chand & Company Ltd. New Delhi.

Question Paper Pattern (Marks: 75) (Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	5	Hours/Week	6	Sub Code	S6BTP6	Semester	VI
Medium of Instruction : English					Core Course :13		

PRACTICAL - VI

PLANT & ANIMAL BIOTECHNOLOGY, ENVIRONMENTAL BIOTECHNOLOGY AND BIOINFORMATICS

I. PLANT & ANIMAL BIOTECHNOLOGY

1. Surface sterilization.
2. Plant Tissue Culture Media Preparation – (i) M.S. Media, (ii) White’s media
3. Callus induction
4. Micropropagation
5. Protoplast isolation
6. Preparation of Animal cell culture media
7. Culture of chick embryo fibroblast.
8. Chick embryo – Demonstration.

II. ENVIRONMENTAL BIOTECHNOLOGY

1. Estimation of Nitrate in Drinking water.
2. Determination of COD and BOD in Sewage water.
3. Determination of Total Dissolved Solids and Suspended Solids of water.

III. BIOINFORMATICS (DEMO ONLY)

1. Retrieval of nucleic acid sequences (DNA & RNA)
2. Performing BLAST for DNA sequences
3. Construction of phylogenetic tree

IV. A field visit to biotechnology related industries

Credits	4	Hours/Week	6	Sub Code	S6BTEL3A	Semester	VI
Medium of Instruction : English					Major Elective Course : 3		

INTRODUCTION TO BIOINFORMATICS

Objectives:

1. To understand the basics of bioinformatics, biological sequence databases, genetic and biochemical interaction networks.
2. To impart knowledge on methods to retrieve and submit biological data in Nucleic acid data bases, protein data bases, structural databases and to understand cell interactions.

Unit I: Bioinformatics - Overview definition and history. Structure and chemical composition of nucleic acids and proteins.

Unit II: Biological resource database - Protein and nucleic acid sequence databases (NCBI, EMBL, GenBank, Swiss-Prot and PIR), Pattern and motif searches (BLOCKS, PRINTS). Structural, classification, Alignment and analysis (SCOP, CATH, FSSP). BLAST, FASTA.

Unit III: Genes and Genomes: Evolution of modularity and transcription networks, riboswitches, metabolite sensing and translational control, non coding sequence and its importance

Unit IV: Pathway bioinformatics: Protein-carbohydrate metabolism, biochemical cycles, interconnection of pathways -metabolic regulation

Unit V: Omics concepts: Genomics, proteomics, metabolomics, transcriptomics- introduction and techniques involved.

Text Books:

1. Attwood, T.K and Parry-Smith. (2006). Introduction to Bioinformatics, 1st Edition, Pearson Education, India.
2. S. Ignacimuthu, (2010). Basic bioinformatics, Narosa publishing house.

Reference Books:

1. David W. Mount, (2005). Bioinformatics sequence and Genome analysis, 2nd edition, CBS.
2. Andreas D., Baxeavanis. B.F and Francis Ouellette, (2005). Bioinformatics, 3rd edition, John Willey and Sons.
3. Brayen Bergeron, (2003). Bioinformatics Computing, M.D. Pearson Education.

Question Paper Pattern (Marks: 75) (Time: 3 Hours)

- Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	4	Hours/Week	6	Sub Code	S6BTEL3B	Semester	VI
Medium of Instruction : English					Major Elective Course : 3		

INTELLECTUAL PROPERTY RIGHTS & BIOETHICS

Objectives:

1. To impart knowledge on IPR & Bioethics
2. To know the benefits and risk factors associated with GE.

Unit I: Introduction to Intellectual Property Types- Patents, Trademarks, Copyright & Related Rights, Design, Draft design, Traditional Knowledge, Geographical Indications- importance of IPR. IP rights in India - IPs of relevance to Biotechnology – few Case Studies.

Unit II: Patent Filing Procedures National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement-meaning, scope, litigation, case studies.

Unit III: IPR Agreements and Treaties History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments..

Unit IV: Bioethics Introduction to ethics/bioethics – framework for ethical decision making; purpose and principles of bioethics, Bioethics in medical – drug testing, non maleficence, Informed consent and human cloning, Bioethics on religious rules and guidelines,

Unit V: Biotechnology and ethics Benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare; Ethical implications of cloning: Reproductive cloning , therapeutic cloning. Ethical implications of human genome project 36.

Text Books:

1. Ellen Frankel Paul, Fred D. Miller, Jeffrey Paul and Fred Dycus Miller (2002). Bioethics, Cambridge University Press.
2. John A. Bryant, Linda Baggott la Velle, John F. Searle, (2002). Bioethics and Science,

Reference books:

1. Jose B. Cibelli, Robert P. Lanza, Keith H. S. Campbell, Michael D. West, (2002). Principles of Cloning, Academic Press, San Diego, Gurdon.
2. Hoosetti, B.B. (2002). Glimpses of Biodiversity. Daya, New Delhi.

Question Paper Pattern

(Marks: 75)

(Time: 3 Hours)

- Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	4	Hours/Week	6	Sub Code	S6BTEL3C	Semester	VI
Medium of Instruction : English					Major Elective Course : 3		

GENOMICS & PROTEOMICS

Objectives:

1. To give an insight into various tool used in genome data bases
2. To impart knowledge on Genomics and Proteomics techniques and their importance in predicting the gene and its functional significance.

Unit I: Introduction to genome databases - database search - Algorithms issues in databases search - sequence database search - FASTA - BLAST – Types of genomic databases and uses: Polymorphic markers, Cytogenic Maps, LINE, SINE- Amino acid substitution matrices PAM and BLOSUM.

Unit II: Gene Therapy: Concept and Principles of Gene Therapy. Principles of gene Expression - Genome Mapping –physical and genetic mapping techniques, Human Genome Project - Genomes of other organisms. Shotgun DNA sequencing - Sequence assembly - Gene predictions - Molecular prediction with DNA strings.

Unit III: Genomic resources, Gene structure and DNA sequences. EST comparison, gene hunting. Expression analysis- SAGE, cDNA library, ORF prediction, Microarray – DNA sequencing and sequence alignment: RFLP, SNP, RAPD, Application of Comparative Genomics.

Unit-IV: Structural Proteomics: Experimental Techniques for Protein Structure Elucidation, X-ray Crystallography, 2-D Electrophoresis- Sample preparation, pH gradient- MALDI-TOF, Electro plot, Protein Microarrays and Bioseparation.

Unit-V: Metabolomics: Understanding the Metabolic Pathways of Microbes, metabolic pathway databases-KEGG. Structure prediction, active site determination, neural networks. Protein –protein interaction, protein – DNA interaction. Enzyme – Substrate interaction. Applications of Proteomics: Plant breeding and Biomedical.

Text Books:

1. Irfan Alikhan and Aliya Khanum, (2003). Fundamentals of Bioinformatics, Ukaag publications.
2. Bioinformatics for beginners- K. Mani and N. Vijayaraj, Kalaikathir Atchagam

Reference Books:

1. Parry and Smith, (1999). Bioinformatics, Addition Wesley long ltd.
2. David Mount, (2005). Bioinformatics: sequence and Genome Analysis, 2nd edition, CBS Publishers and distributors Ltd.
3. T. A. Brown, (2006) Genomes 3, 3rd edition, Garland science.
4. Pennigton and Dunn, (2002). Proteomics, Viva books publishers, New Delhi.

Question Paper Pattern (Marks: 75) (Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	3	Hours/Week	4	Sub Code	S5BTEL01	Semester	V
Medium of Instruction : English					Non Major Elective Course : 1		

HEALTH EDUCATION

Objectives:

1. To understand the concept of biomolecules, their importance and its role in health.
2. To know the basic concept of pollution and its impact on health.
3. To gain knowledge on the basics of mental illness and immunization schedule required for healthy life.

Unit I: Dimensions and Determinants of health, Indicators of health - Characteristics of indicators, Types of indicators, Disease agents - Classification of disease agents.

Unit II: Nutrition - Classification and functions of food, sources and requirement of Carbohydrates, Proteins, Fats, Vitamins and Minerals, Malnutrition - Protein energy Malnutrition (PEM), Balanced diet - Composition of balanced diet

Unit III: Water - Safe and wholesome water, criteria for water quality standards, household purification of water. Air - Health effects of air pollution, prevention and control Ventilation - Standards of ventilation, Light - The requirements of good lighting.

Unit IV: Noise - Effects of noise exposure, Types of mental illness - Major and minor illnesses, Causes of mental ill health - Social pathological causes, Preventive aspects - Primary - Secondary -Tertiary.

Unit V: Immunization - Vaccines and Immunization Schedule, Principles of disease control and prevention.

Text Books

1. Srilakshmi, B. (2015). Food Science, 6th edition, New Age International publishers.

Reference Books:

1. Muruges, N. (2002). Health Education and Community Pharmacy, 3rd Edition, Sathya Publishers, Madurai.
2. Srilakshmi, B. (2012). Nutrition Science, 4th revised edition, New Age International publishers.
3. Khurana, S.P.S. (2007). Health Education and Community Pharmacy, S. Vikas Company, India.

Question Paper Pattern (Marks: 75) (Time: 3 Hours)

- Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

Credits	4	Hours/Week	4	Sub Code	S5BTEL02	Semester	VI
Medium of Instruction : English					Non Major Elective Course : 2		

PHARMACEUTICAL BIOTECHNOLOGY

Objectives:

1. To understand the concept of pharmaceutical biotechnology and its applications.
2. To know the methods of fermentation process used in pharma industries and its advantages in the production of pharmaceutically valuable products.

Unit I: Brief introduction to biotechnology with reference to pharmaceutical sciences, Enzyme biotechnology-methods of enzyme immobilisation and applications, Biosensors-working and applications of biosensors in pharma industries

Unit II: Study of cloning vectors, restriction endonuclease and ligase. Recombinant DNA technology-applications of genetic engineering in medicine-interferons production, vaccines-hepatitis B, hormones-insulin

Unit III: Types of immunity-humoral and cellular, immunoglobulin structure and functions. Hybridoma technology-production of Mabs, purification and application.

Unit IV: Mutation-types of mutation, DNA repair mechanisms, Gene therapy-introduction, types,. Introduction to drug design, evaluation of drugs.

Unit V: Fermentation methods-fermentor design and control, Study of production of penicillin, vitamin B12, griseofulvin. Advantages and disadvantages of pharmaceutical biotechnology.

Text book:

1. Daan J.K. chrommelin, Robert D. Sindelar, Bernd Meibohm, (2007). Pharmaceutical Biotechnology- Fundamentals and applications 3rd edition, Taylor and Francis publication.

Reference Books:

1. Immunology: Nandhini shetty, (2017). An introductory textbook, Rev 2nd ed, Newage international publishers
2. Brown T.A. (2010). Gene Cloning and DNA Analysis: An Introduction, 6th Edition, Wiley Blackwell.
3. Satoskar, R.S., Bhandarkar, S.D and Rege, N.N, (2006). Pharmacology and Pharmacotherapeutics, Popular Prakashan (P) Ltd,

Question Paper Pattern (Marks: 75) (Time: 3 Hours)

Part - A: Two Questions from each Unit (No choice) (10x 2 = 20 Marks)
 Part - B: Either or Questions (One pair from each Unit) (5 x 5 = 25 Marks)
 Part - C: Three out of Five Questions (One from each Unit) (3 x10 = 30 Marks)

SYLLABUS FOR
NON MAJOR ELECTIVE

NMEC1 - for B.Sc., (Statistics) students

NMEC2 - for B.Sc., (Biochemistry) students

DEPARTMENT OF BIOTECHNOLOGY