

# B.Sc., BIOTECHNOLOGY PROGRAMME STRUCTURE

B.Sc Biotechnology Programme (2017–2018 onwards)

(CBCS System)

Sem	Part	Course	Course title	Course code	Hrs/wk	Credits	Marks		
							CIA	ESE	Total
I	I	Tamil I*	செய்யுள், இலக்கிய வரலாறு , உரைநடை, மொழிப்பயிற்சியும் படைப்பாக்கமும்	U15TM1L1	6	3	25	75	100
	II	English I	English Communication Skills - I	U16EGPL1	6	3	40	60	100
	III	Core I	Cell Biology	U16BT101	4	4	25	75	100
		Core Prac. I	Cell Biology Lab	U16BT1P1	3	2	40	60	100
		Allied I	Fundamentals of Microbiology	U16BT1Y1	4	4	25	75	100
		Allied Prac.	Fundamentals and Applied Microbiology Lab	U16BTYP1	3	--	--	--	--
	IV	Env. Stud	Environmental Studies	U16EST11	2	2	25	75	100
	Value Education	Value Education (RI/MI)	U14VL1:1/ U14VL1:2	2	2	25	75	100	
II	I	Tamil II*	செய்யுள், இலக்கிய வரலாறு , சிறுகதைத் திரட்டு, மொழிப்பயிற்சி & படைப்பாக்கம்	U15TM2L2	6	3	25	75	100
	II	English II	English Communication Skills - II	U16EGPL2	6	3	40	60	100
	III	Core II	Biochemistry	U16BT202	6	6	25	75	100
		Core Prac. I	Biochemistry Lab	U16BT2P2	3	2	40	60	100
		Allied II	Applied Microbiology	U16BT2Y2	4	4	25	75	100
		Allied prac.	Fundamentals and Applied Microbiology Lab	U16BTYP1	3	3	40	60	100
	IV	SBEC I	Basics of Bioinformatics	U16BT2S1	2	2	25	75	100
III	I	Tamil III*	செய்யுள் - காப்பியங்கள் , இலக்கிய வரலாறு , நாவல் , மொழிப்பயிற்சி	U15TM3L3	6	3	25	75	100
	II	English III	<b>English for Competitive Examinations</b>	<b>U16EGPL3</b>	6	3	25	75	100
	III	Core III	Genetics	U16BT303	6	5	25	75	100
		Core Prac. II	Genetics Lab	U16BT3P3	3	2	40	60	100
		Allied III	Basics of Chemistry	U16BTC33	4	4	25	75	100
		Allied Prac.	Volumetric and Organic Analysis Lab	U16BTCP2	3	--	--	--	--
	IV	NMEC -I	Basics of Biotechnology	U16BT3E1	2	2	25	75	100
IV	I	Tamil IV /*	செய்யுள் - நாடகம் , இலக்கிய வரலாறு , மொழிப்பயிற்சி	U15TM4L4	5	3	25	75	100
	II	English IV	<b>English through Literature</b>	<b>U16EGPL4</b>	5	3	25	75	100
	III	Core IV	<b>Basics of Immunology (30.05.2017)</b>	<b>U16BT404</b>	6	6	25	75	100
		Core Prac. IV	<b>Basics of Immunology Lab (28.11.2017)</b>	U16BT4P4	3	2	40	60	100
		Allied IV	<b>Chemistry for Life Sciences (02.06.2018)</b>	<b>U17BTC44</b>	4	3	25	75	100

		Allied Prac. II	Volumetric and Organic Analysis Lab	U16BTC2	3	3	40	60	100
	IV	NMEC II	Applied Biotechnology	U16BT4E2	2	2	25	75	100
		Soft Skills	Life Skills	U16LFS41	2	1	--	--	100
	V	Extension Activities	NSS, NCC, Rotaract, Leoclub, etc ...	U16ETA41	--	1	--	--	--

Sem	Part	Course	Course title	Course code	Hrs/wk	Credits	Marks		
							CIA	ESE	Total
V	III	Core V	Molecular Biology	U16BT505	6	6	25	75	100
		Core VI	Genetic Engineering	U16BT506	6	6	25	75	100
		Core Prac. V	Molecular Biology / Genetic Engineering Lab	U16BT5P5	4	2	40	60	100
		Elective I	Plant Physiology / Ecology	U16BT5:1/ U16BT5:2	5	5	25	75	100
		Elective II	Developmental Biology / Basics of Evolution	U16BT5:3/ U16BT5:4	5	5	25	75	100
		SBEC II	Basics of Biostatistics	U16BT5S2	2	2	25	75	100
		SBEC III	<b>Food Biotechnology (02.06.2018)</b>	<b>U16BT5S3</b>	<b>2</b>	<b>2</b>	<b>25</b>	<b>75</b>	<b>100</b>
VI	III	Core VII	Industrial Biotechnology	U16BT607	6	6	25	75	100
		Core VIII	Animal Biotechnology	U16BT608	6	5	25	75	100
		Core IX	Plant Biotechnology	U16BT609	6	5	25	75	100
		Core Prac. VI	Industrial, Plant and Animal Biotechnology Lab	U16BT6P6	3	2	40	60	100
		Elective III	Human Physiology / Bioethics and IPR (02.06.2018)	U16BT6:1/ U16BT6:2	5	5	25	75	100
		Core Project	Project	U16BT6PJ	4	2	--	--	100
	V	Gender Studies	Gender Studies	U16GST61	--	1	--	--	100

**Total credits 140**

SBEC – Skill Based Elective Courses; NMEC – Non Major Elective Courses;

*Other Languages	Hindi	Sanskrit	French		Hindi	Sanskrit	French
Semester I	U14HD1L1	U14SK1L1	U14RR1L1	Semester III	U14HD3L3	U14SK3L3	U14RR3L3
Semester II	U14HD2L2	U14SK2L2	U14FR2L2	Semester IV	U14HD4L4	U14SK4L4	U14FR4L4

Part I : 4	Core Theory : 9	Core Project : 1	Allied Theory : 4	NMEC : 2	Env. Studies : 1	Total : 43
Part II : 4	Core Prac. : 6	Allied Prac.: 2	Elective : 3	SBEC : 3	Exten. Act. : 1	
Soft Skills : 1	Value Education : 1	Gender Studies : 1				

**Total courses : 43**

**NMEC offered by the department:**

Sem	part	Course	Course title	Course code	Pre-requisites	Hrs/wk	Credits	Marks		
								CIA	ESE	Total
III	IV	NMEC -I	Basics of Biotechnology	U16BT3E1	-	2	2	25	75	100
IV	IV	NMEC -II	Applied Biotechnology	U16BT4E2	U16BT3E1	2	2	25	75	100

Course	No. of Papers
Part I	04
Part II	04
Core Theory	09
Core Practical's	04
Elective	03
Allied Theory	04
Allied Practical's	04
SBEC	03
NMEC	02
Environmental Studies	01
Value Education	01
Extension Activities	01
Soft Skills	01
Gender studies	01
In house project	01
<b>Total courses</b>	<b>43</b>

**SEMESTER** : **I**  
**CREDITS** : **4**

**COURSE CODE** : **U16BT101**  
**TOTAL HOURS** : **60**

### **CORE I: CELL BIOLOGY**

#### **OBJECTIVE:**

- To know about the basic concepts of cell and its functions.
- To understand the structural features organelles and the cellular mechanisms.

#### **UNIT-I**

Discovery of Cell -Cell theory-Prokaryotes & Eukaryotes- Cellular Organelles: Structure, Organization and Functions of Plasma membrane, Nucleus & nucleolus, Mitochondria.

#### **UNIT-II**

ER-rough and smooth, Ribosomes, Golgi apparatus, Plastids, Vacuoles, Lysosomes, Peroxisomes and Microbodies.

#### **UNIT-III**

Cell junction. Overview, Structure and Organization of Micro tubules and Microfilaments-Cell movement.

#### **UNIT-IV**

Cell Division: Mitosis and Meiosis-Cell Cycle-Regulation of Cell Cycle- Cell signaling- (adrenalin receptors, acetylcholine receptors, insulin receptors) Programmed Cell Death.

#### **UNIT-V**

Transformation, Transduction and Conjugation, Recombination - Generalized and Site specific in bacteria- Holiday model. Oncogenic cells.

### **TEXT BOOK**

1. Gupta. P.K. Cell and Molecular biology. Rastogi Publications, India, 2005.

### **REFERENCE BOOKS**

1. Harvey Lodish, Molecular Cell Biology, Fourth Edition, W.H. Freeman & Company, New York, 2002.
2. Geoffrey M Cooper, Robert E Hausman, The Cell-A Molecular Approach, Third Edition, ASM Press, Washington, 2004.
3. Gerald Karp, Cell and Molecular Biology, Third edition, John Wiley & Sons, New York, 2001.
4. Alberts, Essential Cell Biology: An Introduction to the Molecular Biology of the Cell, Second edition. Garland Science Taylor & Francis Group, New York, 2003.
5. David Freifelder, Essentials of molecular biology, Narosa Publishing House, New Delhi, 1990.

**SEMESTER : I**  
**CREDITS : 4**

**COURSE CODE : U16BT1Y1**  
**TOTAL HOURS : 60**

### **ALLIED I : FUNDAMENTALS OF MICROBIOLOGY**

#### **OBJECTIVES:**

- To understand the origin of microbes and their contribution to life.
- To know the use of microscopes and sterilization techniques.
- To gain knowledge on the contributions of great scientists towards the growth of microbiology.
- To know the concepts and fundamentals of microbes.

#### **UNIT-I**

Definition and scope of microbiology – History of microbiology. The origin of microbial life – Theory of spontaneous generation. Contributions of Leeuwenhoek, Pasteur, Robert Koch. Characteristic features of bacteria, viruses, fungi, algae and protozoan.

#### **UNIT-II**

Microscopy – Simple, compound, Dark field, Phase contrast, Fluorescence & Electron Microscopy. Microbial evolution and diversity – Binomial nomenclature of Microbes. Classification of three kingdom, five kingdom concept and domain concept.

#### **UNIT-III**

Microbial growth – Growth curve measurement of microbial growth – Measurement of cell number, Measurement of cell mass. Factors affecting growth.

#### **UNIT IV**

Anatomy & Physiology of bacteria –Structure of Cell wall, Cytoplasmic membrane, Cilia, Flagella, Capsule, Sporulation and types of reproduction.

## **UNIT-V**

Sterilization – Methods of sterilization and Disinfection. Antimicrobial chemotherapy – Tests for sensitivity to Antimicrobial agents.

### **TEXT BOOKS:**

1. Pelczar Jr. M.J, Chan. E.C.S and Kreig.N.R, Microbiology- 5th Edition McGraw Hill Inc, New York,2006.
2. Dubey, R.C. and Maheswari, D.K, A Text book of microbiology. S. Chand & Company Ltd. New Delhi, 2005

### **REFERENCE BOOKS:**

1. Gerard J. Tortora, Berdell R. Funke, Christine & L. Case, Microbiology an Introduction. Benjamin Cummings, U.S.A.2001
2. Danial Lim, Microbiology, McGraw-Hill Companies, New York, 1998,
3. Stainer, R.Y., Ingraham, J.L.,Wheelis, M.L and Painter, P.R, General Microbiology, Mac Milan Education Ltd. London, 1986.

**SEMESTER : I**  
**CREDITS : 2**

**COURSE CODE : U16BT1P1**  
**TOTAL HOURS : 45**

**CORE PRACTICAL I : CELL BIOLOGY LAB**

**OBJECTIVES:**

- To understand & develop skill and hands on training in basics of cell biology.
- To identify and analyze the structural features of cells of plants and animals

1. Mitosis in onion root tips.
2. Barr body staining from buccal epithelial cells.
3. Preparation of giant /polytene chromosomes from chironomous larvae.
4. DNA isolation from buccal cells.
5. Cell Staining – Cytochemical Methods for Demonstration of Cellular and sub-cellular components.

**REFERENCE BOOKS:**

- 1 Rajan, S, Experimental Procedures in Life Sciences. Anjanaa Book House, 2010
2. Karp, G, Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> Edition. John Wiley & Sons. Inc.,2010.



**SEMESTER : I/II**  
**CREDITS : 3**

**COURSE CODE :U16BTYP1**  
**TOTAL HOURS : 45**

**ALLIED PRACTICAL I: FUNDAMENTALS AND  
APPLIED MICROBIOLOGY LAB**

**Objectives:**

- To understand the basic laboratory techniques in Microbiology.
  - To know the cultivation techniques of microbial culture
1. Sterilization principle and methods-moist heat - dry heat and filtration methods.
  2. Media preparation: Liquid media, Solid media, Agar deep, Agar slants, Agar plates.
  3. Pure culture technique: Streak plate, pour plate, spread plate, serial dilution.
  4. Cultural characteristics of microorganisms: Growth on different media, growth characteristics and description.
  5. Motility demonstration: Hanging drop preparation.
  6. Simple staining.
  7. Gram's staining.

**APPLIED MICROBIOLOGY LAB**

1. Antibiotic sensitivity testing: Disc diffusion test – Quality control with standards strains.
2. Biochemical characteristics: IMViC test.
3. Isolation of Rhizobium sp.
4. Isolation of Cellulolytic organisms.
5. Isolation of Lactobacillus sp.
6. Fungal staining.

**REFERENCE BOOKS:**

1. Rajan, S, Experimental Procedures in Life Sciences. Anjanaa Book House, 2010
2. Gunasekaran P, Lab Manual in Microbiology. New Age International Publications, 2007

**SEMESTER : II**  
**CREDITS : 6**

**COURSE CODE : U16BT202**  
**TOTAL HOURS : 90**

## **CORE II : BIOCHEMISTRY**

### **OBJECTIVE:**

- To comprehend the structure and properties of biomolecules and their biochemical reactions.
- To understand the basic metabolism, reaction pathway and the kinetics of chemical reaction.

### **UNIT - I**

Basic chemistry in life science: Structure and properties of water. Measurement of pH, determination of  $pK_a$  (Henderson Harselbalch equation). Buffers, buffer actions (strong & weak acids) and biological buffer systems.

### **UNIT - II**

Carbohydrates: Classification, properties, structure and biological functions of monosaccharides (glucose, fructose) Oligo saccharides (lactose, galactose) and polysaccharides. (glycogen, starch, cellulose, agarose).

### **UNIT - III**

Amino acids & Proteins: Structure, classification, physical and chemical properties. Proteins: classification and Biological importance. Primary structure, Secondary, tertiary and quaternary structure- forces stabilizing the structure of proteins. Denaturation, precipitation, separation by solubility differences- isoelectric pH.

### **UNIT - IV**

Lipids and Vitamins: Nomenclature, classification and Biological significance of simple lipids (triglycerides, homolipids) compound lipids (heterolipids) derived lipids, glycerol and fatty acids. Vitamins- Source, structure, biological role, daily requirement and deficiency manifestation of vitamin A, B, C, D, E and K.

## **UNIT - V**

Nucleic acids & Enzymes: Types of DNA and RNA. Composition and structure- their biological importance hydrolysis of nucleic acids by acids, bases and enzymes. Denaturation and renaturation. Enzymes: Nomenclature and classification, enzyme activity; Factors affecting activity, enzyme kinetics –Michaelis Menton equation.

### **TEXT BOOK**

1. Jain, J.L., Sunjay Jain and Nitin Jain, Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, New Delhi, 2010

### **REFERENCE BOOKS**

1. Berg, J.M., Tymoczko, J.L., Stryer, L.. Biochemistry, 7th Edition, W.H. Freeman, USA, 2010
2. Campbell, M.K., Farrell, S.O, Biochemistry, 6th Edition, Brooks Cole Publishing Company, USA, 2007
3. Mathews, C. K., Van Holde, K.E., Ahern, K.G, Biochemistry, 3rd Edition. Addison Wesley, USA, 2000
4. Voet, D., Voet, J.G. and Pratt, C.W, Principles of Biochemistry, 3rd Edition. John Wiley & Sons, USA, 2008
5. Zubay, G.L, Biochemistry, 7th Edition. William C Brown Publishers, New York, 1995
6. Nelson, D.L., Cox, M.M, Lehninger, Principles of Biochemistry, 5th Edition. W.H Freeman and Company, USA, 2008



**SEMESTER : II**  
**CREDITS : 4**

**COURSE CODE : U16BT2Y2**  
**TOTAL HOURS : 60**

## **ALLIED II : APPLIED MICROBIOLOGY**

### **OBJECTIVES**

- To know the principles of Microbiology and to understand the applications of microbes in different fields.
- To learn the concepts of employing microbes in various commercial products.

### **UNIT -I**

Isolation and purification of Enzymes from microbes – Industrial enzymes: Important Enzymes – Application in food, leather, textile, paper, detergent, pharmaceutical industries – Role of transformed microorganism in Enzyme production.

### **UNIT-II**

Pharmaceuticals: Production of ethanol, antibiotics, amino acids, organic acids, vitamins by conventional and Recombinant organisms.

### **UNIT-III**

Agriculture: Biofertilizer, Bio-control of Microbial pathogens, Biopesticides plant promoters, Secondary metabolites.

### **UNIT-IV**

Waste recycling, Industrial effluent treatment – Dairy: Importance of microbes in dairy and Dairy products.

### **UNIT-V**

Microbial Disease- Bacterial (Cholera, Typhoid), Protozoan (Malaria), Viral disease (HIV), Fungal (Candidiasis), Zoonotic and Nosocomial infections.

### **TEXT BOOK**

1. Chan E.C.S. and Noel R.K, Microbiology (Pelczar),An Application Based Approach. Tata McGraw Hill Education Private Limited, New Delhi, 2010

### **REFERENCE BOOKS**

1. Subba Rao, N.S, Soil Microorganism and plant growth, oxford and IBH publishing co.pvt. Ltd.1995
2. Frazier, W.C and Westhoff, D.C, Food microbiology, 4<sup>th</sup> edition. McGraw Hill NY,1988
3. Adams M.M. R and Moss M.O, Food microbiology. New International (P) Ltd. Publishers,1995
4. Alexander, Introduction to soil Microbiology. John Wileyand Sons, 1997

**SEMESTER : II**  
**CREDITS : 2**

**COURSE CODE : U16BT2P2**  
**TOTAL HOURS : 45**

### **CORE PRACTICAL I : BIOCHEMISTRY LAB**

#### **Objectives:**

- To learn the various qualitative and quantitative methods of analysis of biomolecules
  - To develop hands-on skills in bioanalytical techniques.
1. Preparation of solutions: Normality, Molarity, Molality and Percentage solutions.
  2. pH metry -Determination of pH from unknown biological samples using pH paper and pH meter.
  3. Colorimetry – Preparation of standard curve and estimation of the concentration of solute in an unknown sample
  4. Estimation of biomolecules: 1.Sugars –Anthrone method 2. Proteins – Bradford method 3. Lipids- Zak’s method
  - 5 .Chromatography –Paper Chromatography - Determining the Rf value of aminoacids and its separation- Thin layer Chromatography- Separation of Plant pigments
  6. Demonstration of gel electrophoresis. (PAGE/AGE)

#### **REFERENCE BOOKS**

1. Arun Rastogi, Mathur, N.B.L Mathur, N.B. L,An Introduction to PracticalBiochemistry. Anmol Publications, India,2010
2. Joshi, R.A. and Saraswat, M, A textbook of practical Biochemistry. JainPublishers private limited, India, 2002
3. Malhotra, V.K, Practical Biochemistry for students. Jaypee Brothers Publishers, India, 2003
4. Rajan, S, Experimental Procedures in Life Sciences. Anjanaa Book House, 2010
5. B Sashidhar Rao and Vijay Deshpande, Experimental Biochemistry, I K International Publishing House, 2009.



**SEMESTER : II**  
**CREDITS : 2**

**COURSE CODE : U16BT2S1**  
**TOTAL HOURS : 30**

### **SBEC I: BASICS OF BIOINFORMATICS**

#### **OBJECTIVE:**

- To understand the basic concepts and application of Bioinformatics.
- To comprehend the Bioinformatics databases and their applications.
- To know the applications of genomics and proteomics.

#### **Unit I**

Introduction to Bioinformatics - History, scope and applications. Research areas of Bioinformatics, Bioinformatics industries and Institutions in India & Worldwide.

#### **Unit II**

Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum).

#### **Unit III**

Introduction of sequence alignment; Pairwise Alignment, Local and Global Alignment concept, Needleman wunch method and Smith waterman method, Fasta and Blast, Multiple Sequence Alignment-Clustal W.

#### **Unit IV**

Basics of Proteins- Different types of protein structures: Primary, Secondary, Tertiary. Protein structure visualization tools – Rasmol, SPDBv, PyMol,. Tools and Server for protein structure prediction – Phyre2, I-TASSER, SWISS-Model, Modeller.

## **UNIT-V**

Basics and parameters of drug – ADMET properties; Need for developing new drugs: Molecular modification of lead compounds; Active site determination of enzymes; Basics of Docking studies; Types, Steps and tools used for drug designing.

### **TEXT BOOKS**

1. Harshawardhan, P, Bioinformatics principles and application. Tata Mc-GrawHill . Publishers. New Delhi, 2005.
2. Lesk, A.M, Introduction to Bioinformatics, Oxford University Press, NewDelhi, 2003.
3. Sundarajan. S. and Balaji, R, Introduction of Bioinformatics, HimalayaPublishing House, Mumbai,2005.

### **REFERENCE BOOKS**

1. Attwood, T.K. and Parry Smith, D.J, Introduction to Bioinformatics,Pearson Education Ltd., New Delhi, 2004.
2. Manikand Vijayaraj, Bioinformatics for beginners, Kalaikathir Achchagam,Coimbatore, 2002.
3. Mount, D.W, Bioinformatics Sequence and genome analysis, Second Edition. CBS Publishers. New Delhi, 2005.
4. Westhead, D.R, Parish, H.J. and Twyman, R.M, Bioinformatics,Viva books Private Ltd. New Delhi, 2003.
5. Introduction to Bioinformatics T.K.Altwood, D.J.Parry-smith, Pearson Education, 2004.
6. Bioinformatics for the beginners K.Mani & N.vijayaraj
7. Proteomics- Pennigton & Dunn,Viva books publishers, New Delhi, 2002
8. Bioinformatics- A practical guide to the analysis of genes & protein 2nd ED Andreas, Baxevanis and Francis Ouellette.
9. The internet, Christian Crumlish. BPB publications, 1999.

**SEMESTER : II**  
**CREDITS : 5**

**COURSE CODE : U16BT303**  
**TOTAL HOURS : 90**

### **CORE III : GENETICS**

#### **OBJECTIVE:**

- To understand the concept of genes and their behavior.
- To know the basics of genetics and Gene interaction and Chromosomal variation.

#### **UNIT-I**

History of Genetics - Mendelian Principles, Segregation, Independent Assortment, Dominance relations, Multiple alleles, Incomplete dominance, Over dominance.

#### **UNIT-II**

Gene interaction, Epistasis, lethality and lethal genes, Sex determination and sex linkage in diploids, linkage and crossing over, gene mapping. Chromosomal theory of inheritance, maternal effects.

#### **UNIT-III**

Chromosomal variation in number, Changes in Chromosomal structure, Chromosomal aberrations, Genetics of Hemoglobin, Transposable elements in prokaryotes and eukaryotes.

#### **UNIT-IV**

Fine structure of Gene, cistron and recon, Structure of Eukaryotic gene, Experimental evidence for DNA as the genetic material, cytoplasmic genetic systems- mitochondria and chloroplast DNA, Plasmids- F, R and Col plasmids. Relationship between genes and polypeptides.

#### **UNIT-V**

Population genetics, calculating gene frequency, factors affecting gene frequency. Genetic control of development in Drosophila and Arabidopsis - Genetic drift, Shift, Pedigree analysis and genetic counseling.

## **TEXT BOOK**

1. Sambamurty, A.V.S.S, Molecular Genetics, First edition Alpha Science International Ltd, 2007.

## **REFERENCE BOOKS**

1. Hancock, J.T, Molecular Genetics. Viva Books Private Limited, 2008.
2. Klug, W.S., Cummings, M.R., Spencer, C.A., Palladino, M.A, Concepts of Genetics. Pearson Education, 2011.
3. Griffiths, A.J.F, Introduction to genetic analysis. W.H. Freeman, 2008.
4. Hartl D, L. Jones E.W, Genetics Analysis of Genes and Genomes. Seventh edition, Jones and Bartlett Publishers, 2009.

**SEMESTER : III**  
**CREDITS : 4**

**COURSE CODE : U16BTC33**  
**TOTAL HOURS : 75**

### **ALLIED III : BASICS OF CHEMISTRY**

#### **OBJECTIVES**

- To understand the basics concepts of bonding in chemical compounds
- To know about the types and characteristics of reactions in organic chemistry
- To understand the mole concept and its applications to solutions.

#### **UNIT -I**

Chemical bonding: Ionic bond- Nature of Ionic bond Covalent bond , Coordinate Bond – Nature of coordinate bond, Hydrogen bonding-Theory of Hydrogen bonding- one example for inter and intra molecular hydrogen bonding- consequences of hydrogen bonding. Vander Waals forces of interaction.

#### **UNIT- II**

Introduction to organic chemistry: types of reactions-addition reactions, substitution and elimination reactions. Aliphatic compounds-inductive effect; aromatic compounds-Resonance effect. Acidic character of phenols; basic character of aniline. Heterocyclic-five membered and six membered ring. Preparation, Structure,acidic and basic character of pyrrole,furan and pyridine.

### **UNIT- III**

Solutions: Mole Concept -Normality – Molarity – parts per million - Simple problems on concentration terms Primary and secondary standards and preparation of standard solutions and simple problems. Acids and bases: Arrhenius, Lowry- Bronsted, Lewis concepts- strong and weak acids and Bases.-pH, pKa, pK<sub>b</sub> of buffer solutions. Henderson – Hassel Balch equation.

### **UNIT- IV**

Chemical kinetics: rate of reaction, order, molecularity, first order rate law, half lifeperiod And derivation of the first order equation – Catalysis – homogeneous and heterogeneous catalysis, promoters and poisons, applications.

### **UNIT- V**

Colloids :(Colloids – Types with examples – classification based on affinity (lyophilic & Lyophobic). Optical and Kinetic properties of colloids – electrophoresis- electroosmosis – peptization – Coagulation.Applications of colloids.

### **REFERENCE BOOKS**

1. B.K. Sharma, Industrial Chemistry, Goel Publishing Co, 1997.
2. Puri B.R., Sharma L. R., Kalia K.K, Principles of inorganic Chemistry, (23<sup>rd</sup>edition), New Delhi, ShobanLal Nagin Chand & Co, 1993.
3. S. Lakshmi, Pharmaceutical Chemistry, Goel Publishing Co, 1997.
4. Bahl B. S and ArunBahl, Organic Chemistry, 12<sup>th</sup> edition, New Delhi, Sultan Chand and Co, 1997.
5. United States Pharmacopeia Dispensing Information's, USPDI, Rockvillla, Maryland, 1981..
6. The Indian pharmacopoeia 3<sup>rd</sup> edition, volume2, Quality Specifications, world health Organization 1981.
7. Thiagarajan V, Pharmaceutical chemistry, Chennai, KC S. Desikan and Co, 1986.
8. Jayashree Gosh, Text book of Pharmaceutical Chemistry, New Delhi, S.Chand, 2008.

**SEMESTER : III**

**COURSE CODE : U16BT3P3**

**CREDITS : 2**

**TOTAL HOURS : 45**

### **CORE PRACTICAL II : GENETICS LAB**

#### **Objectives:**

- To develop skills in chromosome identification.
  - To understand the laws of genetics.
1. Drosophila – Morphology, Section culture and maintenance.
  2. Identification of Mutants—Physical and Chemical Methods.
  3. Experiments to determine Mendel’s law.
  4. Monohybrid and dihybrid cross using plants.
  5. Human karyotype - demonstration.
  6. Sex chromatin (buccal smear) identification.

#### **REFERENCE BOOKS**

1. Sambrook, J., Russell, D.W, Molecular Cloning: A Laboratory Manual, Third Edition Cold Spring Harbor Laboratory Press, 2001.
2. Bisen, P.S, Laboratory Protocols in Applied Life Sciences. CRC Press, 2014

**SEMESTER: IV**  
**CREDITS: 3**

**COURSE CODE : U16BTCP2**  
**Total Hours: 60**

**ALLIED CHEMISTRY PRACTICAL – I / II**  
**VOLUMETRIC AND ORGANIC ANALYSIS LAB**

**OBJECTIVES:**

- To understand the basic principles and different types of volumetric analysis.
- To identify the organic compounds.
- To know the difference between qualitative and quantitative analysis
- To develop the analytical skills of students

**I. VOLUMETRIC ANALYSIS**

- a) Acidimetry and Alkalimetry
  - i) Estimation of hydrochloric acid
  - ii) Estimation of sodium hydroxide
- b) Permanganometry
  - iii) Estimation of oxalic acid using  $\text{KMnO}_4$
  - iv) Estimation of ferrous sulphate using  $\text{KMnO}_4$

**c. Demonstrative Experiments**

- i) Estimation of acid content in citrus fruits
- ii) Determination of total hardness of water
- iii) Determination of calcium in commercial milk powder by EDTA method
- iv) Determination of dissolved oxygen in water (Winkler's Method)

**II. ORGANIC ANALYSIS**

- a) Analysis of organic compounds with the following
  - (i) tests for Aromatic/ Aliphatic,
  - (ii) saturated/ unsaturated
  - (iii) solubility in common solvents, and
  - (iv) presence of nitrogen

Test for Functional groups

- i) Carbohydrate
- ii) Diamide
- iii) Aldehyde
- iv) Ketone
- v) Acid
- vi) Amine

**b) Demonstration**

- Preparation of Buffer solution
- Determination of pH using pH meter
- Preparation of standard solution (Molar, ppm & Normal)

**Reference Books**

1. V.Venkateswaran, R.Veerasingam, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, New Delhi, 1997



**SEMESTER : IV**  
**CREDITS : 6**

**COURSE CODE : U16BT404**  
**TOTAL HOURS : 90**

### **CORE IV : BASICS OF IMMUNOLOGY**

#### **OBJECTIVES:**

- To understand the immune system and its significance.
- To know the mechanism of immune cells and organs.
- To acquire knowledge in pathology and clinical aspects of Immunology.

#### **UNIT-I**

History and scope of Immunology: Historical perspective of Immunology, Early theories of Immunology, Types of Immunity Innate, Adaptive (cell mediated and humoral). Passive: Artificial and Natural Immunity, Active: Artificial and Natural Immunity

#### **UNIT-II**

Immune system and its mechanism: Primary and Secondary organs of immune system –structure and function ,Hematopoiesis- Significance - Origin and differentiation of lymphocytes: T-cells, B-cells, myeloid cells, antigen presenting cells, cell mediated subset of T-Cells, helper and suppressor cells, natural killer cells.

#### **UNIT-III**

Cellular and molecular interactions: Antigens: Structure and properties - Immunogenicity vs antigenicity, factors affecting antigenicity, epitopes, haptens, adjuvants and vaccines – Types and vaccination schedule. Immunoglobulins: Structure, types, distribution and biological functions. Antigen antibody interactions: principle, methods and applications of precipitation and agglutination.

## **UNIT-IV**

Immune response: Recognition of antigen: MHC, antigen processing and presentation, T-cell and B - cell activation Cell mediated-Mechanism and target cell lysis , Humoral response, antibody dependent cell mediated cytotoxicity, Complements - Classical and Alternative pathways, role in immunity.

## **UNIT-V**

Clinical Immunology:Organ transplantation- types of graft, mechanism of allograft rejection,Immunosuppression,Allergic reactions- Immunology & types of hypersensitivity. Auto antibodies – Autoimmune diseases and examples.Immunological Techniques in Clinical Diagnosis: Widaltest, Pregnancytest, ELISA

## **TEXT BOOKS**

1. Kuby, J, Immunology. (Sixth edition) W.H.Freeman and company, New York, 2007.
2. Abbas AK, Lichtman AH, Pillai S, Cellular and Molecular Immunology 6th edition Saunders Publication, Philadelphia, 2007.

## **REFERENCE BOOKS**

1. E. Riot, Essential Immunology 12<sup>th</sup> Edition, Wiley & Blackwell, 2011
2. Richard M. Hyde, Microbiology and Immunolog, 3<sup>rd</sup> Edition. Springer Science & Business Media, 2012.
3. Brostoff J, Seaddin JK, Male D, Roitt IM, Clinical Immunology, 6<sup>th</sup> Edition. Gower Medical Publishing, 2002.
4. Paul, Fundamental of Immunology, 4<sup>th</sup> Edition, Lippencott Raven, 1999.
5. Janeway, Immunobiology, 4<sup>th</sup> Edition, J Current Biology publications, 1999.
6. D. M. Weir, John Stewart, Immunology, 8<sup>th</sup> Edition, Churchill Livingstone, 1997.
7. P.J.Delves, I S.J.Artin, I D.R.Burton and I I.M.Roitt, Essential Immunotechnology, 12<sup>th</sup> Edition. Wiley & Blackwell, 2006.



**SEMESTER : IV**  
**CREDITS : 2**

**COURSE CODE : U16BT4P4**  
**TOTAL HOURS : 45**

### **CORE PRACTICAL II: BASICS OF IMMUNOLOGY LAB**

#### **Objectives:**

- To understand the basic immunological techniques.
1. Preparation of serum from blood
  2. Total WBC and RBC counting
  3. Differential Leukocyte count
  4. Agglutination reactions : blood grouping
  5. Immunodiffusion. ( Rocket)
  6. Dot Elisa Assay
  7. Demonstration: Preparation of Antibodies.
  8. Demonstration: A preface to Immunization and bleeding techniques

#### **REFERENCE BOOKS**

1. Lesile Hudson, Frank C.Hay, III edition. Practical Immunology. BlackwellScientific Publication, 1989.
2. Peakman M, and Vergani D, Basic and Clinical Immunology 2<sup>nd</sup> edition Churchill Livingstone Publishers, Edinberg, 2009.
3. Richard C and Geiffrey S, Immunology6th edition. Wiley Blackwell Publications, 2009.
4. Murphy K, Travers P, Walport M, Janeway's Immunobiology.7<sup>th</sup> edition Garland Science Publishers, New York, 2008.

**SEMESTER : V**  
**CREDITS : 6**

**COURSE CODE : U16BT505**  
**TOTAL HOURS : 90**

### **CORE V: MOLECULAR BIOLOGY**

#### **OBJECTIVE:**

- To understand the basic molecular concepts, Gene expression and regulation.
- To know the general principles of gene organization and expression in both prokaryotic and eukaryotic organisms.

#### **UNIT-I**

Structure of DNA and RNA- Composition, Types and Functions, Replication. Mechanisms - Enzymes involved in replication.

#### **UNIT-II**

Mutation: Origin and Classification - Types- Molecular Mechanism of Mutation- Detection of DNA damage at molecular level, Ames test, cytogenetic analysis in mammalian cells- in vitro and in vivo- Host mediated assay-

#### **UNIT-III**

DNA repair and recombination mechanisms. Transposons and transposable elements- Mechanism of transposition. Transcription and RNA processing: Transcription in Prokaryotes and Eukaryotes -Post transcriptional modifications.

#### **UNIT-IV**

Genetic code and Translation: Features of genetic code -Deciphering of the codon- Translation in Prokaryotes and Eukaryotes- Post translation modifications- Protein targeting.

#### **UNIT-V**

Cistron, muton and recon -exons and introns. Regulation of Gene expression: Regulation of gene expression in prokaryotes and eukaryotes - positive and negative control in prokaryotes- Operon models- Spatial and Temporal regulation of eukaryotic genes, mi RNA, siRNA, Micro-satellites.

## **TEXT BOOK**

1. Gupta. P.K, Cell and Molecular biology, Rastogi Publications, India, 2005.

## **REFERENCE BOOKS:**

1. Alberts, B., Bray, D., Hopkin, K., Johnson, A. D., Johnson, A., Lewis, J., Raff,M., Roberts, K., Walter, P, Essential Cell Biology, 3rd Edition. Garland science,USA, 2009.
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P, Molecular Biology of the Cell, 5th Edition, Garland Science, USA, 2008.
3. Lodish, H. Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M., Scott, M.P.Lawrence Z., Darnell, J, Molecular cell biology, 5th Edition. W. H. Freeman, USA, 2003.
4. Rastogi, S.C, Cell and Molecular Biology, 3rd Edition. New Age International Publishers, India, 2012.
5. Sathyanarayana U, Biochemistry, 3rd Edition. New Central Book Agency(p) Ltd, 1999.
6. Karp, G, Cell and Molecular Biology: Concepts and Experiments. 5<sup>th</sup>Edition. John Wiley and Sons, USA, 2007.
7. Cooper, G.M., Hausman, R.E, The cell Molecular approach, 5th Edition.American Society of Microbiology press, USA, 2009.

**SEMESTER : V**  
**CREDITS : 6**

**COURSE CODE : U16BT506**  
**TOTAL HOURS : 90**

### **CORE VI: GENETIC ENGINEERING**

#### **OBJECTIVES:**

- To understand the modern concept of Genetic Engineering and its applications.
- To know about the different areas of rDNA technology including DNA modifying enzymes, cloning strategies, analysis of expression and various modern techniques.

#### **Unit – I**

Enzymes in Recombinant Technology: Enzymes in Genetic engineering- Restriction endonucleases Type I & II, DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, T4 DNA ligase, Terminal deoxynucleotidyl transferase, Reverse transcriptase.

#### **Unit – II**

Vector: Different kinds of vector- Cloning and expression vectors. Cloning vectors for E. coli- Bacterial artificial chromosome (BAC), Cloning vectors for Eukaryotes- Yeast shuttle vector, Yeast artificial chromosome, Phage life cycle- Viral vector, phage vector, phagemids, cosmids.

#### **Unit – III**

Molecular cloning: Cloning strategies. Cloning System for amplifying different sized fragments, Cloning System for producing single-stranded and mutagenized DNA. Methods of introduction DNA into the cell - Microinjection, lipofection, electroporation, calcium precipitation, DEAE and biolistic.

## **Unit – IV**

Recombinant selection and screening - Construction of genomic libraries and cDNA Libraries. Principle of Nucleic acid hybridization assays, and microarrays.

## **Unit – V**

Polymerase chain Reaction and DNA sequencing: Polymerase chain reaction (PCR): key concepts, Applications of PCR: Ligase chain reaction. DNA Finger printing, RFLP and RAPD. Sequencing (chemical degradation; chain termination and automated sequence).

### **TEXT BOOKS**

1. Brown, T.A, Gene Cloning and DNA analysis: An Introduction, 6th Edition. Wiley-Blackwell, USA, 2010.
2. Primrose, S.B. Twyman, R.M, Principles of Gene Manipulation. 7th Edition, Wiley-Blackwell, USA, 2006
3. Jogdand, S.N, Gene biotechnology. Himalaya Publishing House, 2009

### **REFERENCE BOOK(S)**

1. Old, R.W and S.B. Primrose, Principles of Gene Manipulation: An Introduction to Genetic Engineering. Blackwell Scientific Publications, Oxford, 1996.
2. Glover, DM. and BD. Hames, DNA Cloning: A Practical Approach.. IRL Press, Oxford, 1995.
3. Innis, M.A., D.H. Gelfand and J.J. Sninsky, PCR Strategies.. Academic Press, San Diego, 1995
4. Persing, D.H., K T.F Smith, F.C. Teower and T.J.While, Diagnostic Molecular Microbiology. ASM Press, Washington D.C. 1993
5. Watson J.D., Gilman M., Witkowski, J., and Zoller M, Recombinant DNA. Scientific American Books, New York, 1992
6. Tvan R.S, Recombinant Gene Expression Protocols. Humana Press Inc., Tokowa, 1997.



**SEMESTER : V**  
**CREDITS : 2**

**COURSE CODE : U16BT5P5**  
**TOTAL HOURS : 60**

**CORE PRACTICAL III: MOLECULAR BIOLOGY AND GENETIC  
ENGINEERING LAB**

**Objectives:**

- To learn and develop skills in Molecular Biology Techniques.
1. Isolation of plasmid DNA from *E.coli*.
  2. Isolation of genomic DNA from animal tissue.
  3. Isolation of buccal cell DNA.
  4. Agarose gel electrophoresis of plasmid and genomic DNA.
  5. Restriction digestion of DNA. - Single and double digestion\*.
  6. PCR amplification, RFLP\*.
  7. Southern blotting\*
  8. Ligation\*.
  9. Transformation of *E. coli* with plasmid DNA using CaCl<sub>2</sub> \*.

\* Practical by demonstration only.

**REFERENCE BOOKS:**

1. Bisen, P.S,. Laboratory Protocols in Applied Life Sciences. CRC Press, 2014.
2. Sambrook, J., Russell, D.W, Molecular Cloning: A Laboratory Manual, Third Edition Cold Spring Harbor Laboratory Press, 2001.

**SEMESTER : V**  
**CREDITS : 5**

**COURSE CODE : U16BT5:1**  
**TOTAL HOURS : 75**

### **ELECTIVE I: PLANT PHYSIOLOGY**

#### **OBJECTIVE**

- To acquire a basic knowledge on how plants function.
- To understand the plant metabolism

#### **UNIT - I**

Photosynthesis : Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways.

#### **UNIT - II**

Respiration and photorespiration : Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

#### **UNIT - III**

Nitrogen metabolism: Nitrate and ammonium assimilation; amino acid biosynthesis.

#### **UNIT - IV**

Solute transport and photo assimilate translocation: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photo assimilates.

#### **UNIT- V**

Stress physiology : Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress.

#### **TEXT BOOKS**

1. Jain V.K, Fundamentals of Plant Physiology, 5th edition. S Chand & Co Ltd; New Delhi, 2000.

2. Salisbury, F. B. and Ross. E, Plant Physiology. Wadsworth, Belmont, California, USA, 1992.
3. Verma, S. K, Plant Physiology. S. Chand & Co., New Delhi, 1999.

**REFERENCE BOOK(S):**

1. Devlin, R. M. and Baker, Photosynthesis, Reinhold Affiliated East-West Press Pvt.Ltd, New Delhi, 1973.
2. Harold, F.M, The vital force; A study of bioenergetics. Freeman & Co., New York, 1986.
3. Hewitt, E.J. and cutting, C.V, Nitrogen metabolism of plants, Academic Press, 1979.
4. Leopold, A. C, Plant Growth and Development. Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1973.
5. Meyer, Anderson and Bonning, Introduction to Plant Physiology. D. VanNostrand, 1965..
6. Noggle, R. and Fritz, G. I, Introductory Plant Physiology. 2nd ed. Prentice Hall, New Delhi, 1989.

**SEMESTER : V**  
**CREDITS : 5**

**COURSE CODE : U16BT5:2**  
**TOTAL HOURS : 75**

### **ELECTIVE I: ECOLOGY**

#### **OBJECTIVE :**

- To understand the dynamics of our surroundings and to take proper measures to conserve it if and when required.
- To know structural adaptations and functional adjustments of organisms to their physical environment.
- To comprehend the inter-relationship between organisms in population and communities.

#### **UNIT -I**

**Concept of an Ecosystem:** Definition: Characteristics of an Ecosystem, Complete Nature of Ecosystem; Components of Ecosystems: Biotic and Abiotic Components.

#### **UNIT-II**

**Ecosystems:** Introduction, types and characteristic features of the Forest, Grassland, Desert and Aquatic (Pond, Ocean) ecosystems.

#### **UNIT-III**

**Population and Community Ecology:** Basic concepts, Population characteristics, Population dynamics, Characteristics of a community, Community structure, Community dynamics (ecological succession), Concept of Habitat and Niche.

#### **UNIT-IV**

**Environmental Pollution:** Cause, effects and control measures of : Air (CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, O<sub>3</sub> CFC, PAN, Green house effect), Water (Cd, Hg, Pb, F, As, BOD), Noise and Radiation (Strontium and Cesium) pollution., Solid waste management, Biomagnification, Methalmoglobinemia , Global warming and Climate change (cause and consequences).

#### **UNIT-V**

**Environmental Laws:** Environmental Impact Assessment, Environmental planning and National Environment Policy

**TEXT BOOK**

1. Misra S.P. and S.N. Pandey, Essential Environmental Studies. Anne Books Pvt.,Ltd., New Delhi, 2008.

**REFERENCE BOOKS:**

1. Sharma P.D, Environmental Biology and Toxicology, 1993.
2. Chapman, J.L. and M.J. Reiss, Ecology, Principle and Applications, Cambridge University Press, 1995.
3. De, A.K., Environmental Chemistry, Wiley Eastern Ltd., 1993.
4. Kormondy, E.J, Concept of Ecology, Prentice-Hall of India Pvt. Ltd., 1989.
5. Abbasi, S.A. and Abbasi, N, Renewable Energy Sources and their Environmental Impact, Prentice-Hall of India Pvt. Ltd., New Delhi, 2002.
6. Biotechnology of Biofertilizers. Edited by Sadasivam Kannaiyan, Kluwer Academic Publishers, 2002.

**SEMESTER : V**  
**CREDITS : 5**

**COURSE CODE : U16BT5:3**  
**TOTAL HOURS : 75**

## **ELECTIVE II: DEVELOPMENTAL BIOLOGY**

### **OBJECTIVE:**

- To understand the cell development and its stages.
- To comprehend the links of basic aspects of the cell with the advances in stem cell biology

### **UNIT-I**

Origin of developmental patterns: History, Anatomical tradition, Principles of development -life cycles, Developmental patterns and evolution of differentiation, Experimental embryology, Role of genes in development, Amniocentesis.

### **UNIT-II**

Early Embryonic Development: Gametogenesis- Spermatogenesis and oogenesis, Types of eggs, Fertilization changes in gametes, mono and polyspermy; the early development of *C. elegans* -The early development of Xenopus cleavage, Gastrulation, Embryonic induction and organizers; the early development of chick cleavage, Gastrulation.

### **UNIT-III**

Later Embryonic Development: Differentiation of germ layers-Formation of neural tube (development of CNS and eye), skin, notochord, somites, coelom and digestive tube (upto rudiments), Extraembryonic membranes in birds and human, Implantation of embryo, Placentation – structure, types and physiology of placenta.

### **UNIT-IV**

Post-Embryonic Development: Metamorphosis changes and hormonal regulation of metamorphosis in insects and amphibians, Regeneration modes of regeneration epimorphosis, Morphallaxis and compensatory regeneration (with one example), Ageing3 concepts and model (*C. elegans*)

### **UNIT-V**

Implications of Developmental Biology: Medical implications: Infertility – Diagnosing Infertility, IVF, Teratogenesis – teratogenic agents and effect of

teratogens on embryonic development;Embryonic stem cells –A new generation stem cells in biomedical field

### **TEXT BOOK**

Agarwal,V.K and Verma, P.S,Chordate Embryology S. Chand Publishing, New Delhi, 1995.

### **REFERENCES BOOKS**

1. Scott F Gilbert, Developmental Biology, X Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA, 2013
2. Balinsky, B.I, An introduction to Embryology, International Thomson Computer Press,London, UK, 2008.
3. Jonathan M. W. Slack, Essential Developmental Biology Wiley-Blackwell, Hoboken, New Jersey, United States, 2012.
4. Kalthoff, Analysis of Biological Development, II Edition, McGraw Hill Professional,New York, USA, 2000.

**SEMESTER : V**  
**CREDITS : 5**

**COURSE CODE : U16BT5:4**  
**TOTAL HOURS : 75**

## **ELECTIVE II: BASICS OF EVOLUTION**

### **Objective:**

- To understand the concepts of population genetics and product of evolution and their evidences.

### **UNIT-I**

Life's Beginnings: Chemogeny, Biogeny, Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism

### **UNIT-II**

Evidences of Evolution: Fossil record, Sources of variations: Heritable variations and their role in evolution

### **UNIT-III**

Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population Evolutionary forces upsetting H-W equilibrium. Natural selection and Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies

### **UNIT-IV**

Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches)



## **UNIT-V**

Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus* leading to *Homo sapiens*, molecular analysis of human origin.

### **TEXT BOOK:**

Agarwal, V.K and Verma, P.S. “Basis of Evolution” S.Chand Publishing, New Delhi, 1995

### **REFERENCE BOOKS**

1. Ridley, M Evolution III Edition Blackwell publishing, 2004
2. Hall, B.K. and Hallgrimson, B Evolution IV Edition. Jones and Barlett Publishers, 2008.
3. Campbell, N.A. and Reece J.B Biology. IX Edition. Pearson, Benjamin, Cummings, 2011.
4. Douglas, J. Futuyma ,Evolutionary Biology. Sinauer Associates, 1997
5. Pevsner, J, Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell, 2009.
6. Minkoff, E, Evolutionary Biology. Addison-Wesley, 1983.

**SEMESTER : V**  
**CREDITS : 2**

**COURSE CODE : U16BT5S2**  
**TOTAL HOURS : 30**

## **SBEC II: BASICS OF BIOSTATISTICS**

### **OBJECTIVE:**

- To know the computational, mathematical, and statistical approaches available to probe biological data, from DNA to biological processes of healthcare systems.

### **UNIT-I**

Biostatistics -definition -statistical methods-basic principles. Variables-measurements, functions, limitations and uses of statistics.

### **UNIT-II**

Collection of data primary and secondary -types and methods of data collection procedures -merits and demerits. Classification -tabulation and presentation of data -sampling methods.

### **UNIT-III**

Measures of central tendency -mean, median, mode, geometric mean -merits & demerits. Measures of dispersion -range, standard deviation, mean deviation, quartile deviation -merits and demerits; Co-efficient of variations.

### **UNIT-IV**

Correlation-types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression.

### **UNIT-V**

Statistical inference -hypothesis -simple hypothesis -student 't' test -chi square test.

### **TEXT BOOKS**

1. Panner Selvam R, Research Methodology. Prentice- Hall of India Private Limited, New Delhi, 2006
2. Pillai RSN and Bhavathy V) Statistics, S.Chand Company Ltd, 2005.

## REFERENCE BOOKS

1. S. Palanisamy and M. Manoharan, Statistical methods for Biologists. Palani Paramount Publication, Anna Nagar, Palani, T. N, 2002.
2. S.C. Gupta and K. Kapoor, Fundamentals of Applied Statistics. 3rd Edition. Sultan Sons Educational Publisher, N.D, 2002.
3. N. Gurumani, An introduction to Biostatistics. MJP Publishers, Chennai, 2002.
4. P.R. Vittal, and V. Malini, Statistical and Numerical Methods. Margham Publications, Chennai, 2002.
5. Thomas Clover and Kevin Mitchell, An introduction to Biostatistics. McGraw Hill Higher Education N., 2002..
6. Daniel, W.W, Biostatistics, New York, John Wiley Sons 1987.

**SEMESTER : V**  
**CREDITS : 2**

**COURSE CODE : U16BT5S3**  
**TOTAL HOURS : 30**

### **SBEC III: FOOD BIOTECHNOLOGY**

#### **Objectives**

- To understand the effects of biotechnology on food production, processing, and quality
- To know the Integration between molecular biology and biochemical pathways for food technology
- To learn the fermentation biotechnology of modern and traditional foods worldwide, including the bioprocessing of food waste

#### **UNIT I**

##### **Fermentation and Bioprocess Engineering in Food**

Fermentation Biotechnology of Traditional Foods, Fermentation Technology and Bioreactor Design, Technologies Used for Microbial Production of Food Ingredients, Process Developments in Solid-State Fermentation and submerged fermentation for Food Applications, Production of Amino Acids: Physiological and Genetic Approaches, Enzymatic Bioprocessing of food Wastes, Cold Active Enzymes in Food Processing, Enzyme Technology for the Dairy Industry, Enzymatic Synthesis of Oligosaccharides: Progress and Recent Trends.

#### **UNIT II**

##### **Molecular Biology and Genetic Engineering**

Principles of Biochemistry and Molecular Biology, Metabolic Engineering of microorganisms for Food Ingredients, Application of Microbial Molecular Techniques to Food Systems, Application of ELISA Assays for Detection and Quantification of Toxins in Foods, Biochemical Markers for Antioxidant Functionality, Genetics of Dairy Starter Cultures, Genetic Engineering of Baker's Yeast: Challenges and Outlook, Application of Transgenic Fish Technology in Sea Food Production

#### **UNIT III**

##### **Microbial Biotechnology in Food**

Microbial Biotechnology of Microbial metabolites and Food products Production, Biotechnology in Wine Yeast. Applications : Biotechnological Approaches to Improve Nutritional Quality and Shelf Life of Fruits and Vegetables, Solid-State Bioprocessing for Functional Food Ingredients and Food Waste Remediation.

#### **UNIT IV**

Microbial Production of Oils and Fats, Production of Pectinases and Utilization in Food Processing, Biotechnology of Citric Acid Production, Potential Uses of Cyanobacterial Polysaccharides in the Food Industry, Food Applications of Algae, Bioprocessing of Starch Using Enzyme Technology, Biotechnology in Wine Industry, Biotechnology of Nonnutritive Sweeteners.

#### **UNIT V**

Biosensors for Food Quality Assessment: International Aspects of the Quality and Safety Assessment of Foods Derived by Modern Biotechnology.

#### **References**

1. Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto and Robert E. Levin.. Food Biotechnology. CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, 2006
2. Sinosh Skariyachan / Abhilash M. Introduction to Food Biotechnology, CBS, 364 pages, 2012.
3. Byong H. Lee.. Fundamentals of Food Biotechnology, 2nd Edition, 544 pages, 2014.
4. Gustavo F. Gutierrez-Lopez. Food Science and Food Biotechnology. CRC Press Reference - 360 Pages, 2003.
5. Vinod K. Joshi and R. S. Singh. Food BiotechnologyI K International Publishing House; First Edition edition. 848 pages, 2012.
6. Watson, K. Industrial Biotechnology Volume 1. CBS. 544 pages, 2016.

**SEMESTER : VI**  
**CREDITS : 6**

**COURSE CODE : U16BT607**  
**TOTAL HOURS : 90**

## **CORE VII: INDUSTRIAL BIOTECHNOLOGY**

### **OBJECTIVES**

- To know the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- To apply the knowledge in industry for the bulk production of commercially important modern Bio products, Industrial Enzymes, Products of plant and animal cell cultures.

### **UNIT-I**

Exploitation of microorganisms and their products, screening, strain development strategies, immobilization methods, fermentation media, raw material used in media production, antifoaming agents, buffers, downstream processing.

### **UNIT-II**

Fermentation equipment and its uses, fermentor design, Types of fermentors and fermentations- single, batch, continuous, multiple, surface, submerged and solid state.

### **UNIT-III**

Industrial products from microorganisms- antibiotics: production of penicillin, streptomycin. Interferons, vaccines, hormones, vitamins.

### **UNIT-IV**

Enzymes from microbes: amylase, protease. Organic acids: citric acid, acetic acid, amino acids: glutamic acid, lysine.

### **UNIT-V**

Production of alcoholic beverages: beer and wine, biofuels: ethanol, methane, biogas.

### **TEXT BOOKS**

1. Dubey, R.C. and Maheswari, D.K. A Text book of microbiology. S. Chand & Company Ltd. New Delhi, 2005.

2. A.H. Patel Industrial Microbiology, Macmillan, 2011.

### **REFERENCE BOOKS**

1. Stanbury,P.F.,& Whitakar, A., Principles of Fermentation Technology, Pergamon Press, 1984.
2. Mansi.E.MT.El.,&C.F.A.Bryce, Fermentation Microbiology and Biotechnology, 3<sup>rd</sup>edn. CRC Press, 2011
3. BaileyandOllis, Biochemical Engineering Fundamentals, McGrawHill,Newyork, 1986.
4. CasidaL.E.Jr., Industrial Microbiology, New Age International Publishers, 2007 .

**SEMESTER : VI**  
**CREDITS : 5**

**COURSE CODE : U16BT608**  
**TOTAL HOURS : 90**

### **CORE VIII: ANIMAL BIOTECHNOLOGY**

#### **OBJECTIVE:**

- To understand the applications of biotechnology in animal products.
- To know about the basics of animal tissue culture, Animal products, production & improvement of them.

#### **UNIT-I**

Basic techniques in animal cell culture and organ culture: Cell lines- types and isolation, culture media-types and supplements, cell fusion, cell differentiation, maintenance and preservation of cell lines.

#### **UNIT-II**

Gene transfer: Gene transfer methods-mechanical, chemical, biological-viral-Adenovirus, Herpes simplex, Retrovirus

#### **UNIT-III**

Transgenesis: Transgenic animals production, applications of transgenic in agriculture and medicine, In-vitro fertilization and embryo transfer

#### **UNIT-IV**

Applications: Development of recombinant vaccines, monoclonal antibody their applications, human genome project and gene therapy.

#### **UNIT-V**

Secondary metabolites: Bioreactors for large scale culture of cells, Production of secondary metabolites/products: Insulin, growth hormones, interferon etc.



## **TEXT BOOKS**

1. Ramadass. P., Animal Biotechnology: Recent Concepts and Developments.MJP Publishers, India. 2008.
2. Singh. B., Gautam, S.K., Chauhan, M.S.. Text Book of Animal Biotechnology. The Energy and Resources Institute, TERI. 2013

## **REFERENCE BOOKS**

1. Ian Freshney, R., Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 6th edition. Wiley publications.
2. Mather, J.P and Barnes, D.. Animal cell culture methods (Methods in cell biology Vol. 57. Academic Press, London 1998.
3. Mehta, V.. Animal Biotechnology. Campus Books International, New Delhi,India. 2006
4. Sasidhara. S., Animal Biotechnology. MJP publishers, India. 2009
5. Holland, A.J., Johnson, A. Animal Biotechnology and Ethics. Springer. 1998.

**SEMESTER : VI**  
**CREDITS : 5**

**COURSE CODE : U16BT609**  
**TOTAL HOURS : 90**

### **CORE IX: PLANT BIOTECHNOLOGY**

#### **OBJECTIVES**

- To learn the basic principles and techniques involved in plant cell culture.
- To understand the concepts of transformation and achievements of biotechnology in plants.
- To apply knowledge of molecular concepts in different areas of plant Biotechnology including plant Tissue Culture, genetic engineering and transformation.

#### **UNIT-I**

Introductory history - Laboratory organization - sterilization techniques – nutrition for plant cells, types of media – MS – Nitsch&Nitsch media, Gamborg's media, White's Media. Structure and function of Growth regulators – Auxins, Cytokinins and Gibberellins. Establishment and maintenance of callus and suspension cultures. Somatic embryogenesis, cytology of callus. Green house effect.

#### **UNIT-II**

Haploid production, Anther and microspore culture. Gynogenesis, embryo culture and rescue in agricultural and horticultural crops. In vitro pollination and fertilization.

#### **UNIT-III**

Protoplast isolation, Culture regeneration, fusion. Somatic hybrids, cybrids, cryopreservation, Synthetic seeds – Terminator seed concept. Gene transfer techniques in plants. Applications of transgenic plants.

#### **UNIT-IV**

Plant micro propagation – micro grafting – *in vitro* clonal multiplication – clonal orchards – meristem culture and virus elimination shoot tip culture. Edible vaccines from plants – Banana, Watermelon.

## **UNIT-V**

Somaclonal and Gamatoclonal variation in vitro cultures, Secondary metabolites in plants - production –screening - applications. Role of tissue culture in agriculture, forestry. Biodiversity and conservation.

### **TEXT BOOKS**

1. Bhojwani, S.S., Razdon. R.. Plant Tissue Culture: Theory and Practice. Elsevier. 2010
2. Chawla, H.S.. Plant Biotechnology, Oxford and IBH, New Delhi. 2000
3. Glick, B.R., Pasternak, J.J.. Molecular biotechnology, Principle and applications of Recombinant DNA. ASM Press, Washington, D.C. 2002

### **REFERENCE BOOKS**

1. Gupta, P.K. Plant Biotechnology. Rastogi Publications, India. 2010
2. Mahipal Singh Shekhawat and Vikrant. S. Plant Biotechnology: In Vitro Principles, Techniques and Applications. MJP Publishers. 2010
3. Near Stewart, C., Plant Biotechnology and Genetics: Principles, Techniques and Applications. Wiley India Private Limited. 2013.
4. Singh, B.D. Plant Biotechnology. Kalyani Publishers, India. 2010.
5. Slater, A., Scott, N., Fowler, M.. Plant Biotechnology – The genetic manipulation of plants, 2nd Edition. Oxford University press, USA. 2008

**SEMESTER : VI**  
**CREDITS : 2**

**COURSE CODE : U16BT6P6**  
**TOTAL HOURS : 45**

**CORE PRACTICAL IV: INDUSTRIAL, PLANT AND ANIMAL  
BIOTECHNOLOGY LAB**

**Objectives:**

- To acquire knowledge on isolation and screening of industrially important organisms.
- To develop skills in plant & animal tissue culture

**INDUSTRIAL BIOTECHNOLOGY LAB**

1. Bacteriological analysis of food products.
2. Determining the quality of milk by MBRT.
3. Antibiotic sensitivity testing-Well and Disc methods.
4. Screening of cellulolytic organisms
5. Isolation and identification of major bacterial pathogens such as *Staphylococcus*, *Streptococcus* etc.
6. Isolation of lactobacillus from fermented foods

**PLANT BIOTECHNOLOGY LAB**

1. Micropropagation and indirect organogenesis
2. Induction and culture of Somatic Embryos
3. Measurement of plant cell growth (PCV, cell number, Wet and Dry Weights)
4. Seed culture technique; Production of Synthetic seeds.

**ANIMAL BIOTECHNOLOGY LAB**

1. Preparation of culture media and sterilization
2. Cell counting by haemocytometer
3. Viability testing by trypan blue
4. Giemsa staining
5. Isolation of cells from organ
6. Preparation of serum

**REFERENCE BOOKS:**

1. Chawala, H.S. Plant Biotechnology: Laboratory Manual for Plant Biotechnology. Oxford and IBM Publishing Co. Pvt Ltd. 2008
2. Gunasekaran, P. Lab Manual in Microbiology. New Age International Publications. 2007
3. Ian Freshney, R. Culture of animal cells: A manual of Basic technique and specialized application. Sixth Edition, Wiley –Blackwell. 2011

4. Purohit, S.S. Plant Biotechnology a Laboratory Manual. Agro-Bios. 2002
5. Rajan, S. Experimental Procedures in Life Sciences. Anjanaa Book House 2010

**SEMESTER : VI**  
**CREDITS : 5**

**COURSE CODE : U16BT6:1**  
**TOTAL HOURS : 75**

### **ELECTIVE III: HUMAN PHYSIOLOGY**

#### **OBJECTIVE:**

- To know about the anatomy and physiological systems of human beings.
- To understand the functioning of human organ system

#### **UNIT-I**

Digestive system: Anatomy of the digestive system, Salivary, Gastric and Biliary Secretions functions. Digestion and absorption of carbohydrates, Lipids and proteins.

#### **UNIT-II**

Body fluids: Plasma, Lymph & Blood. Blood- cells, Haemoglobin, blood coagulation.

#### **UNIT-III**

Circulation: Structure of Heart and blood vessels, Functions of heart. Respiration: Anatomy, and physiology of respiration.

#### **UNIT-IV**

Excretory system: Structure and functions of kidney. Urine- composition and formation. Renal regulation of acid-base balance.

#### **UNIT-V**

Central nervous system: General organization. Conduction of nerve impulse. Synaptic transmission. Brain chemical composition, neurotransmitters and Camp. Biochemical aspects of learning and memory.

#### **TEXT BOOK:**

Martini, Frederick Human Anatomy and Physiology 9<sup>th</sup> edition Pearson, Benjamin Cummings. 2012

#### **REFERENCES:**

1. Human Physiology: Vol I & II C.C. Chatterjee.
2. Functions of the Human body – Guyton A.C.
3. The living body-Best C.H, Taylor N.B.
4. Human Physiology-Systemic & applied-Sahalya.
5. Human Nutrition and Dietetics – Swaminathan, Bangalore printing and Pulv. Co. Ltd.
6. Review of Medical Physiology – Ganong, Appleton

**SEMESTER : VI**  
**CREDITS : 5**

**COURSE CODE : U16BT6:2**  
**TOTAL HOURS : 75**

## **BIOETHICS AND IPR**

### **OBJECTIVES:**

- To provide a comprehensive introduction on Bioethics
- To enhance the knowledge of the students on intellectual property rights

### **UNIT-I**

**15 HOURS**

**Introduction to Intellectual Property:** Types of IPR: Patents, Trademarks, Copyright & Related Rights, Design, Draft design, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO). IP rights in India - IPs of relevance to Biotechnology – few Case Studies.

### **UNIT-II**

**15 HOURS**

**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**

**15 HOURS**

**IPR Agreements and Treaties:** History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments. Patent and copyright Infringement, Patent and copyright misappropriation, and enforcement. Trade secret.

### **UNIT-IV**

**15 HOURS**

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

#### **UNIT-V**

**15 HOURS**

**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, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy – Ethical implications of human genome project

#### **TEXT BOOKS:**

1. Trayror Pc, Frederic R and Koch M (2002) Biosafety Board of Trustees. Michigan State University, USA.
2. Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.

#### **REFERENCE BOOKS:**

1. Paul RC (2000) Situation of Human Rights in India Efficient Offset Printers.
2. Belmont TL and Leroy W (1999), Cotemporary issue in Bioethics, Wards worth Publishing Co Belmont, California.
3. Vadakar Praveen (2000) Theories and practice of Human Rights, Rajat Publication.





**SEMESTER : VI**  
**CREDITS : 2**

**COURSE CODE : U16BT6PJ**  
**TOTAL HOURS : 60**

**PROJECT**

**SEMESTER : VI**  
**CREDITS : 2 + 1**

**COURSE CODE : U16BT6PJ**

**EXTENSION ACTIVITIES/ GENDER STUDIES**

**SEMESTER** : III/IV  
**CREDITS** : 2

**COURSE CODE** : U16BT3E1  
**TOTAL HOURS** : 30

### **NMEC I : BASICS OF BIOTECHNOLOGY**

#### **OBJECTIVE:**

- To know the basics and scope of biotechnology.
- To understand the information about DNA and genes and how it influences the function of the organism as a whole.

#### **UNIT-I**

Scope of Biotechnology. History of Biotechnology. Biotechnology Tree – Roots and Branches. Strategies of gene cloning.

#### **UNIT-II**

Tools used in gene cloning – Restriction endonucleases – Types – Features. Ligases – Linkers & adaptors. Modifying enzymes – Nucleotide kinase, Alkaline phosphates. Gene amplification by PCR.

#### **UNIT-III**

Vectors – Properties of good Vector .Constructed plasmids- pBR322. Cosmid vectors, Animal vectors- SV40. Plant vectors- Ti derivatives.

#### **UNIT-IV**

Introduction of genes – Vector mode – transformation and transfection. Vector less mode –Biolistics, Electroporation, Microinjection.

#### **UNIT-V**

Properties of *E.coli* as good hosts. Selection of recombinants – Reporter genes, Colony hybridization.

### **TEXT BOOK**

1. Dubey, R. C. A text book of Biotechnology, S.Chand& Company Ltd. New Delh , 2007.

### **REFERENCE BOOKS**

1. Old & Primrose, Principles of Gene Manipulation, 3rd edition, Blackwell Scientific Publications, Oxford, 1989.
2. Satyanarayana. U. Biotechnology, Books and Allied (p) Ltd, 2008.
3. Gupta P.K .Biotechnology and Genomics, Rastogi publication, 2004.
4. Brown, T.A. Gene cloning and DNA analysis, Blackwell science,Osney Mead, Oxford, 1996.
5. Singh, B. D .Biotechnology, Kalyani Publishers, New Delhi, 2004.

**SEMESTER : IV**  
**CREDITS : 2**

**COURSE CODE : U16BT4E2**  
**TOTAL HOURS : 30**

## **NMEC II: APPLIED BIOTECHNOLOGY**

### **OBJECTIVE:**

- To understand the various applications of biotechnology for the human welfare.
- To acquire knowledge related to the field of biopharmaceutical products

### **UNIT-I**

Plant biotechnology-Role of tissue culture in agriculture, horticulture and forestry, Edible Vaccines from plants – Banana, Watermelon.

### **UNIT-II**

Animal biotechnology-Production of Vaccines in animal Cells, Transgenic Animals – cloning, Applications of Transgenic mice and sheep.

### **UNIT-III**

Medical biotechnology-Gene therapy, Production and Applications of monoclonal antibodies, Somatic and Germ line Engineering, molecular diagnosis.

### **UNIT-IV**

Industrial biotechnology-Production of Microbial products- Alcoholic Beverage – Beer, Antibiotic – Penicillin Industrial uses of enzymes – Detergents, Leather, food and Pharmaceutical.

### **UNIT-V**

Environmental biotechnology-Microorganisms as Bio indicators, Genetic engineered microorganisms to degrade xenobiotics, Biological weapons and bioterrorism.

## **TEXT BOOK**

R. C. Dubey, A text book of Biotechnology, Rajendra Printer, New Delhi, 2001.

## **REFERENCE BOOK(S)**

1. Old & Primrose , Principles of gene manipulation, Blackwell Scientific Publications, Oxford, 1989.
2. M .M. Ranga, Animal Biotechnology ,Agrobios India, 2000.
3. R. Ian Freshney, Culture of Animal Cells, (4th Edition), *Wiley-Liss*.
4. Hawla, Introduction to Plant Biotechnology.(2nd edi) oxford and IBH publishers, 2003.
5. Satyanarayana. U, Books and Allied (p) Ltd, 2008.
6. A.H. Patel, Industrial Microbiology –MacMillan Publishers.
7. Gupta P.K, Biotechnology and Genomics,Rastogi publication.
8. T.A Brown, Gene cloning and DNA analysis, Blackwell science,Osney Mead, Oxford, 1996.