

B.Sc., BIOTECHNOLOGY

SYLLABUS

Under Choice Based Credit System (CBCS)

(For the students admitted in the academic year 2018–2019)



DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

BISHOP HEBER COLLEGE (Autonomous)

(Affiliated to Bharathidasan University)

(Nationally Reaccredited at the 'A' Grade by NAAC with the CGPA of 3.58 out of 4)

(Recognized by UGC as "College with potential for Excellence")

TIRUCHIRAPPALLI-620 017.

TAMILNADU, INDIA

B.Sc., BIOTECHNOLOGY PROGRAMME STRUCTURE

B.Sc Biotechnology Programme (2018–2019 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	English for Competitive Examinations	U16EGPL3	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	English through Literature	U16EGPL4	5	3	25	75	100	
	III	Core IV	Basics of Immunology (30.05.2017)		U16BT404	6	6	25	75	100
		Core Prac. IV	Basics of Immunology Lab (28.11.2017)		U16BT4P4	3	2	40	60	100
		Allied IV	Chemistry for Life Sciences		U17BTC44	4	3	25	75	100

			(02.06.2018)						
		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	Food Biotechnology (02.06.2018)	U16BT5S3	2	2	25	75	100
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
Total courses	43

SEMESTER : I
CREDITS : 4

COURSE CODE : U16BT101
HOURS/WEEK :4

CORE I: CELL BIOLOGY

OBJECTIVES:

- To know about the basic concepts of cell and its functions.
- To understand the structural features of organelles and the cellular mechanisms.
- To learn about the causes of cancer, prevention and treatment.

UNIT-I

12 Hours

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

UNIT-II

12 Hours

Cellular Organelles-structure and functions: ER-rough and smooth, Ribosomes, Golgi apparatus, Plastids, Vacuoles, Lysosomes, Peroxisomes and Microbodies.

UNIT-III

12 Hours

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

UNIT-IV

12 Hours

Cell division: Mitosis and Meiosis-Cell Cycle-Regulation of Cell cycle- Cell signalling- cell surface receptors, G protein coupled Receptors.

UNIT-V

12 Hours

Cancer: The development and causes of cancer, oncogenes, tumor suppressor genes, apoptosis, prevention and treatment.

TEXT BOOK:

1. Gupta. P.K.Cell and Molecular biology. Rastogi Publications, India, 2010.

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
HOURS/WEEK : 4

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

12 Hours

Milestones and scope of microbiology: 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

12 Hours

Introduction to microscopy: 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

12 Hours

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

UNIT-IV

12 Hours

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

UNIT-V

12 Hours

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
HOURS/WEEK : 3

CORE PRACTICAL I : CELL BIOLOGY LAB

OBJECTIVES:

- To develop skills in basics of cell biology.
 - To identify and analyse the structural features of cells of plants and animals
1. Mitosis in onion root tips.
 2. Meiosis in Grasshopper.
 3. Barr body staining from buccal epithelial cells.
 4. Preparation of giant /Polytene chromosomes from chironomous larvae.
 5. DNA isolation from buccal cells.
 6. Cell Staining – lignin

REFERENCE BOOKS:

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

SEMESTER : I/II
CREDITS : 3

COURSE CODE :U16BTYP1
HOURS/WEEK: 3

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
HOURS/WEEK : 6

CORE II : BIOCHEMISTRY

OBJECTIVES:

- 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

16 Hours

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

UNIT – II

16 Hours

Carbohydrates: Classification, properties, structure and biological functions of monosaccharides (glucose, fructose) Oligo saccharides (lactose, galactose) and polysaccharides. (glycogen, starch, cellulose, agarose). glycolysis, krebs cycle, pentose shunt pathway, oxidative phosphorylation- Electron transport chain.

UNIT – III

16 Hours

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

16 Hours

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

UNIT – V

16 Hours

Nucleic acids & Enzymes: Types of DNA and RNA. Composition and structure. Denaturation and renaturation. DNA synthesis: Denovo and salvage pathway. 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. 2010. Fundamentals of Biochemistry,

Fifth Edition, S. Chand and Company Ltd, New Delhi.

2.

REFERENCE BOOKS:

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

SEMESTER : II
CREDITS : 4

COURSE CODE : U16BT2Y2
HOURS/WEEK : 4

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

12 Hours

Aquatic Microbiology: Potability of water – Microbial assessment of water quality – major water borne diseases and their control measures. Physical, chemical and microbial assessment of water and potability test for water. Colour, pH, alkalinity, acidity, COD, BOD, anions and cations.

UNIT -II

12 Hours

Food Microbiology: Contamination, spoilage and preservation of various food products. Food borne diseases, intoxication and food poisoning. Food preservations: principles-methods of preservation-Physical and chemical methods. Food sanitations - GMP- HACCP

UNIT -III

12 Hours

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

UNIT -IV

12 Hours

Environmental Microbiology: Positive and negative roles of microbes in environment: Waste water recycling, Biodegradation of recalcitrant compounds - lignin – pesticides. Bioaccumulation of metals and detoxification. Biopesticides, Biodeterioration of paper. Leather, wood, textiles and metal corrosions.

UNIT -V

12 Hours

Medical Microbiology: 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, 4th 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
HOURS/WEEK : 3

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. pHmetry -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 Practical Biochemistry. 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
HOURS/WEEK : 2

SBEC I: BASICS OF BIOINFORMATICS

OBJECTIVES:

- 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

6 Hours

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

Unit II

6 Hours

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

6 Hours

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

6 Hours

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

6 Hours

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, Himalaya Publishing House, Mumbai, 2005.

REFERENCE BOOKS:

1. Attwood, T.K. and Parry Smith, D.J, Introduction to Bioinformatics, Pearson Education Ltd., New Delhi, 2004.

2. Manik and 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. Pennington & Dunn, Proteomics, Viva books publishers, New Delhi, 2002
6. Andreas Baxevanis and Francis Ouellette, Bioinformatics- A practical guide to the analysis of genes & protein, Wiley-Blackwell, Third Edition, 2004
7. The ABCs of internet, Christian Crumlish. Sybex Inc., U.S, 1996

SEMESTER : III
CREDITS : 5

COURSE CODE : U16BT303
HOURS/WEEK : 6

CORE III: GENETICS

OBJECTIVES:

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

UNIT-I

16 HOURS

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

UNIT-II

16 HOURS

Alleles and Genes: 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

16 HOURS

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

UNIT-IV

16 HOURS

Experimental evidence for DNA as the genetic material: transformation, transduction, conjugation. Fine structure of Gene, cistron and recon, Structure of Prokaryotic and Eukaryotic gene, cytoplasmic genetic systems- mitochondria and chloroplast DNA.

UNIT-V

16 HOURS

Developmental Genetics: 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
HOURS/WEEK : 4

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

15 HOURS

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

15 HOURS

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 rings. Preparation, Structure, acidic and basic character of pyrrole, furan and pyridine.

UNIT-I

15 HOURS

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_b of buffer solutions. Henderson – Hassel Balch equation.

UNIT-I

15 HOURS

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

UNIT-I

15 HOURS

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, (23rd 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, 12th edition, New Delhi, Sultan Chand and Co, 1997.
5. United States Pharmacopeia Dispensing Information's, USPDI, Rockvilla, Maryland, 1981..
6. The Indian pharmacopoeia 3rd 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
CREDITS : 2

COURSE CODE : U16BT3P3
HOURS/WEEK : 3

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. Study of polyploidy in onion root tip.
 4. Experiments to determine Mendel's law.
 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
HOURS/WEEK : 3

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 KMnO_4
 - iv) Estimation of ferrous sulphate using 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
- b) Test for Functional groups**
- i) Carbohydrate
 - ii) Diamide
 - iii) Aldehyde
 - iv) Ketone
 - v) Acid
 - vi) Amine
- c) Demonstration**
- Preparation of Buffer solution
 - Determination of pH using pH meter
 - Preparation of standard solution (Molar, ppm & Normal)

REFERENCE BOOK:

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
HOURS/WEEK : 6

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

18 Hours

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

18 Hours

Immune system and its mechanism: Primary and Secondary organs of immune system – structure and function, Haematopoiesis - 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

18 Hours

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

18 Hours

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

Unit IV

18 Hours

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

SEMESTER : IV
CREDITS : 3

COURSE CODE : U16BTC44
HOURS/WEEK : 4

CHEMISTRY FOR LIFE SCIENCES

OBJECTIVES:

- To understand the chemistry of biomolecules.
- To learn the elementary concepts of chemical analysis
- To learn the principles of analytical techniques like chromatography and colorimetry.

UNIT- I Chemistry of Biomolecules

12 HOURS

Classification of carbohydrates, glucose & fructose – preparation – properties – mutarotation, interconversion of glucose and fructose, manufacture of sucrose, test for sugars, Amino acids – preparation and properties of glycine and alanine, peptides (elementary treatment) – proteins – classification based on physical properties and biological functions- structure of proteins –primary and secondary –Test for proteins.

Coordination compounds: Biological role of haemoglobin and chlorophyll

UNIT-II Chemistry of Water

12 HOURS

Water as a universal solvent – hardness of water – permanent and temporary hardness, disadvantage of hard water – DO, BOD and COD – definition, determination (any one method). Water Softening methods – zeolite process, reverse osmosis. Preparation of Deionised water – Distilled water – Double Distilled water – Packaged drinking water.

UNIT-III Basics of Quantitative Analysis

12 HOURS

Error Analysis: accuracy, precision, determinate and indeterminate errors, relative error, absolute error. Quantitative analysis: Titrimetric – principle, acid – base titrations and redox titrations with examples – End point and equivalence points. Theory of Indicators- Types of indicators – Quinonoid theory.

UNIT-IV Analytical Techniques

12 HOURS

Chromatography – introduction – principles, sampling and applications of paper, thin layer and column chromatography. Colorimetry: Beer – Lambert's Law, components of a colorimeter (Block diagram), application (estimation of iron).

UNIT- V Types of Reactions

12 HOURS

Types of chemical reactions – substitution (one example for Nucleophilic and electrophilic with mechanism) – Addition (Addition of HBr on alkenes) – Elimination (Dehalogenation of alkyl halides) – Condensation (formation of ester) – Polymerisation (Formation of Poly vinyl Chloride) – Reduction reaction (Hydrogenation of oil) – Oxidation (KMnO₄ for conversion of benzaldehyde to benzoic acid). Types of intermediates- Electrophiles – nucleophiles – free radicals

REFERENCE BOOKS:

1. Tiwari K.S., Melhotra S.N., Vishnoi N.K, A Text book of Organic Chemistry, Vikas Publishing House Pvt. Ltd., New Delhi, 2006 (Unit-I, V)
2. R. Gopalan, P. S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand and Sons, New Delhi, 1997(Unit- IV)
3. Puri B.R., Sharma L. R., Kalia K.K, Principles of Inorganic Chemistry-23 rd edition, New Delhi, ShobanLalNagin Chand & Co, 1993(Unit- I, III)
4. Puri B.R., Sharma L. R., Kalia K.K, Principles of physical Chemistry, 23 rd edition, New Delhi, ShobanLalNagin Chand & Co, 1993(Unit-II)
5. R.T. Morrison &R.N.Boyd, Study Guide to Organic Chemistry, Prentice Hall, New Delhi, 2000
6. R.L. Madan and G.D.Tuli, Inorganic Chemistry, S. Chand Co., Ltd., New Delhi, 2003
7. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House, Meerut, 2000

SEMESTER : IV
CREDITS : 2

COURSE CODE : U16BT4P4
HOURS/WEEK : 3

CORE PRACTICAL II: BASICS OF IMMUNOLOGY LAB

OBJECTIVES:

- To understand the basic immunological techniques.
1. Preparation of serum from blood
 2. To perform 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, Blackwell Scientific Publication, 1989.
2. Peakman M, and Vergani D, Basic and Clinical Immunology, 2nd edition Churchill Livingstone Publishers, Edinberg, 2009.
3. Richard C and Geiffrey S, Immunology, 6th edition, Wiley Blackwell Publications, 2009.
4. Murphy K, Travers P, Walport M, Janeway's Immunobiology, 7th edition Garland Science Publishers, New York, 2008.

SEMESTER : V
CREDITS : 6

COURSE CODE : U16BT505
HOURS/WEEK : 6

CORE V: MOLECULAR BIOLOGY

OBJECTIVES:

- 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

18 Hours

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

Unit II

18 Hours

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

18 Hours

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

18 Hours

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

Unit V

18 Hours

Regulation of gene expression in prokaryotes: 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.
2. Rastogi, S.C, Cell and Molecular Biology, 3rd Edition. New Age International Publishers, India, 2012.

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. Sathyanarayana U, Biochemistry, 3rd Edition. New Central Book Agency(p) Ltd, 1999.
5. Karp, G, Cell and Molecular Biology: Concepts and Experiments. 5th Edition. John Wiley and Sons, USA, 2007.
6. 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
HOURS/WEEK : 6

CORE VI: GENETIC ENGINEERING

OBJECTIVES:

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

UNIT I

18 Hours

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

18 Hours

Vector: Different kind 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

18 Hours

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

18 Hours

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

UNIT V

18 Hours

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 BOOKS:

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
HOURS/WEEK : 4

CORE PRACTICAL III: MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

OBJECTIVE:

- To learn and develop skills in Molecular Biology Techniques.

1. Isolation of plasmid DNA from bacteria.
2. Isolation of genomic DNA from animal tissue.
3. Isolation of genomic DNA from plant.
4. Isolation of buccal cell DNA.
5. Agarose gel electrophoresis of plasmid and genomic DNA.
6. Restriction digestion of DNA. - Single and double digestion*.
7. PCR amplification*, RFLP*.
8. Southern blotting*
9. Ligation*.
10. Transformation of E. coli with plasmid DNA using CaCl₂ *.

*** 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
HOURS/WEEK : 5

ELECTIVE I: PLANT PHYSIOLOGY

OBJECTIVES:

- To acquire a basic knowledge on functioning of plants.
- To understand the plant metabolism

UNIT - I

15 HOURS

Photosynthesis : Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C₃, C₄ and CAM pathways.

UNIT - II

15 HOURS

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

UNIT - III

15 HOURS

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

UNIT - IV

15 HOURS

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

15 HOURS

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 BOOKS:

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
HOUR/WEEK : 5

ELECTIVE I: ECOLOGY

OBJECTIVES:

- To understand the dynamics of our surroundings and to take proper measures to conserve it.
- 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

15 HOURS

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

UNIT - II

15 HOURS

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

UNIT - III

15 HOURS

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

15 HOURS

Environmental Pollution: Cause, effects and control measures of : Air (CO₂, SO₂, NO_x, O₃, CFC, PAN, Green house effect), Water (Cd, Hg, Pb, F, As, BOD), Noise and Radiation (Strontium and Cesium) pollution., Solid waste management, Biomagnification, Methemoglobinemia, Global warming and Climate change (cause and consequences).

UNIT - V

15 HOURS

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, Rastogi publications, 2005.
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
HOURS/WEEK : 5

ELECTIVE II: DEVELOPMENTAL BIOLOGY

OBJECTIVES:

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

UNIT - I

15 HOURS

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

15 HOURS

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 chick cleavage, Gastrulation.

UNIT - III

15 HOURS

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

UNIT - IV

15 HOURS

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

15 HOURS

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:

1. 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
HOURS/WEEK : 5

ELECTIVE II: BASICS OF EVOLUTION

OBJECTIVES:

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

UNIT - I

15 HOURS

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

UNIT - II

15 HOURS

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

UNIT - III

15 HOURS

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

15 HOURS

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

15 HOURS

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

TEXT BOOK:

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

REFERENCE BOOKS:

1. Ridley M, Evolution, II Edition, Oxford University Press, 2004
2. Hall, B.K. and Hallgrimson, B Evolution IV Edition. Jones and Barlett Publishers, 2008.
3. Reece J.B, Urry L.A, Cain, M.L, Campbell Biology, IX Edition, 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
HOURS/WEEK : 2

SBEC II: BASICS OF BIOSTATISTICS

OBJECTIVES:

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

UNIT - I

6 HOURS

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

UNIT - II

6 HOURS

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

6 HOURS

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

6 HOURS

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

UNIT - V

6 HOURS

Statistical inference: hypothesis -simple hypothesis -student 't' test -chi square test. ANOVA,SPSS.

TEXT BOOKS:

1. PannerSelvam 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
HOURS/WEEK : 2

SBEC III: FOOD BIOTECHNOLOGY

OBJECTIVES:

- This course is designed to give adequate knowledge on food technology so as to train the student's entrepreneurs.
- To understand the role of nutrition on different age groups.
- To know about the quality control management of food products.

UNIT I

6 HOURS

Food – Uses, Nutrition: types of Nutrition, Food used in different ages – infants, children, school age, adult, pregnant women and old age. Importance of mother milk.

UNIT II

6 HOURS

Food chemistry: Constituent of food - contribution to texture, flavor and organoleptic properties of food; food additives - intentional and nonintentional and their functions; enzymes in food processing.

UNIT III

6 HOURS

Food Processing: Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations - mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing.

UNIT IV

6 HOURS

Food Preservation: Use of high temperatures - sterilization, pasteurization, blanching, canning - concept, procedure & application; Low temperature storage - freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods.

UNIT V

6 HOURS

Manufacture of food products: Bread and baked goods, dairy products - milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages.

TEXT BOOKS:

1. Crosby, N.T. 1981. Food packaging. Materials Applied Science Publishers, London.
2. David, S. Robinson. 1997. Food Chemistry and nutritive value. Longman group, UK.
3. Frazier, W.C. and Westhoff, D.C. 1988. Food Microbiology. 4th Edition. McGraw- Hill, New York.
4. Pyke, M. 1981. Food Science and Technology. 4th Edition. John Murray, London.
5. Sivasankar, B. 2002. Food processing and preservation. Prentice Hall, New Delhi.

REFERENCE BOOKS:

1. Brenner, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E.V. 1979. Food engineering Operations. 2nd Edition. Applied Sciences Pub. Ltd., London.
2. Desrosier, N.W. 1996. The Technology of Food Preservation. CBS Publishers and Distributors, New Delhi.
3. Fennema, O.R. 1976. Principles of food science: Part I, Food chemistry, Marcel Dekker, New York.
4. Lindsay, W. 1988. Biotechnology, Challenges for the flavor and food Industries. Elsevier Applied Science.

SEMESTER : VI
CREDITS : 6

COURSE CODE : U16BT607
HOURS/WEEK : 6

CORE VII: INDUSTRIAL BIOTECHNOLOGY

OBJECTIVES:

- To know the overall industrial bioprocess in order to manipulate the process to the requirement of the industrial needs.
- To apply the knowledge for the production of commercially important Industrial Enzymes, plant and animal cell cultures.

UNIT-I

18 HOURS

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

18 HOURS

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

UNIT-III

18 HOURS

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

UNIT-IV

18 HOURS

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

UNIT-V

18 HOURS

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. Patel, A.H. 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, 3rdedn. CRC Press, 2011
3. Bailley and Ollis, Biochemical Engineering Fundamentals, McGrawHill, Newyork, 1986.
4. Casida L.E.Jr., Industrial Microbiology, New Age International Publishers, 2007.

SEMESTER : VI
CREDITS : 5

COURSE CODE : U16BT608
HOURS/WEEK : 5

CORE VIII: ANIMAL BIOTECHNOLOGY

OBJECTIVES:

- 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

18 HOURS

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

18 HOURS

Gene transfer: Gene transfer methods-mechanical (microinjection, electroporation), chemical, (CaCl₂, PEG, liposome) biological-viral-Adenovirus, Herpes simplex, Retrovirus

UNIT-III

18 HOURS

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

UNIT-IV

18 HOURS

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

UNIT-V

18 HOURS

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.
6. Holland, A.J., Johnson, A. 1998. Animal Biotechnology and Ethics. Springer.

SEMESTER : VI
CREDITS : 5

COURSE CODE: U16BT609
HOURS/WEEK : 5

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

18 HOURS

Lab Organization and Sterilization: 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.

UNIT-II

18 HOURS

Establishment and maintenance of callus and suspension cultures: Somatic embryogenesis, cytology of callus. Haploid production, Anther and microspore culture. Gynogenesis, embryo culture and rescue in agricultural and horticultural crops. In vitro pollination and fertilization. Green house effect.

UNIT-III

18 HOURS

Culture regeneration and gene transfer methods: 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

18 HOURS

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

18 HOURS

Somaclonal and Gametoclonal 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., Razdan. 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

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
HOURS/WEEK : 2

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. Citric acid production.
4. Wine production & alcohol fermentation process.
5. Screening and isolation of extra cellular enzyme producing organisms
6. Demonstration of fermenter assembly and operations

PLANT BIOTECHNOLOGY LAB

1. Aseptic seed germination
2. Direct organogenesis – shoot and root induction
3. indirect organogenesis – callus induction
4. Seed culture technique - Production of Synthetic seeds.

ANIMAL BIOTECHNOLOGY LAB

1. Preparation of animal cell culture media and sterilization
2. Demonstration of primary cell culture
3. Viability and cell count g by trypan blue.

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
HOURS/WEEK : 5

ELECTIVE III: HUMAN PHYSIOLOGY

OBJECTIVES:

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

UNIT-I

15 HOURS

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

UNIT-II

15 HOURS

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

UNIT-III

15 HOURS

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

UNIT-IV

15 HOURS

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

UNIT-V

15 HOURS

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:

1. Martini, Frederick Human Anatomy and Physiology 9th edition Pearson, Benjamin Cummings. 2012

REFERENCE BOOKS:

1. Chatterjee, Human Physiology: Vol I & II, CBS Publishing, 11 edition 2016
2. Guyton A.C, Functions of the Human body, Saunders (W.B.) Co Ltd, 4th edition, 1974
3. Best C.H, Taylor N.B, The living body, Chapman & Hall Publishing, 1954
4. Human Nutrition and Dietetics – Swaminathan, Bangalore printing and Pulv. Co. Ltd, 1996
5. Barrett K, Ganong's Review of Medical Physiology, McGraw Hill Education; 24 edition, 2012

SEMESTER : VI
CREDITS : 5

COURSE CODE : U16BT6:2
HOURS/WEEK : 5

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
HOUR/WEEK :2

PROJECT

SEMESTER : VI
CREDITS : 2 + 1

EXTENSION ACTIVITIES/ GENDER STUDIES

SEMESTER : III/IV
CREDITS : 2

COURSE CODE : U16BT3E1
HOURS/WEEK : 2

NMEC I : BASICS OF BIOTECHNOLOGY

OBJECTIVES:

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

UNIT-I

6 HOURS

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

UNIT-II

6 HOURS

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

UNIT-III

6 HOURS

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

UNIT-IV

6 HOURS

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

UNIT-V

6 HOURS

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 Delhi, 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
HOURS/WEEK : 2

NMEC II: APPLIED BIOTECHNOLOGY

OBJECTIVES:

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

UNIT-I

6 HOURS

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

UNIT-II

6 HOURS

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

UNIT-III

6 HOURS

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

UNIT-IV

6 HOURS

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

UNIT-V

6 HOURS

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

TEXT BOOK:

1. Dubey R. C, A text book of Biotechnology, Rajendra Printer, New Delhi, 2010.

REFERENCE BOOKS:

1. Old & Primrose , Principles of gene manipulation, Blackwell Scientific Publications, Oxford, 1989.
2. Ranga M. M, Animal Biotechnology, Agrobios, India, 2000.
3. Ian Freshney R, Culture of Animal Cells, Wiley-Blackwell; 6th Revised edition, 2010
4. Hawla, Introduction to Plant Biotechnology.(2nd edi) oxford and IBH publishers, 2003.
5. Satyanarayana. U, Books and Allied (p) Ltd, 2008.
6. Patel A.H, Industrial Microbiology, Laxmi Publications, Second edition 2011.
7. Gupta P.K, Biotechnology and Genomics,Rastogi publication, 6th reprint 2013.
8. T.A Brown, Gene cloning and DNA analysis, Blackwell science, Osney Mead, Oxford, 1996.