Curriculum for B. Sc Biotechnology

For the Candidates admitted in 2022-2023 onwards
Under Autonomous, CBCS & OBE pattern

DEPARTMENT OF BIOTECHNOLOGY

VIVEKANANDHA
COLLEGE OF ARTS AND SCIENCES FOR WOMEN
[AUTONOMOUS]

An ISO 9001:2015 Certified Institution | Affiliated to Periyar University
Approved by AICTE | Re-accredited with "A" Grade by NAAC|
Recognized Under 2(f) and 12 (b) of UGC Act, 1956.
Elayampalayam, Tiruchengode-637 205, Namakkal Dt., Tamil Nadu, India

B.Sc BIOTECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO: 1	Biotechnology graduate students shall attain professional/industrial expertise by developingcompetent, creative and ever ready personality to accept recent, innovative and challenging roles in Industry and Academic and Research sectors
PEO: 2	Students shall inculcate in the development of entrepreneurial traits in order to cuddle innovative opportunities by adapting emerging biotechnological concepts in terms of techniques with subsequent development of leadership in the course of start-up of small-medium scale biotech based industry
PEO: 3	Students shall progressively adapt, follow and learn the concepts of biotechnologycontinuously by aiding modern teaching tools
PEO: 4	Imparting the basic and outstanding knowledge in all terms of biotechnology
PEO: 5	Students shall acquire the concepts to disseminate the advanced biotechnological aspects andits cutting edge developments in specific and developing area in the field of Biotechnology

PROGRAMME OUTCOMES (POs)

GRADE	OUTCOME
PO: 1	To train and develop students with the much needed biotechnological education, so that they develop added competitive skill metrics (CSM) for industrial employment higher education and employment upon graduation
PO: 2	To comprehend the assorted knowledge of biotechnical concepts domains and their applicability in the development of value added products for the welfare of the society
PO: 3	To develop a broad range of biotechnological skills and knowledge, development of general and specific competences to meet-out current expectations and requirements of medical, pharmaceutical, bio-molecular and agricultural sectors
PO: 4	To understand and merge the knowledge and concepts of biochemical, biophysical and bio statistical domains
PO: 5	To clarify various challenges in health care by integrating different biological domains including clinical, immunological, pharmaceutical and cancer genomics

PROGRAMME SPECIFIC OUTCOMES (PSOs)

GRADE	SPECIFIC OUTCOME
PSO: 1	To provide solutions for the challenges faced by pharmaceutical and molecular diagnostic Sectors
PSO: 2	To provide technical products with high frequency of reproducibility to the society
PSO: 3	To gain vertical mobility in career that will make students more competent to face national/international qualifying exams with practical knowledge acquaintance and in modern biotechnology field
PSO: 4	To solve complex problems in the field of Biotechnology with an understanding of social, ethical, legal and cultural aspects of the society
PSO: 5	To understand the over-all theme/concepts of each specialization in biotechnology and analyzing the frequency of its applicability in industry, research and for the goodness of Society

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)

Elayampalayam – 637 205, Tiruchengode, Tamilnadu

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., Biotechnology Curriculum (Autonomous, CBCS & OBE pattern)

SCHEME OF EXAMINATION

(For the Candidates admitted during the academic year 2022-2023 onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theor	Practica	Internal	External	Total
Semester - I							
Language I Courses (Any one course)							
21U1LT01	Tamil I	3	6	-	25	75	100
21U1LM01	Malayalam I						
21U1LH01	Hindi I						
21U1LF01	French I						
Language II Course							
21U1CE01	Communicative English	3	6	-	25	75	100
21U1LSPE01	Professional English			-	25	75	100
Core Courses							
22U1BTC01	Cell Biology	4	4	-	25	75	100
22U1BTC02	Basics in Lab Safety	2	2	-	25	75	100
22U1BTCP01	Lab in Cell Biology	3	-	3	40	60	100
Allied Courses							
22U1BCA01	Biochemistry I	4	4	-	25	75	100
22U1BCAP01	Lab in Biochemistry I	3	-	3	40	60	100
Mandatory course (Value Education)							
17U1VE01	Yoga	2	2	-	25	75	100
Total		**24**	**24**	**6**	**255**	**645**	**900**
Semester – II							
Language I Courses (Any one course)							
21U2LT02	Tamil II	3	6	-	25	75	100
21U2LM02	Malayalam II						
21U2LH02	Hindi II						
21U2LF02	French II						
Language II Course							
21U2CE02	Communicative English	3	6	-	25	75	100
21U2LSPE02	Professional English			-	25	75	100
Core Courses							
22U2BTC03	Basic calculations in Biology	4	4	-	25	75	100
22U2BTC04	Genetics	2	3	-	25	75	100
22U2BTCP02	Lab in basic biology calculations	3	-	2	40	60	100
Allied Courses							
22U2MBA02	Microbiology	4	4	-	25	75	100
22U2MBAP02	Lab in Microbiology	3	-	3	40	60	100
Mandatory course (Value Education)							
22U2BTVE01	Environmental Sciences	2	2	-	25	75	100
Research Activity							
22U2BTPR01	Micro Project	-	-	-	40	60	100
Total		**24**	**25**	**5**	**295**	**705**	**1000**

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., Biotechnology Curriculum (Autonomous, CBCS & OBE pattern)

SCHEME OF EXAMINATION

(For the Candidates admitted during the academic year 2022-2023 onwards)

Semester – III							
Language I Courses (Any one course)							
21U3LT03	Tamil III	3	6	-	25	75	100
21U3LM03	Malayalam III						
21U3LH03	Hindi III						
21U3LF01	French III						
Language II Course							
21U2CE02	Communicative English	3	6	-	25	75	100
Core Courses							
22U3BTC05	Molecular Biology	4	4	-	25	75	100
22U3BTCP03	Lab in Molecular Biology	3	-	3	40	60	100
Allied Courses							
18U1BCA03	Plant Science	4	4	-	25	75	100
18U1BCAP03	Lab in Plant Science	3	-	3	40	60	100
Skill based Elective course (SBEC) -I							
22U3BTS01	Forensic Sciences & Technology	2	2	-	25	75	100
22U3BTS02	Food Biotechnology						
Non-Major Elective Course (NMEC) - I							
22U3BTN01	Biosafety, Bioethics & IPR	2	2	-	25	75	100
22U3BTN02	Bioinformatics						
Total		**24**	**24**	**6**	**230**	**570**	**800**
Semester - IV							
Language I Courses (Any one course)							
21U4LT04	Tamil IV	3	6	-	25	75	100
21U4LM04	Malayalam IV						
21U4LH04	Hindi IV						
21U4LF04	French IV						
Language II Course							
21U2CE02	Communicative English	3	6	-	25	75	100
Core Courses							
22U4BTC06	Genetic Engineering	4	4	-	25	75	100
22U4BTCP04	Lab in Genetic Engineering	4	-	3	25	75	100
Allied Courses							
22U4ZOA02	Developmental Biology	3	3	-	25	75	100
22U4ZOAP02	Lab in Developmental Biology	3	-	3	40	60	100
Skill based Elective course (SBEC) -II							
22U4BTS03	Poultry science	2	2	-	25	75	100
22U4BTS04	Marine Biotechnology						
Non-Major Elective Course (NMEC) - II							
20U4BTN03	Concepts of Biotechnology	2	2	-	25	75	100
20U4BTN04	Biotechnology for Society						
Research Activity							
22U4BTPR02	Mini Project	-	-	1	40	60	100
Total		**24**	**23**	**7**	**255**	**645**	**900**

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SCHEME OF EXAMINATION

(For the Candidates admitted during the academic year 2022-2023 onwards)

Semester - V							
Core Courses							
22U5BTC07	Immunology	4	5	-	25	75	100
22U5BTC08	Biostatistics	4	5	-	25	75	100
22U5BTC09	Medical Lab Technology	4	5	-	25	75	100
Practical							
22U4BTCP05	Lab in Immunology & Medical lab tech	3	-	6	40	60	100
22U4BTCP06	Lab in Biostatistics	2	-	3	40	60	100
Elective - I							
20U5BTE01	Pharmaceutical Biotechnology	3	3	-	25	75	100
20U5BTE02	Tissue Engineering						
Skill based Elective course (SBEC) -III							
20U5BTS05	Bioinformatics	2	2	-	25	75	100
20U5BTS06	Cancer Biology						
Mandatory Course							
19U5BTEX01	Internship	-	1	-	40	60	100
Total		**22**	**21**	**9**	**245**	**555**	**800**
Semester - VI							
Core Courses							
22U5BTC010	Bioprocess technology	4	5	-	25	75	100
22U5BTC011	Plant and Animal Biotechnology	4	5	-	25	75	100
Practical							
22U4BTCP07	Lab in Bioprocess technology	3	-	5	40	60	100
22U4BTCP08	Lab in Plant and Animal biotechnology	3	-	5	40	60	100
Elective- II							
20U6BTE03	Genomics and Proteomics	3	3	-	25	75	100
20U6BTE04	Biophysics and Bioinstrumentation						
Skill based Elective course (SBEC) -III							
20U6BTS07	Nano Biotechnology	2	2	-	25	75	100
20U6BTS08	Environmental Biotechnology						
Research Activity							
22U6BTPR03	**Major Project**	**3**	**-**	**5**	**40**	**60**	**100**
Extension Activity							
22U6BTEX01	**Extension activity**	**-**	**-**	**-**	**40**	**60**	**100**
		22	**15**	**15**	**260**	**540**	**800**
		140	**132**	**48**	**1540**	**3660**	**5200**

Course Code	22U1BTC01	CORE – I CELL BIOLOGY	Hours/ weak		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
2. Students will understand how these cellular components are used to generate and utilize energy in cells.
3. Students will understand the cellular components, Structural features, Organelles and the cellular mechanisms and mitotic cell division.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Design the model of a cell.	K1
CO2	Differentiate the structure of prokaryotic and eukaryotic cell.	K2
CO3	Explain the organization of cytoskeleton, morphology and its aberrations	K3
CO4	Compare and contrast the events of Membrane trafficking, cellular organelles.	K4
CO5	Explain the microscope and cell fractionation.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**FUNDAMENTALS OF CELL STRUCTURE**	**13 Hrs**

Discovery of cells; Basic properties of cells; Different classes of cells – Prokaryotic and Eukaryotic cells. Cell division: Cell cycle; mitosis; meiosis, binary fission.

UNIT II	**CELLULAR MEMBRANES AND MATRICES**	**13 Hrs**

Cell membrane- Chemical composition, Structure, functions and transportation (Unit membrane model (Robertson), Sandwich (Danielli and Dayson model); Fluid Mosiac model (Sanger Nicolson).

UNIT III	**CYTOSKELETON – STRUCTURE AND FUNCTION**	**14 Hrs**

Microtubules- Cilia, flagella and intermediate filaments; Microfilaments- actin and myosin; cytoskeleton; Junctions- Gap Junction and Tight Junction Desmosomes.

UNIT IV	**STRUCTURE AND FUNCTION OF CELLULAR ORGANELLES**	**15 Hrs**

Nucleus, Nucleolus, Ribosomes, Endoplasmic reticulum-(RER and SER), Golgi complex, Mitochondria and Chloroplast; Peroxisomes and Glyoxisomes, vacuoles; Membrane trafficking.

UNIT V	**TECHNIQUES IN CELL BIOLOGY**	**15 Hrs**

Microscopy: Types of Microscopes, Principles of light and compound microscope; Cell fractionation

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Paul, A. 2007. Text book of cell and molecular biology, Books and Allied (P) Ltd. 2nd edition, Kolkata 700 009, pp-1310.
2. Lodish et al Molecular Cell biology 8th ed. Freeman, 2016.
3. Alberts et al Molecular biology of the cell. 6th ed. Garland Sci. 2014.
4. Watson. Molecular Biology of the Gene. 7th ed. Pearson Edu, 2013.
5. Genes and Genomes by M Singer, and P Berg, Blackwell Scientific Pub.
6. George M. Malacinski& David Freifelder. 1998. Essentials of Molecular Biology, 3rd Edition. Jones and Bartcett Publishers
7. R.C. Rastogi. 2010. Cell and Molecular Biology. New Age International Publishers
8. PragyaKhana. 2008. Cell and Molecular Biology. IK International Publishing House

Course Code	22U1BTC02	COREPAPER-II BASICS IN LAB SAFETY	Hours/weak			
Credits	2		TotalHours:45			
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. Students will comprehend the appropriate lab clothing and regulations.
2. Students will be knowledge able with laboratory emergencies, chemical risks, electrical hazards, waste management and laboratory accident response.
3. Upon successful completion of the course, students should have a clear understanding of laboratory safety precautions, emergency first aid, and response.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Respond to laboratory emergency procedures of laboratory incidents or accidents.	K1
CO2	Know the laboratory safety signs.	K2
CO3	Differentiate the various biological safety levels.	K3
CO4	Adopt for PPE usage and protective measures.	K4
CO5	Understand the disposal of experimental wastes and spill clean-up.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit:1	GENERAL LAB SAFETY	7 hours

Lab rules and safety signs, Personal protective equipment, protecting clothing, hand protections, foot protection, hearing protection, respiratory protection, Eye and face Protection.

Unit:2	GLASS WARE SAFETY	7hours

Inspecting glassware before use, safe handling and storage, vacuum and pressure operations, cleaning and drying, disposal and spill clean-up.

Unit:3	CHEMICAL AND ELECTRICAL SAFETY	8hours

Safety Datasheet, storage guidelines, chemical spills, chemical exposure monitoring; Electricity general specifications, electrical system usage guide lines, preventing electrical Hazards.

Unit:4	BIOLOGICAL SAFETY	8hours

Biological safety levels, safety data sheets for infectious substances, decontamination, transport and shipment of biological materials, emergencies, exposures and spills, biological waste disposal.

Unit:5	EMERGENCY PROCEDURES AND RESPONSE TO ACCIDENTS	10hours

Emergency procedures- Spill, First aid and Emergency kits, protective procedures, Fire extinguishers, eye wash stations, Emergency showers, Responses–chemical spills, gas leakages, fire and explosions, personal injury and contaminations.

Unit:6	CONTEMPORARY CLASSES	5hours

Videos one emergency procedure, response to incidents, biological and chemical waste disposals.

Reference Books

1.	Laboratory Safety Handbook, 1st Edition, Sabanc University (2016).
2.	Raj Mohan Joshi(Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.
3.	Bioethics & Biosaftey By Sateesh Mk (2008),Ik Publishers.
4.	https://www.ccri.edu/safety/lab_safety_for_students.html.
5.	https://www.esafety.com/courses/spill-response-awareness/.
6.	https://ehs.ucsc.edu/programs/research-safety/video-resources.html#fire-safety.

Paper Code	22U1BTCP01	CORE PRACTICALS-I LAB IN CELL BIOLOGY	Hours/weak			
Credits	3		TotalHours:45			
Total Hours	60		T	P	Int	Ext
Max. Mark	100		-	3	40	60

Course Objectives:

The main objectives of this course are to:

1. To introduce fundamentals of cell biology techniques.
2. To teach students the basic techniques and instrument principles in biotechnology
3. To give hands on cell biology experiments

Course Outcomes:

On the successful completion of the course, student will be able to:

CO1	Be aware of the laboratory preparation of solutions.	K1
CO2	Understand the importance, preparation of buffers.	K2
CO3	Learns to visualize the cells by employing different types of microscopes	K3
CO4	Bring in the basic techniques of cell biology	K4
CO5	Analysis of characterization of known and unknown microbes and cells.	K5&K6

K1 - Remember**;** **K2** - Understand; **K3** - Apply; **K4** Analyze **K5** - Evaluate; **K6** - Create

Cell Biology	Hours
1. Preparation of stock and working solution: Percent solution, normal solution, molar solution.	3
2. Micrometer.	3
3. Blood smear- differential staining.	3
4. Microscopy and usage of Pointer and Camera Lucida.	3
5. Demonstration of various stages of mitosis using onion root tip.	3
6. Demonstration of various stages of meiosis using grasshopper testis squash.	3
7. Preparation of Buccal Smear squash.	3
8. Cell counting and viability.	3
9. Preparation of Microscope slide [DicotLeafSection].	3
10. Permanent slide preparation.	3

Reference Book(s)

David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.

D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia

Mary L. Ledbetter. 1993. Cell Biology: Laboratory Manual. Edition: 2. Published by RonJon Publishing. Incorporated.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.azolifesciences.com/article/What-is-a-pH-Meter-and-How-Does-it- Work.aspx

Text Book

Ruban. P. Basic Biotechniques. 1st Edition. Notion press. 2020

Course Code	22U1BCA01	ALLIED COURSE – I BIOCHEMISTRY	Hours/ weak		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make the students understand the basics biological molecules existing the living cell.
2. Students also acquire knowledge on their biological functions and their importance in of molecules in cell and its growth.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Acquiring knowledge on carbohydrate and its types in biology.	K1
CO2	Understanding the basic concepts on proteins and amino acids and their properties	K2
CO3	Under the role of biological catalysts (Enzymes) and lipids, their rolein basic biochemical reactions	K3
CO4	To gain over all information on vitamins, their physiological functions and deficiency symptoms and consequent diseases	K4
CO5	Acquiring knowledge on carbohydrate and its types in biologicalsystems.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	CARBOHYDRATES	13 Hrs

Carbohydrate – classification, monosaccharide's (glucose, fructose, galactose & xylose)- physical and chemical properties, disaccharides (sucrose, lactose), polysaccharides (glycogen, starch, pectin, keratin sulphate & chondroitin sulphate).

UNIT II	AMINO ACIDS AND PROTEINS	13 Hrs

Classification, Structure, Essential and Non- essential amino acids. Definition, Classification, Functions and Propertiesof protein. Proteins-primary, secondary, tertiary and quaternary structures.

UNIT III	ENZYMES	14 Hrs

Definition, holo enzyme, apo enzyme, active site, Enzyme units classification, Lock and Key model and Induced fit hypothesis. Enzyme kinetics (MM & LB plot), factors affecting enzyme activity.

UNIT IV	LIPIDS	15 Hrs

Classification, structure, function and properties of simple,Compound, Derived, Essential fatty acids and Non-essential fatty acids,cholesterol.

UNIT V	VITAMINS	15 Hrs

Classification, occurrence, deficiency symptoms and biochemical functions of vitamins (Fat soluble and water soluble vitamins).

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	5 Hrs

Reference Book(s)

1. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper"s biochemistry,twenty fifth edition, Prentice Hall, New Jersey.
2. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
3. G.L Zubay (1999) Biochemistry, 4th Ed, WCB, McGraw-Hill, New York.
4. Ambika Shanmugam(1998)., Fundamentals of Biochemistry for Medical Students.
5. U. Satyanarayana., (2006) A textbook of Bi oc hemistry, Books & Allied, Kolkata.
6. J.L Jain., (2005). Fundamentals of Biochemistry. S.Chand Publishing, New Delhi.
7. D.L.Nelson and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5thEd, W.H.Freeman and Company, New York.

Course Code	22U1BCAP01	ALLIED COURSE PRACTICAL – I BIOCHEMISTRY	Hours/ WK		Marks	
Credits	3					
Total Hours	60		T	P	Int	Ext
Max. Mark	100		-	3	40	60

Course Objectives:

The main objectives of this course are:

1. To make students on understanding and identification of simple and polysaccharides, and to make them in understanding the knowledge on qualitative identification of amino acids.
2. The Students also gain hands on skills on basic separation of biomolecular by simple chromatographic techniques.

Course outcomes

On successful completion of the course, students will be able to:

CO1	Acquiring knowledge on preparation of solutions.	K1
CO2	Acquiring knowledge on qualitative analysis of carbohydrates.	K2
CO3	Acquiring knowledge on qualitative analysis of amino acids.	K3
CO4	Understand the separation of amino acids by thin layer chromatography.	K4
CO5	Understand the separation of lipids role by thin layer chromatography.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	**PREPARATION OF SOLUTION** Normal, Molar, Percentage solution and calculation	**3**
2	**Analysis of sugars** a) Monosaccharides - Glucose, Fructose.	3
3	**Analysis of sugars** a) Monosaccharides - Galactose, Pentose.	**3**
4	**Analysis of sugars** b) Disaccharides - Sucrose, Maltose and Lactose.	3
5	**Analysis of sugars** c) Polysaccharide – Starch	**3**
6	**Analysis of amino acids** a) Histidine b) Tyrosine	**3**
7	**Analysis of amino acids** c) Tryptophan d) Methionine	3
8	**Analysis of amino acids** e) Cysteine f) Arginine	**3**
9	Separation of amino acids by paper chromatography	3
10	Separation of lipids by thin layer chromatography	**3**

REFERENCES:

1. An Introduction to Practical Biochemistry by Rodney Boyer (2003). Pearson Education.
2. Laboratory Manual of Biochemistry by J.Jayaraman (1988) Wiley Eastern
3. Practical Biochemsitry by Wilson and Walker (1994). Cambridge University Press
4. Handbook of Laboratory culture media, Reagents, Stains and Buffers by N. Kannan (2003), Panima Publishers, New Delhi
5. Calculations in Molecular Biology and Biotechnology. A Guide to Mathematics in the Laboratory by (Frank H. S tephenson) (2003) ACADEMIC PRESS An Imprint of Elsevier

SEMESTER II

Course Code	22U2BTC03	CORE-III BASIC CALCULATIONS IN BIOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. Students will comprehend the appropriate rounding off Significant.
2. Students will be knowledge able in laboratory conversions.
3. Upon successful completion of the course, students should have a clear understanding of calculations, rule for calculations.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Acquiring knowledge on round off of numbers.	K1
CO2	Understanding the basic concepts of calculations in preparation of solutions	K2
CO3	To understand the rule of logarithms.	K3
CO4	To gain over all information to calculate with time.	K4
CO5	Acquiring knowledge on calculating expected genotype.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**SCIENTIFIC NOTATION**	**13 Hrs**

Scientific Notation and Metric Prefixes-Rounding Off Significant Digits in Calculations-Converting Numbers from Scientific Notation to Decimal Notation. Conversion Factors and Canceling Terms.

UNIT II	**SOLUTIONS MIXTURES**	**13 Hrs**

Solutions Mixtures and Media-solution Concentrations by a Factor of X -Preparing Percent Solutions-Diluting Percent Solutions-Moles and Molecular Weight: Definitions- and Converting Molarity to Percent-Converting Percent to Molarity- defitions of Ph.

UNIT III	**RULE FOR LOGARITHMS**	**14 Hrs**

PCR-The Polymerase Chain Reaction-PCR Efficiency- Definition of Product Rule for Logarithms-Power Rule for Logarithms-Calculating the T m of the Target Sequence-dNTPs-Quantitative PCR.

UNIT IV	**CALCULATING WITH TIMES**	**15 Hrs**

Centrifugation-Relative Centrifugal Force (g Force) and Calculating Sedimentation Times-Converting g Force to Revolutions per Minute-Definition Forensic Science-Alleles and Genotypes.

UNIT V	**CALCULATING EXPECTED GENOTYPE**	**15 Hrs**

Calculating Genotype Frequencies-Calculating Allele Frequencies-The Hardy-Weinberg Equation and Calculating Expected Genotype Frequencies-Sample Variance and Sample Standard Deviation-The Multiplication Rule.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Calculations in Molecular Biology and Biotechnology. A Guide to Mathematics in the Laboratory by (Frank H. S tephenson) (2003) ACADEMIC PRESS An Imprint of Elsevier
2. Handbook of Laboratory culture media, Reagents, Stains and Buffers by N. Kannan (2003), Panima Publishers, New Delhi
3. Laboratory Manual of Biochemistry by J.Jayaraman (1988) Wiley Eastern

Course Code	22U2BTC04	CORE IV GENETICS	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100			-	25	75

Course Objectives:

The main objectives of this course are:

1. Students will be knowledge able chromosome alterations.
2. Upon successful completion of the course, students should have a clear understanding of mendelian genetics

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Acquiring knowledge on mendelian principles.	K1
CO2	Understanding the basic concepts of extensions of mendelian principles.	K2
CO3	To understand the ploidy.	K3
CO4	To gain over all information about population genetics.	K4
CO5	Acquiring knowledge on DNA transfer mechanism.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**MENDELIAN PRINCIPLES**	**13 Hrs**

Domination, segregation, independent assortment, deviation from Mendelian inheritance. Genotype & phenotype.

UNIT II	**EXTENSIONS OF MENDELIAN PRINCIPLES**	**15 Hrs**

Codominance, incomplete dominance, gene interactions, pleiotropy, penetrance and expressivity, Linkage, sex linkage, sex limited and sex influenced characters.

UNIT III	**PLOIDY**	**13 Hrs**

Structural and numerical alterations in chromosome – Euploidy – Aneuploidy – Deletion – Duplication – insertion – Translocation.

UNIT IV	**POPULATION GENETICS**	**14 Hrs**

Pedigree analysis, Mendalian traits and sex – linked traits in human – population genetics – Hardy - Weinberg genetic equilibrium.

UNIT V	**DNA TRANSFER MECHANISM**	**15 Hrs**

In Prokaryotes – Transformation, Transduction (Generalized and specialized) & Conjugation. Transposons (Bacteria, Human). Davis U Tube experiments.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. *Molecular Genetics* of *Bacteria* (2013) *Larry Snyder*, *Joseph E. Peters*, *Tina M. Henkin*. ASM Press publication.
2. Behavioral Genetics - published 2012 – 12th editionsbyRobert Plomin, John C. DeFries, Gerald E. McClearn
3. Human Biology - Genetics - published 2013 - 2nd editionsbyCK-12 Foundation

Course Code	22U2BTCP02	CORE IV LAB IN BASIC BIOLOGY CALCULATIONS	Hours/ WK		Marks	
Credits	3					
Total Hours	24		T	P	Int	Ext
Max. Mark	100		-	3	40	60

Course Objectives:

The main objectives of this course are:

1. To make the students understand the basics biological calculations.
2. Students also acquire knowledge on their biological calculations. and their importance laboratory.

Course outcomes

On successful completion of the course, students will be able to:

CO1	Tounderstandandimplementtheprinciplesofasepticpracticesin Laboratory	K1
CO2	To gain knowledge on the media preparation and culturing the microorganism	K2
CO3	To identify the caliberation in lab instruments.	K3
CO4	To check the estimations of biomolecules like proteins.	K4
CO5	To understand and quantition of nucleic acids.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v).	**3**
2	Calibration of pH meter	**3**
3	Preparation of biological buffer - phosphate buffer	**3**
4	Extraction of Proteins from biological materials	**3**
5	Preparing percent solutions and Diluting percent solutions	**3**
6	. SDS PAGE – Group Experiment	**3**
7	Estimation of Proteins by Lowry's method	**3**
8	Estimation of Proteins by Biuret method	**3**
9	Quantitation of Nucleic Acids by Ultraviolet Spectroscopy	**3**
10	Calculating the Amount of Fragment Ends	**3**

REFERENCES:

1. An Introduction to Practical Biochemistry by Rodney Boyer (2003). Pearson Education.
2. Laboratory Manual of Biochemistry by J.Jayaraman (1988) Wiley Eastern
3. Practical Biochemsitry by Wilson and Walker (1994). Cambridge University Press
4. Handbook of Laboratory culture media, Reagents, Stains and Buffers by N. Kannan (2003), Panima Publishers, New Delhi
5. Calculations in Molecular Biology and Biotechnology. A Guide to Mathematics in the Laboratory by (Frank H. S tephenson) (2003) ACADEMIC PRESS An Imprint of Elsevier.

Course Code	22U2MBA02	ALLIED II MICROBIOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students understanding and identification of basic microbiology.
2. The students about various methods of sterilization and also about antimicrobial chemotherapy.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand historical prospective on the evolution of microbiology.	K1
CO2	To acquire knowledge on the basic concepts on prokaryotic cellular structure.	K2
CO3	To acquaintance of basic nutritional requirements of microorganism.	K3
CO4	To know about the anti-microbial therapy and their mode of action.	K4
CO5	To understand historical prospective on the evolution of microbiology.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	DEFINITION AND SCOPE OF MICROBIOLOGY	13 Hrs

History and recentDevelopments:ContributionsofLeevenhoek,LouisPasteur,Robert Koch, Elie Metchnikoff ,Edward Jenner, Alexander Fleming, Spontaneous generation, Biogenesis of Microbiology .Nobel prize winners in the field of Medicine.

UNIT II	MICROSCOPY	13 Hrs

Simple and Compounds microcopes. Dark field contrast, Fluorescence microscopes. Electron microscopes (TEM &SEM).Stain and staining techniques–Simple,differential and special staining (Endospore and Capsular).

UNIT III	CELLULAR STRUCTURES OF PROKARYOTES	14 Hrs

Ultra structure and functions of bacterial cell wall, Plasma membrane, Flagella, Pili and capsule. Ultra structure of fungi, Viruses and cyanobacteria.

UNIT IV	STERILIZATION AND CULTURE TECHNIQUES	15 Hrs

Physical and chemical methods. Growth of bacteria – multiplication nutritional requirements. Factors affecting growth. Growth curve, Determination of growth. Media and its types, Culture techniques (pureculture, anaerobic culture). Cultivation of anaerobes, Chemoautotrophs, chemoheterotrophs and photosynthetic microbes. Culture collection,preservation, lyophilization and freeze drying.

UNIT V	ANTIMICROBIAL CHEMOTHERAPY	15 Hrs

Definition and types of antibiotics .Mode of action of broad and narrow spectrum antibiotics. Anti-microbial resistance. Mechanisms of resistance. Test for evaluating anti-microbial effect. Microbial metabolism- Microbial metabolism. Photosynthesis in microbes. Role of chlorophylls, carotenoids and phycobilins.

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	5 Hrs

REFERENCES:

1. Microbiology–concepts and application by PaulA. Ketchum, Wiley Publications2010.
2. Fundaments of Microbiology-Frobisher, Sauders &Toppanpublications1975.
3. Microbiology-Ronald M. Atlas1993.
4. Introductory Biotechnology –R. Singh C.B.D. India(1990)
5. Industrial Microbiology–Casida,E. Wiley EasternLtd1962.
6. Industrial Microbiology–Casida,E. Wiley EasternLtd1962.

Course Code	22U2MBAP02	CORE PRACTICAL - II LAB IN MICROBIOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	49		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students understand on microbiological techniques, aseptic practices in laboratory.
2. The candidate also shall know how to maintain and culture the microorganisms. In laboratory and their biochemical identification mechanisms

Course outcomes

On successful completion of the course, students will be able to:

CO1	To understand and implement the principles of aseptic practices in Laboratory.	K1
CO2	To gain knowledge on the media preparation and culturing the Microorganism.	K2
CO3	To identify the microorganisms by staining techniques and biochemical tests.	K3
CO4	To check the growth pattern of microorganisms towards various classes of antibiotics.	K4
CO5	To understand and implement the principles of aseptic practices in Laboratory.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	General Laboratory rules to be followed in microbiological Laboratory.	**3**
2	Sterilization techniques (Dry heat, Moist heat, Filtration-membrane And HEPA filters).	**3**
3	Preparation of nutrient media (Solid, semi-solid and liquid).	**3**
4	Isolation.of.pure.culture(Streaking methods–simple, continuous, quadrant and T‟streaking)	**3**
5	General Laboratory rules to be followed in microbiological Laboratory	3
6	Simple and negative staining	**3**
7	Differential staining(Gram's staining, Capsule staining, Spore	**2**
8	Fungal staining(LCB)	
9	Determination of bacterial motility(Hanging drop method)	**2**
10	Antibiotic sensitivity test(Kirby-Bauer method)	**3**

REFERENCES:

1. Fundaments of Microbiology-Frobisher, Sauders &Toppan publications1975.
2. Microbiology-Ronald M. Atlas1993.
3. Introductory Biotechnology –R.B.Singh C.B.D.India(1990)
4. Industrial Microbiology–Casida, E.Wiley EasternLtd1962.

Course Code	22U2VE02	MANDATORY COURSE-II ENVIRONMENTAL SCIENCES	Hours/ WK		Marks	
Credits	2		T	P	Int	Ext
Total Hours	24		2	-	25	75
Max. Mark	100					

Course Objectives:

The main objectives of this course are:

1. To impart appropriate information and adequate knowledge about environmental impact assessment and environmental acts; to acquaint students in the area of disasters management.
2. To understand the energy sources, environmental pollution and remediation using biotechnology and its control

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Acquire a complete knowledge about bio-fuel and bio-energy and its needs	K1
CO2	Understand dangerous effects of environmental pollution and its methods of control and management which make them to create more remediation .	K2
CO3	Familiarize the different methods of environmental pollution using biotechnological approaches	K3
CO4	Obtain a comprehensive knowledge about global environmental problem.	K4
CO5	This course is important to handle the environmental hazards.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**ENVIRONMENT**	**5 Hrs**

– Definition – Scope – Structure And Function Of Ecosystems– Food Chain, Food Webs And Ecological Pyramids.

UNIT II	**NATURAL RESOURCES**	**5Hrs**

Renewable - Air, Water, Soil, Land And Wildlife Resources- Non – Renewable – Mineral Coal ,Oil And Gas.

UNIT III	**ENVIRONMENTAL PROBLEMS**	**3Hrs**

Environmental Problems Related To The Extraction And Use Of Natural Resources.

UNIT IV	**BIODIVERSITY**	

Definition – Values – Consumption Use, Productive Social, Ethical, Aesthetic And Option Values Threats To Bio Diversity.

UNIT V	**POLLUTIONS**	**6hrs**

Definition – Causes, Effects And Mitigation Measure S – Air Pollution, Water Pollution, Soil Pollution Noise Pollution, Thermal Pollution – Nuclear Hazards – Solid Wastes Acid Rain – Climate Change And Global Warming.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERANCE :

1. Bridge, J. &Demicco, R. 2008. Earth Surface Processes, Landforms and Sediment deposits. Cambridge University Press.
2. Duff, P. M. D. and Duff, D. (Eds.). 1993. Holmes' Principles of Physical Geology. Taylor & Francis.
3. Gupta, A. K., Anderson, D. M., &Over peck, J. T. 2003. Abrupt changes in the Asian southwest monsoon during the Holocene and their links to the North Atlantic Ocean. Nature 421: 354-357.
4. Gupta, A. K., Anderson, D. M., Pandey, D. N., &Singh VI, A. K. 2006. Adaptation and human migration, and evidence of agriculture coincident with changes in the Indian summer monsoon during the Holocene. Current Science 90: 1082-1090.

SEMESTER III

Course Code	22U3BTC05	CORE V MOLECULAR BIOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. To familiarize the student in various aspects of cell and molecular biology streams including cellular organization and their interactions in central dogma of life.
2. To develop comprehensive understanding on the complete cellular and molecular functions of cell organelles in terms of cell to cell interaction, gene regulation, cellular signaling.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand the basic concepts of DNA/RNA structure as genetic material.	K1
CO2	To under the mechanisms of replication of DNA and it regulation.	K2
CO3	To know about the transcription and translation into proteins.	K3
CO4	To acquire the concepts of gene regulation and know about the transposition.	K4
CO5	To know the function of Gene regulation and function	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	GENETIC MATERIAL	8Hrs

Evidences showing DNA and RNA as genetic material; DNA- Chemical composition & molecular structure, Watson and Crick's model-its biological significance; Forms of DNA (A, B, C, D&Z). Central dogma of molecular biology.

UNIT II	DNA REPLICATION	12 Hrs

Origin & Models of - Meselson and Stahl‟s experiment - types of replication - Mechanism of DNA replication in prokaryotes and eukaryotes - Enzymology of replication. DNA repair- causes of DNA damage & biochemical mechanism of DNA repair. Homologous recombination- Holliday model.

UNIT III	TRANSCRIPTION	12Hrs

RNA types and functions; RNA polymerase; Transcription in prokaryotes and eukaryotes; Posttranscriptional modification -Transcription and processing of RNA in prokaryotes; Post transcriptional modifications, splicing, spliceosomes. Editing, Nuclear export of mRNA Transcription and processing of RNA in prokaryotes.

UNIT IV	TRANSLATION & PROTEIN SYNTHESIS	13Hrs

Genetic code: Properties of genetic code; codon- anticodon interaction- Wobble hypothesis and elucidation of genetic code; Translation in prokaryotes and eukaryotes; Post translational modification of proteins & molecular chaperones .

UNIT V	REGULATION OF GENE EXPRESSION	15 Hrs

Gene expression. In transcriptional level (lac and trp operon); gene expression in bacteriophages. Transposes–types and mechanism of transposition. Gene silencing. Recombination–Homologous and Non–homologous recombination. Molecular techniques; DNA finger printing, DNA Microarray, Gene Mapping, Protein Microarray.

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	5 Hrs

REFERENCES:

1. David Freifelder. 1990. Molecular Biology,2nd Edition. Narosa Publishing house
2. GeorgeM.Malacinski.2008.Essentials of Molecular Biology, 4th Edition.
3. Veer Bala Rastogi. 2010. Fundamentals of Molecular Biology. Ane Books India

4. JamesD. Watson, Tania A.Baker, StephenP. Bell, Alexander Gann, Michael Levine and Richard Losile. 2008. Molecular Biology of the gene, 5th Edition. Pearson Education.
5. Lodhish, Berk, Matsundairg, Kaiser, Krieger, Scott, Zipursky and Darnell. 2004. Molecular Cell Biology, 5thEdition.W. H. Freeman and Company
6. RobertF.Weaver.1999.MolecularBiology.WCBMcGrawHill
7. E. D. P. De Robertis& E. M. F De Robertis, Jr. 2001. Cell and Molecular Biology, 8thEdition.Lipincott William and Wilkins
8. Lehninger.2005.PrinciplesofBiochemistry.NelsonCox,CBSPublishers
9. Alexander Mc Lenna, Andy Bates, Puil Turner & Mike White. 2015. Molecular Biology, 4thEdition.GS Garlan Sciences, Taylorand Francis Group
10. George M. Malacinski & David Freifelder. 1998. Essentials of Molecular Biology, 3rdEdition.Jones and Bartcett Publishers.

Course Code	22U3BTCP03	CORE PRACTICAL -III LAB IN MOLECULAR BIOLOGY	Hours/ WK		Marks	
Credits	3					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		-	3	40	60

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic procedure in isolation separating purifying proteins.
2. The students gain knowledge in DNA quantification and gene transfer methods

Course outcomes

On successful completion of the course, students will be able to:

CO1	To know about the isolation, purification and quantification ofprotein	K1
CO2	To know about the separation and quantification of DNA	K2
CO3	To know about the various types of gene transfer techniques	K3
CO4	To identify and isolate the mutated bacterial by special techniques	K4
CO5	To know about the replica plating.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	Isolation of protein	**3**
2	Estimation of protein by Lowry‟s method	3
3	Purification of protein by dialysis	**3**
4	Separation of proteins by native – PAGE	3
5	Separation of DNA by agarose gel electrophoresis	**3**
6	Quantification of DNA by UV-visible spectrophotometer	**3**
7	Induction of mutation in bacterial cells UV light	3
8	Bacterial DNA transformation by CaCl method	**3**
9	Bacterial conjugation	3
10	Isolation of auxotrophic mutants by replica plating technique	**3**

REFERENCES:

1. 1 RichardR.Sinden.1994.DNA Structure and function .Academic press
2. R.C.Rastogi.2010.Cell and Molecular Biology. New Age International Publishers.
3. Pragya Khana.2008.Cell and Molecular Biology. IK International Publishing House
4. William D. Stanfield, Jaine S. Colome and Raul J. Cano. 2008. Shaum‟s Outline- Molecular Cell Biology. Tata Mc Graw Hill
5. H.S.Bhamrah & Kavita Juneja.2002.Molecular Cell Biology. Anmol Publications
6. G.P.Jeyanthi. 2009.MolecularBiology. MJP Publishers
7. N. Vidhyarasthi & D. M. Chelan. 2007. Molecular Biology. IK International Publishing House
8. Phil Turner, Alexander Mc Lennan, Andy Bates & Mike White. 2001. Molecular Biology, 3rdEdition.Bios Instant Notes
9. H.D.Kumar.2000. Molecular Biology, 2nd Edition. Vikas Publishing House
10. AVSSSambamurhty.2008.MolecularBiology.NarosaPublishingHouse

Course Code	19U3BOA01	ALLIED III PLANT SCIENCE	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. To familiarize the student in various aspects of plants.
2. To develop comprehensive understanding on the complete classifications of plants.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To gain knowledge on basics of fungi and algae	K1
CO2	To gain knowledge on basics of bryophytes	K2
CO3	To gain knowledge on basics of lichens	K3
CO4	To gain knowledge on basic concepts of plant physiology	K4
CO5	To the economically importance of algae and fungi	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**ALGAE**	**12Hrs**

Generalcharacteristicsofalgae.Studyonthallusstructure,reproduction and life cycle of *Gellidium*, *Gracillaria* and *Polysiphonia* .Economic importance of algaein industries

UNIT II	**FUNGI**	**12Hrs**

Generalcharacteristicsoffungi.Studyonthallusstructure,reproductionandlifecycleof*Agaricus,Penicilliu*mand*Saccharomycescerevisieae*.Economicimportanceoffungi

UNIT III	**LICHENS**	**12Hrs**

General characteristics of fungi. Study on thallus structure ,reproduction of foliose, Crustose, Fruticose and Squamulose groups of lichens

UNIT IV	**BRYOPHYTES,PTERIDOPHYTESANDGYMNOSPERMS**	**12Hrs**

General characteristics. Study on the structure, reproduction and life cycle of bryophytes (*Marchantia*), Pteridophytes(*Lycopodium*),Gymnosperms(Cycus)and their economic importance.

UNIT V	**PLANT PHYSIOLOGY**	**12Hrs**

Absorption of water (Activeandpassive). Photosynthesis (Light and Dark reactions). Cyclic and non-cyclic photophosphorylation.Transpirationanditstypes (Stomataltranspiration).

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Vashishta BR, AK. Sinha. (2010). Botany for Degree student – Fungi. S. Chand & Co.New Delhi.
2. Pandey SN, MishraSP and Trivedi PS.(2009). Atextbook of
3. Botany, VolII, Vikas Publishing House Pvt. Ltd., Delhi.
4. TextBookofAlgae. (2018).KS.Bilgramiand LCSaha,1st edition,CBSPublishers.
5. Algae.(2011). OP.Sharma,Tata McGraw Hill Education.
6. AdvancesinMycology.(2012).SohanSharma,randomPublicationsP ublishersandDistributors,New Delhi.
7. BP. Pandey. (2011). A Textbook of Botany: Angiosperms – Taxonomy, Anatomy, Embryology and Economic Botany, S. Chand Limited.
8. BP Pandey.(1986). Text Book of Botany ,VolI & II Chand. S &Co. NewDelhi.

Course Code	19U3BOAP01	ALLIED PRACTICAL-III LAB IN PLANT SCIENCE	Hours/ WK		Marks	
Credits	3					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		-	3	40	60

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic concepts of fungi algae and bryophytes.
2. The students also know about the lichenology and basic plant physiology.

Course outcomes

On successful completion of the course, students will be able to:

CO1	To gain knowledge on the identification of fungi and algae	K1
CO2	To gain knowledge on the identification basics of bryophytes	K2
CO3	To gain knowledge on the economic importance of major plantKingdoms.	K3
CO4	To gain experimental knowledge on plant physiology	K4
CO5	To gain knowledge on the identification of fungi and algae	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	Sectioning of given specimens Algae (or) Fungi, Bryophyte (or) Pteridophyte, Gymnosperms.	**3**
2	Identification of spotters (Permanent slides) Algae (or) Fungi, Bryophyte (or) Pteridophyte, Gymnosperms (or) Lichens	3
3	Identification of spotters (Morphology) Algae (or) Fungi, Bryophyte	**3**
4	Identification of the given setup (Physiology) Ganong‟s photometer (or) Wilmutt‟ bubbl.	3
5	Identification of spotter (Economic importance) *Gellidium* (or) *Penicillium* (or) Yeast	**3**

REFERENCES:

1. 1. Text Book of Algae. (2018). KS. Bilgrami and LC Saha, 1st edition, CBS Publishers.
2. Algae. (2011). OP. Sharma, Tata Mc Graw Hill Education.
3. Advances in Mycology. (2012). Sohan Sharma, random Publications Publishers andDistributors, New Delhi.
4. BP. Pandey. (2011). A Textbook of Botany: Angiosperms – Taxonomy, Anatomy,Embryology and Economic Botany, S. Chand Limited.

Course Code	22U3BTS01	SBEC – I FORENSIC SCIENCE AND TECHNOLOGY	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. To familiarize the student in various aspects of cell and molecular biology streams including cellular organization and their interactions in DNA replication, and protein biosynthesis and translational regulation
2. To develop comprehensive understanding on the complete cellular and molecular functions of cell organelles in terms of cell to cell interaction, gene regulation, cellular signaling.
3. To impart the molecular biology knowledge in applications of various human health care

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Gain knowledge on forensic science laboratories across India	K1
CO2	Acquires knowledge on fingerprint identification system	K2
CO3	Know whereabouts on the FAI and the concepts of fatality Forensics	K3
CO4	Understand the concepts of DNA finger printing technology	K4
CO5	Finally analyzing and resulting the finger printing techniques	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**INTRODUCTION**	**6Hrs**

Definition, Scope and branches of forensic science. Central F.S.L. and State F.S.L.Biological Evidence: Nature, collection, identification, evaluation of hair and fibres.

UNIT II	**DEFINITION AND CLASSIFICATION OF FINGERPRINTS (HENRY SYSTEM):**	**7Hrs**

Taking finger prints from living and dead persons. Automatic finger print identification system(AFIS).

UNIT III	**FORENSICART ILLUSTRATION**	**5Hrs**

Introduction, Finding and identifying human face image. Postmortem drawing, methods of superimposition.

UNIT IV	**FATALITY FORENSICS**	**5 Hrs**

Introduction, cause, manner and characteristics of death, Road traffic fatality (RTF) investigation. General classification of RTFs.

UNIT V	**DNA FINGERPRINTING (DFP) TECHNOLOGY**	**7 Hrs**

An overview, Applications of DFP in forensic investigations, paternity disputes. DNA Profiling practice in India with reference to criminal cases.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES

1. Richard Saferstein, 2001, Criminalistic: An Introduction to Forensic Science. 7th edition Prentice-Hall,New Jersey.
2. Chowdhri,S. ,Forensic Biology B.P.R.& D,Govt.of India.
3. Cammins,H.and MiddleC.,1961.Fingerprints PalmsandSoles.DoverPublications.
4. Furley,M.A. and Hamington,J.J.Fo2r4ensic DNA Technology.
5. Kirby,DNA Fingerprinting Technology.
6. Epplen,J.T. and Eabjulm,T.,1999.DNAProfilingandDNA Fingerprinting Bukhaagar Verlag, Switzerland.

Course Code	22U3BTS02	SBEC – I FOOD BIOTECHNOLOGY	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. To develop comprehensive understanding on food biotechnology.
2. To impart the technological knowledge in applications food.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand the concepts of basic food preservation methods	K1
CO2	To understand the role of water in food spoilage and preservation	K2
CO3	To explore the physical factors involving in food processing	K3
CO4	To make familiar with food sanitation and its importance	K4
CO5	To prevent food wastage and protect the food materials	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**FOOD PRESERVATION BY APPLICATION OF HEAT**	**8Hrs**

Principles of Heat Transfer, Blanching, Pasteurization, Heat Sterilization.

UNIT II	**FOODPRESERVATIONTHROUGHWATERREMOVAL**	**8Hrs**

Forms of Water in Foods, Sorption of Water in Foods, Water Activity, Drying Technology, Evaporation Technology.

UNIT III	**FOOD PRESERVATION THROUGH PHYSICAL AND CHEMICAL METHODS**	**8Hrs**

Chilling, Freezing, Radiation, Ionizing, Microwave, Salt, Smoke, Sugar, Other Chemical Additives.

UNIT IV	**SENSORYE VALUATION OFFOOD QUALITY**	**8Hrs**

Quality factors for consumer safety. FSSAI, HACCP, FDA. Food Packaging, Food Plant Sanitation, Environmental Aspects of Food Processing.

UNIT V	**GENETICALLY MODIFIED FOOD**	**8Hrs**

Bovine somatotropin, alphalact albumin & lactoferrin in milk, Edible vaccine (Cholera vaccine – potatoes & Hepatitis B vaccine -maize)

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Microbial Enzyme Technology in Food Applications (Food Biology Series)" by Ramesh C Ray and Cristina M Rosell.
2. Encyclopedia of Biotechnology in Agriculture and Food" by Dennis R Heldman and Dallas G Hoover
3. Fermentation Processes Engineering in the Food Industry (Contemporary Food Engineering)" by Carlos Ricardo Soccol and Ashok Pandey
4. Advances in Food Biotechnology" by Ravishankar Rai V

Course Code	22U3BTN01	NMEC – I BIOSAFETY, BIOETHICS & IPR	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles of Biosafety guidelines and to understand concepts of intellectual property right and its types.
2. The student also gains added knowledge on ethical, legal and social considerations on implementing/ marketing biotechnologicalproducts.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Understand the concepts of basic Biosafety and Biosafety levels.	K1
CO2	Understand Biosafety guidelines and role genetically modified Organisms.	K2
CO3	Understand the basic principles of IPR, its types and patentingProcedures.	K3
CO4	Understand the concepts of ethical, legal considerations on the release of genetically modified organisms.	K4
CO5	Understand the concepts of bioethics..	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I		**8 Hrs**

Bio safety: Introduction – bio safety issues in biotechnology - historicalbackground.
Biosafety Levels - Levels of Specific Microorganisms,
Infectious Agents and Infected Animals.

UNIT II		

Biosafety Guidelines: Guidelines and regulations (Cartagena Protocol).
Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee,RCGM, GEAC.

UNIT III		**8Hrs**

Intellectual Property Rights: Introduction to IPR, Types of IP - Patents,
Trademarks, Copyright & Related Rights, Importance of IPR – patentableand non patentable.

UNIT IV		**8Hrs**

Patents and Patent Laws: Objectives of the patent system - Basic, principles and general requirements of patent law. Patentable subjects and protection inBiotechnology.

UNIT V		**8Hrs**

Bioethics: Introduction to ethics and bioethics, framework for ethical
Decision making. Ethical, legal and socioeconomic aspects of gene therapy. Ethical implications of GM crops, biopiracy and biowarfare.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES

1. Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBHPublishing Co. New Delhi.
2. Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.
3. Rajmohan Joshi (Ed.). 2006. Biosafety^{2}a^{6}nd Bioethics. Isha Books, Delhi.
4. Sasson A, Biotechnologies and Development, UNESCO Publications.
5. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, India.

Course Code	22U3BTN02	NMEC – I BIOINFORMATICS	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. To familiarize the student in various aspects of cell and molecular biology streams including cellular organization and their interactions in DNA replication, and protein biosynthesis and translational regulation.
2. To develop comprehensive understanding on the complete cellular and molecular functions of cell organelles in terms of cell to cell interaction, gene regulation, cellular signaling.
3. To impart the molecular biology knowledge in applications of various human health care.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand basic knowledge of nucleic acid sequence databases.	K1
CO2	To understand the concepts of specialized databases.	K2
CO3	To understand the basic concepts of sequence analysis and sequence Alignment.	K3
CO4	To understand the concepts of gene prediction method s through *Insilico* approaches	K4
CO5	Finally calculation and result the finger printing methods.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	BIOINFORMATICS AND BIOLOGICAL DATABASES	8 Hrs

Nucleic acid sequence databases– Gen Bank/NCBI, EMBL, and DDBJ. Protein sequence databases – Uniprot KB and PIR, Structure databases – PDB, CATH and SCOP.

UNIT II	SEQUENCEANALYSIS	8Hrs

BLOCKS, PRINTS and Pfam, Microarrays- Microarray data analysis, Proteomic data Analysis.

UNIT III	MULTIPLESEQUENCEALIGNMENT	8Hrs

Sequence alignment, Dotplot, pairwise Sequence Alignment-Local alignment and Global alignments-Dynamic programming algorithm for sequence alignment, Scoring matrices, gap penalties.

UNIT IV	TRANSLATION & PROTEIN SYNTHESIS	8Hrs

Scoring methods-clustal W -Phylogenetic Analysis-tree construction methods-Maximum likelihood and maximum parsimony-distancemethods-Databasesimilaritysearch-BasicLocalAlignmentsearch tool (BLAST).

UNIT V	REGULATIONOF GENE EXPRESSION	8Hrs

Gene expression in transcriptional level (lac and trp operon); gene expression in bacteriophages. Transposons – types and mechanism of transposition.Gene silencing. Recombination – Homologous and Non – homologous recombination. Molecular techniques; DNA finger printing, DNA Microarray, Gene Mapping, Protein Micro array.

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	5 Hrs

REFERENCES

1. Bioinformatics: Sequence, Structure and Databanks: A Practical Approach (The Practical Approach Series, 236), Des Higgins (Editor), Willie Taylor. 1st edition, October 2000,Oxford University Press. ISBN:978-0199637904.
2. Bioinformatics: Sequence and Genome Analysis, David W. Mount. 2nd edition, June2004,Cold spring harbor laboratorypress.ISBN:978-0879697129
3. David, H.M.2005. Bioinformatics. Secondedn .CBS Publishers, New Delhi.

4. David,R., Westhead,J., Howard,P.and Richard, M. and Twyman Instant Notes- Bioinformatics Viva Books Private Limted, Chennai.
5. Gribskov,M.,Devereux,J.1989.Sequence analysis primer. Stockton Press.
6. Introduction to Bioinformatics, Teresa Attwood, David Parry-Smith, 1st edition, May2001, Pearson Education. ISBN:978-8178085074
7. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition, Andreas D. Baxevanis, B. F. Francis Ouellette. 3nd edition, October 2004, A John Wiley & Sons, Inc., Publication. ISBN: 978-0471478782.
8. Seizberg, S. L., Searls, D. B. and Kasif, S. 1998. Computational methods in Molecular biology now comprehensive Biochemistry. Elsevier.

Semester - IV

Course Code	22U4BTC06	CORE COURSE-V GENETIC ENGINEERING	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles of gene manipulation and its application in the development of novel pharmaceutical and drug products
2. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
3. 3. To expose students to application of recombinant DNA technology in biotechnological research.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To know about DNA manipulating enzymes and its role in rDNA Technology	K1
CO2	To gain knowledge on different types plasmid vectors and their Usage.	K2
CO3	To acquire knowledge on basic gene cloning strategies.	K3
CO4	To evaluate the usage and applications of gene cloning for the development value added products.	K4
CO5	To know-how on versatile techniques in recombinant DNA technology.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	SCOPE AND MILE STONES OF GENETIC ENGINEERING	15 Hrs

Bimolecular tools and their applications in genetic engineering: Restriction endonucleases and its types, DNA polymerases, DNA Ligase, Methylase, Taq polymerase, Reverse transcriptase. DNA modifying enzymes (Alkalinephosphatase, Polynucleotide kinase, Terminal deoxy nucleotidyl transferase). S1nuclease, RNAse H and DNAse I. Ligation(cohesive & blunt end ligation) – linkers & adaptor.

UNIT II	GENE CLONING VECTORS	15 Hrs

Plasmids (PBR322, PUC and BAC), Lambda vectors, Phagemids, Cosmids, M13 vectors, Shuttle vectors and artificial chromosomes (YAC and BAC). DNA sequencing (Maxam-Gilbert and Dideoxy) methods. DNA amplification: PCR (Principles & types - RT PCR, Real time PCR and Nested PCR). cDNA synthesis and cloning:mRNA enrichment, reverse transcription.

UNIT III	CLONING STRATEGIES	15 Hrs

Cloning of interacting genes - Yeast two hybrid systems. - Nucleic acid micro arrays and Site directed mutagenesis. Methods to study gene regulation: DNA transfection, Primer extension, S1 mapping, RNase protection assay.

UNIT IV	INTRODUCTION TO CLONING	15 Hrs

Detection & Screening of clones. Expression strategies for heterologous genes. Vector engineering and codon optimization. In-vitro transcription, expression of cloned genes in prokaryotes (bacteria – Glucose promoter) and eukaryotes (Yeast – Alcohol promoter).

UNIT V	APPLICATIONS OF rDNA TECHNOLOGY	15 Hrs

Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); cytoplasmic male sterility; delay of fruit ripening.

Transgenic animals – Pharmaceutical products - insulin. Farm animal production. Recombinant DNA Technology in the production of vaccine. T-DNA tagging and transposon tagging, Transgenic and gene knock out technologies.

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	5 Hrs

REFERENCES:

1. Molecular cloning: a laboratory manual. J. Sambrook, EF. Frisch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.2000.
2. DNA cloning: a practical approach, DM. Glover and BD Hames, IRL Press, Oxford, 1995.
3. Molecular and Cellular Methods in Biology and Medicine, PB. Kaufman, W.Wu. D, Kim and L.J Cseke, CRC Press, Florida, 1995.
4. Methods of Enzymology vol. 152, Guide to molecular cloning techniques, SL. Berger and AR. Kimmel Academic Press, Inc. An Diego, 1998.
5. Methods in Enzymology. Vol 185, gene expression technology, DV. Goeddel Academic Press, inc. San Deigo, 1990.
6. DNA science. A first Course in Recombinant Technology. DA. Mickloss and GA. Freyer; CokJ Spring Harbor Laboratory Press, New York, 1990.
7. Molecular Biotechnology. SB. Primrose, Blackwell Scientific Publishers, Oxford, 1994.
8. Milestones in Biotechnology. Classic papers on genetic Engineering. JA. Davis and WS. Reznikoff, Butterworth-Heinemann, Boston, 1992.
9. Route maps in Gene technology, MR. Walker and R. Rapley, BlackwelScience Ltd., Oxford, 1997.
10. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes, SM. Kingsman and AJ. Kingsman, Blackwell Scientific Publications, Oxford, 1998.
11. Molecular Biotechnology - Glick and Pasternak.
12. Principles of gene manipulations - Old & Primrose.

Course Code	22U4BTCP04	CORE PRACTICAL -IV LAB IN GENETIC ENGINEERING	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	40	60

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles on the usage of genomic and plasmid DNA in the development of microbial recombinant clones
2. To Learning tools and techniques in rDNA technology
3. To acquire skills on techniques of construction of recombinant DNA - Cloning vectors and isolation of gene of interest.
4. To Learning techniques for production of pharmaceuticals, growth hormones, vaccines, gene therapy in expression system.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To isolate genomic and plasmid DNA, and to digest them restriction Enzyme	K1
CO2	Shall acquire practical knowledge on vector handling and target DNA	K2
CO3	Shall know about the amplification strategies of cloned vector	K3
CO4	To demonstrate the selection of recombinant clones by using selectable markers	K4
CO5	To conduct gene amplification experiments by PCR analysis.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	Isolation of Genomic DNA from *E.coli*.	10
2	Isolation of Plasmid DNA from *E.coli*	10
3	Construction of restriction map of a plasmid by Hind III and Bam HI	10
4	Ligation of DNA and plasmid byT4 DNA ligase.	5
5	Purification of DNA fragments from gel by electro-elution.	5
6	Amplification of ligated plasmid by PCR.	10
7	Transformation of recombinant DNA in Host E.coli by CaCl method.	10
8	Selection of recombinant clones by (IPTG-X-gal: Blue white selection).	15

REFERENCES:

1. Laboratory Manual for Genetic Engineering Paperback – 1 January 2009 by Vennison, S John.
2. BIO2450L Genetics Laboratory Manual Christopher Blair CUNY New York City College of Technology

Course Code	22U4ZOA02	ALLIED COURSE-IV DEVELOPMENTAL BIOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. To provide a comprehensive understanding of the concepts of early animal development
2. To develop a critical appreciation of methodologies specifically used to study the process of embryonic development in animals.
3. To generates cellular diversity and order within each generation.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To able to list the types of characteristics that make an organism ideal for the Study of developmental biology.	K1
CO2	To familiar with the events that lead up to and comprise the process of Fertilization.	K2
CO3	To understand the difference between Blastulation and gastrulation.	K3
CO4	To able to describe organogenesis.	K4
CO5	To Knowledge of Artificial Reproductive Technology	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**GAMETOGENESIS**	**12 Hrs**

Introduction to Developmental Biology , Spermatogenesis and structure of spermatozoa, Oogenesis, Structure and types of ovum.

UNIT II	**FERTILIZATION**	**12 Hrs**

Fertilization and its types, Process of fertilization in invertebrates and vertebrates, Parthenogenesis – Mechanism and its types.

UNIT III	**BLASTULATION AND GASTRULATION**	**12 Hrs**

Planes and patterns of cleavage, Blastulation and Morula. Morphogenetic movements, Gastrulation in Mammals.

UNIT IV	**ORGANOGENESIS**	**12 Hrs**

Origin and development of organs, Development of eye, heart and brain.

UNIT V	**ARTIFICIAL REPRODUCTIVE TECHNOLOGY**	**12 Hrs**

Induced ovulation, Artificial Insemination, IVF, Embryo transfer, ICSI, Birth control.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Biologia Del Desarrollo/ Developmental Biology Scott F. Gilbert 2006
2. Developmental Biology /Leon W.Browder
3. Developmental Biology Scott F. Gilbert 2013
4. Developmental Biology Leonaid Roosevelt
5. Developmental Biology Mary. S Tyler
6. Developmental Biology Michael .J f , Scott F Gibert
7. Developmental Biology Subramanian. M. A
8. Developmental Biology David. J. Caroll
9. Human embryonic stem cells in Development Ali H. Brivanlou
10. Principles of Development Lewis Wolpert.

Course Code	22U4ZOAP02	ALLIED PRACTICAL COURSE-IV LAB IN DEVELOPMENTAL BIOLOGY	Hours/ WK		Marks	
Credits	3					
Total Hours	60		T	P	Int	Ext
Max. Mark	100		-	3	40	60

Course Objectives:

The main objectives of this course are:

1. To emphasize the fundamentals of biology and build upon those fundamentals.
2. To allow students to gain an appreciation of development and what can be gained from studying various vertebrates.
3. To allow students to understand key concepts and techniques in developmental biology.
4. To provide students with the opportunity to work together in a collaborative effort.
5. To strengthen the ability of students to think critically.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To able to list the types of characteristics that make an organism ideal for the Study of developmental biology.	K1
CO2	To familiar with the events that lead up to and comprise the process of Fertilization.	K2
CO3	To understand the difference between Blastulation and gastrulation.	K3
CO4	To able to describe organogenesis.	K4
CO5	To Knowledge of Artificial Reproductive Technology	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	To study the developing Gametes (Testis and Ovary)	6
2	To study the developmental stages of chick embryos (24hours, 48 hours, 72 hours and 96 hours)	6
3	To study the developmental stages of Egg, Blastula and Gastrula	6
4	To study the frog metamorphosis	3
5	To study the different types of placenta	6
6	To observe the the structure of Sperm and Egg.	3

REFERENCES:

1. Laboratory manual, BIOLOGY Developmental Biology Laboratory BIOL-A309 McGraw-Hill Publishers

Course Code	22U4BTS03	SBEC – II POULTRY SCIENCE	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. To impart knowledge on different systems of breeding of poultry.
2. To gain knowledge about selection methods of poultry
3. To design and implementation of breeding programmer in developing egg-type and meat type.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To impart knowledge about care and management of breeders, hatchery operation, health management.	K1
CO2	To study the nutrition in Poultry Science	K2
CO3	To gain knowledge business skills needed in poultry production.	K3
CO4	To develope basic sciences and mathematics about Poultry Science.	K4
CO5	To understanding of the Poultry Farming and production of eggs, meat,	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**GENERAL INTRODUCTION OF POULTRY**	**8 Hrs**

Introduction to poultry keeping , poultry industry in India , Poultry breeds and classes of fowls , Poultry housing , general principles of building poultry house.

UNIT II	**POULTRY MANAGEMENT**	**8 Hrs**

Rearing of fowls – growers. Layers and broilers – growth management – summer and winter management.

UNIT III	**POULTRY NUTRITION**	**8 Hrs**

Poultry nutrition –Composition of poultry feed – nutrient requirements for fowls – nutritional deficiency symptoms.

UNIT IV	**PRECAUTION Of POULTRY**	**8 Hrs**

Poultry diseases: Ranikhet disease, New castle disease, Fowl pox, Birds flu. Vaccination schedules

UNIT V	**ECONOMICS Of POULTRY**	**8 Hrs**

Poultry egg production – composition and nutritive value of egg - use of feathers and poultry manure. Economics of poultry. Field visit.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Prakash Malhotra (2008) Economic Zoology, Adhyayna Publishers & Distributors, New Delhi.
2. GnanamaniA.R.Modern aspects of commercial Poultry keeping. Giri Publication, Madurai.
3. Banerjee G.C. A text book of Animal Husbandry –Oxford & IBH publishing Co Pvt. Ltd., New Delhi.
4. Jawaid, A. and Sinha, S. P. (2008) A Handbook of Economic Zoology. S. Chand & Company, New Delhi.
5. Upadhya, V.B. (2006) Economic Zoology. Rastogi Publications, Meerut, India.
6. Biester, H.E. and Schwarte, L.H. (1969) Diseases of Poultry, 5th Edn. Oxford and IBH Publishing Co, NewDelhi.

Course Code	22U4BTS04	SBEC – II MARINE BIOTECHNOLOGY	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. To understanding the significance and importance of marine micro biota.
2. To rational applicability in the development of industrially important products.
3. To gain knowledge on the environmentally hazardous management marine ecosystem.
4. To understanding the marine pharmacology.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand basics of marine ecosystem and its pollution issues.	K1
CO2	Tounderstandbasicbiodegradationandbioremediationmarineecosyst empollutants	K2
CO3	To understand the principles of biofouling.	K3
CO4	To acquire knowledge of waste water treatment in marine ecosystem.	K4
CO5	To acquire knowledge of marine toxins.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**MARINE ORGANISMS AND ENVIRONMENT INTERACTION**	**8 Hrs**

Types of marine environment - Physical, Chemical and Biological aspects and their interaction with marine life; Air – Sea interaction; Green - house gases (CO2 and Methane)

UNIT II	**POLLUTION**	**8 Hrs**

Marine pollution-major pollutants (heavy metal, pesticide, oil, thermal, radioactive, plastics, litter and microbial); Biological indicators (Marine microbes, algae and crustaceans) and accumulators: Application of Protein biomarkers; Biosensors and biochips.

UNIT III	**BIOMATERIAL INTERACTION**	**8 Hrs**

Biodegradation and Bioremediation; Biodegradation of natural and synthetic waste materials; Bioremediation; Separation, purification and bio removal of pollutants.

UNIT IV	**FOULING AND CORROSION**	**8 Hrs**

Biofouling; Biofilm formation; Marine fouling and boring organisms - their biology, adaptation; Factors influencing the settlement of macro foulers; Antifouling and Anti boring treatments; Corrosion Process and control of marine structures.

UNIT V	**INTRODUCTION TO MARINE PHARMACOLOGY**	**8 Hrs**

Terms and definitions; Medicinal compounds from marine flora and fauna - marine toxins, antiviral and antimicrobial agents.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

1. Recent Advancesin MarineBiotechnologyVolume3– Milton fingermanet al.,1999.
2. Cynobacterial and Algal Metabolisms and Environment Biotechnology – TasneemFatma, 1999.
3. Environmental Biotechnology and cleaner Bioprocess–Olguni, E.J. etal., 2000.
4. Environmental Biotechnology Theory and applications–Evansetal., 2000.
5. Environmental Biotechnology –G3a6rethM.Evamsetal.,2003
6. Biotechnology, Recombinant DNA Technology, Environmental Biotechnology – S.Maheshet al., 2003.

Course Code	20U4BTN03	NMEC - II CONCEPTS OF BIOTECHNOLOGY	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make non major life science students in understanding basic and applied principles of biotechnology
2. To understand technical approach in society in generating value added, reliable and reproducible products.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand the scope and application of biotechnology	K1
CO2	Use of enzymes ingenerating basic recombinant DNA concepts.	K2
CO3	Use of plasmid vectors in experimenting and designing cloning Strategies	K3
CO4	Use molecular techniques of the identification of positive recombinant clones.	K4
CO5	To gain knowledge about technologies in biotechnology.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**SCOPE OF BIOTECHNOLOGY**	**8 Hrs**

History of Biotechnology; Conventional and modern Biotechnology – Biotech industries. Biotechnology tree. Strategies for gene cloning.

UNIT II	**TOOLS USED IN GENE CLONING**	**8 Hrs**

Restriction endonucleases – Types – Features. Ligases – linkers, adaptors and homopolymer tailing. Modifying Enzymes

UNIT III	**VECTORS**	**8 Hrs**

Properties of good vector. Constructed plasmids-pBR 322. Cosmid vectors, Animal vectors-SV40. Plant vectors – Ti derivatives

UNIT IV	**INTRODUCTION OF GENES**	**8 Hrs**

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

UNIT V	**SELECTION OF RECOMBINANTS**	**8 Hrs**

Markers – PCR, RFLP, RAPD and blotting techniques

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Principles of gene manipulations. Old and Primrose (1989), 3rd edition.
2. Biotechnology, Sathyanarayana U (2008), Books and Allied (p) ltd.
3. Biotechnology and genomics, Gupta PK (2004). Rastogi publications.
4. Gene cloning and DNA analysis. Brown TA. (1996). Blackwell science, Osney Mead, Oxford.
5. A text book of Biotechnology, Dubey RC (2007). S.Chand& Company Ltd, New Delhi.
6. Biotechnology, Singh BD (2004). Kalyani Publications. New Delhi.

Course Code	20U4BTN04	NMEC – II BIOTECHNOLOGY FOR SOCIETY	Hours/ WK		Marks	
Credits	2		T	P	Int	Ext
Total Hours	45		2	-	25	75
Max. Mark	100					

Course Objectives:

The main objectives of this course are:

1. To make students on understanding the applied part of biotechnology to non-major and non-life science back ground students
2. To understand technical approach in society in generating value added, reliable and reproducible products.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand basic knowledge of silkworm, earthworm cultivation and its applications	K1
CO2	To understand the concepts of biofertilizers, bioplastics and Bioweapons .	K2
CO3	TounderstandthebasicconceptsofbiodegradationofxenobioticCompounds	K3
CO4	To understand the concepts of generating genetically modified transgenic organisms	K4
CO5	To understand the concepts of Transgenic animals	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**TRENDS IN ECONOMIC BIOTECHNOLOGY**	**8 Hrs**

Seri culture, Aquaculture, Apiculture, Vermi culture and Mushroom Technology.

UNIT II	**REGULATIONS IN BIOTECHNOLOGY**	**8 Hrs**

Biofertilizers, Biopesticides, Bio repellents, Pest control and management, Biomass (SCP), Bioplastics, Bioweapons.

UNIT III	**BIOFUELS**	**8 Hrs**

Bio dyes, Bio fuels – Biodiesel & Biogas, Bio indicators, Biodegradation – Role of genetically modifies organisms.

UNIT IV	**rDNA TECHNOLOGY**	**8 Hrs**

Production of penicillin, Recombinant Vaccines (HBV), Recombinant Insulin, Plantibodies, Vaccines in animal cells, Gene therapy.

UNIT V	**APPLICATION OF BIOTECHNOLOGY**	**8 Hrs**

Transgenic animals and their applications. Mice, Sheep and Fish. Transgenic plants and their applications – BT cotton, Flavr-Savr tomato and golden rice.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Animal Biotechnology, Ranga MM (2000). Agrobios
2. Introduction to Plant Biotechnology. Chawla (2003).2nd edition. Oxford and IBH publications.
3. Biotechnology, Sathyanarayana U (2008), Books and Allied (p) ltd.
4. Industrial Microbiology Patel AH (2005). Mac Millan Publishers.
5. A text book of Biotechnology, Dubey RC (2007). S.Chand& Company Ltd, New Delhi.

6.Environmental Biotechnology, Chatterji AK, 3rd edition, PHI Learning Pvt Ltd, Newdelhi.

Semester - V

Course Code	22U5BTC07	CORE COURSES-VII IMMUNOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		5	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students on exposing themselves to know in underlying concepts of biology of the immune system and how immunity being developed in human beings.
2. In addition the students also know where about on the mechanisms on the host pathogen interaction, principle defense mechanisms against infectious diseases and basic immune diagnostic techniques.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Acquire knowledge on history on immunology development, and cells and their role in developing overall host immune system.	K1
CO2	Knowing about the functions and properties of immunoglobulinand its expression in genetic level.	K2
CO3	Acquire knowledge on antigen recognition and its processing principles by host immune system.	K3
CO4	Acquire basic concepts of immune regulatory molecules andtheir role in defense and concepts of autoimmunity.	K4
CO5	Evaluate the defense mechanism against any pathogens.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	HISTORY AND SCOPE OF IMMUNOLOGY	13 Hrs

Types of Immunity. Cells of Immune system. Organs of Immune response and their functions. Haematopoiesis. Antigen- properties, classes, epitopes, haptens and adjuvants. Factors influencing antigenicity.

UNIT II	IMMUNOGLOBULINS AND ITS EXPRESSION	13 Hrs

Immunoglobulin- Structure, types, properties and functions. Immunoglobulin gene re-arrangements. Generation antibody diversity. Somatic hyper mutation. Ig gene expression and its regulation.

UNIT III	ANTIGEN PROCESSING AND PRESENTATION	14 Hrs

MHC – types and importance- distribution and function. Antigen processing and presentation to T-lymphocytes. Major classes of MHC genes and its regulation.Antigen – Antibody reactions – Agglutination, precipitation,RIA, ELISA, FACS and Immuno panning. Hybridoma Technology.

UNIT IV	CYTOKINES, IMMUNE CELL ACTIVATION AND ALLERGIC REACTIONS	15 Hrs

Definition of cytokines, classification and types of cytokine, Biological functions of cytokines. Cytokine receptors. T-cell and B-cell activation and differentiation. Hypersensitivity reactions and its types. Plasma cells and memory cells.

UNIT V	AUTOIMMUNITY	15 Hrs

Definition, types of autoimmune disorders. Mechanism of autoimmunity. Immunodeficiency disorder. Vaccines and its types. Immune response to bacterial, protozoan & parasitic diseases. Immuno deficiency diseases (HIV). Transplantation immunology – types of grafts. Mechanism of graft rejection Immunosuppressive therapy.

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	5 Hrs

REFERENCES:

1. Ivan Riot – Blackwell, 1988. Essentials of Immunology (6th Edition): Scientific Publications, Oxford,
2. Paul W.E (Eds) Ravan prss 1988.Fundamentals of Immunology:, New York,
3. Harlow and David Lane, 1988. Antibodies A laboratory Manual: cold spring harbor laboratory.
4. Janis Kuby Immunology, 1997. WH Freeman & Company, New York.
5. Tizard, 1995. Immunology IV Ed Saunders college publishers, New York.
6. Robert M.Coleman., 1992. Fundamental Immunology. 2 nd edition. Wim. C.Brown Publishers.
7. Eli Benjamini et al., 1991. Immunology A short course –Wiley Publishers, NY.

Course Code	22U5BTC08	CORE COURSES-VIII BIOSTATISTICS	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		5	-	25	75

Course Objectives:

The main objectives of this course are:

1. Enhance students' skill towards use of statistics and its application of biostatistics in biotechnological Research.
2. In addition the students also know about the mechanisms enzymes and basic enzyme techniques

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To make understand the students in math and statistics.	K1
CO2	Knowing about the Mean, Median, Mode	K2
CO3	Acquire knowledge on Mean Deviation and Standard Deviation.	K3
CO4	Acquire basic concepts of Correlation, Regression.	K4
CO5	Evaluate the test of significance.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**STATISTICS**	**13 Hrs**

Definitions – Limitation and uses of Statistics – Sources of data in Life Sciences – Collection data – Primary &Secondary data – Methods of collection of data – Classification, Tabulation & assentation.

UNIT II	**MEASURES OF CENTRAL TENDENCY**	**13 Hrs**

Mean, Median, Mode – Merits and Demerits.

UNIT III	**MEASURES OF DISPERSION**	**14 Hrs**

Range, Quartile Deviation, Mean Deviation and Standard Deviation – Merits and Demerits – Coefficient of Variation.

UNIT IV	**REGRESSION & CORRELATION**	**15 Hrs**

Types of Correlation, Rank Correlation, Regression equations – Fitting and redictions (Simple problems).

UNIT V	**TEST OF SIGNIFICANCE**	**15 Hrs**

Null and Alternative hypothesis – Large sample tests based on mean, difference of means, small sample test – student t-test, chi-square test.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Gupta, S.P. (2011). Statistical Methods. 41 th edition, Sultan Chand & sons, New Delhi.
2. Mahajan, B.K. (1997). Methods in Biostatistics. 6 th edition, Jaypee BrothersMedical Publishers (P) Ltd.

Course Code	22U5BTC09	CORE COURSES-IX ENZYMOLOGY AND ENZYME TECHNOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		5	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students on exposing themselves to know in underlying concepts of enzyme and enzyme technology.
2. In addition the students also know where about the mechanisms enzymes and basic enzyme techniques.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Acquire knowledge in the subject enzymes and enzyme technology	K1
CO2	Knowing about the functions and properties of enzymes.	K2
CO3	To understand their functional attributes.	K3
CO4	Acquire basic concepts Enhance knowledge on industrial application of enzymes.	K4
CO5	Evaluate Legal issues related to enzyme based industries.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**INTRODUCTION TO ENZYMES**	**13 Hrs**

Enzyme nomenclature, enzyme commission numbers, and classification of enzymes. Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turn over number, Marker enzymes.

UNIT II	**ENZYME KINETICS:**	**13 Hrs**

Steady state, pre-steady state, equilibrium kinetics, Michaelis and Menten Equation and its derivation, Different methods to calculate the Km and Vmax and their significance. Factor affecting Enzyme activity and catalysis: pH, substrate and enzyme concentration, temperature, coenzyme and cofactors, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis. Enzyme inhibition, different types of inhibitors and activators.

UNIT III	**STRUCTURE AND FUNCTION OF ENZYMES**	**14 Hrs**

Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes. Bioinformatics analysis of structural and functional properties of enzymes.

UNIT IV	**ENZYME TECHNOLOGY**	**15 Hrs**

Immobilization of enzymes, whole cell immobilization and their application, commercial production of enzymes,RNA-catalysis, Catalytic antibodies -abzymes, Protein and Enzyme engineering: Design and construction of novel enzymes using Insilco methods.

UNIT V	**ENZYMES IN INDUSTRIES**	**15 Hrs**

Paper making, Meat processing, Bread making, Detergent preparation, Enactments, regulations and guidelines in Enzyme industries, IPR in enzyme technology (Stone wash, Bioplastics, corn to plastic)

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Trevor, P. 2004. Enzymes: Biochemistry, Biotechnology, Clinical chemistry –East West Press

Edition, New Delhi.
2. Satyanarayana, U. and Chakrapani, U. 2008. Biochemistry, Books and Allied (P) Ltd, Kolkata. Nicholas, C. and Price Lewis Stevens, 1998. Fundamentals of Enzymology, 2 nd edition, Oxford University Press, New York.
3. David L. Nelson and Michael M. Cox, 2007. Lehninger Principles of Biochemistry, W.H Freeman and Company, New York.
4. Lubert, S. Jeremy M. Berg and John L. Tymoczko, 2001. Biochemistry, V edition, W.H.Freeman & Company, Newyork.
5. Ashok Pandey, Colin Webb, Calos Ricardo Soccl and Christian Larroche, 2005.
6. Enzyme Technology, Asiatech publishers Inc, New Delhi.

Course Code	22U4BTCP05	CORE IV LAB IN IMMUNOLOGY & ENZYME TECHNOLOGY	Hours/ WK		Marks	
Credits	3		T	P	Int	Ext
Total Hours	75		-	6	40	60
Max. Mark	100					

Course Objectives:

The main objectives of this course are:

1. To make students on practical exposure towards immunological techniques in-terms of handling of laboratory animals, qualitative and quantitative estimation of antigen - antibody specificity.

Course outcomes

On successful completion of the course, students will be able to:

CO1	Gaining knowledge on handling of laboratory animals.	K1
CO2	Knowing about the methods of immunization of bleeding andseparation serum and plasma from blood.	K2
CO3	Analysis of qualitative & quantitative estimation of antigen -antibody interaction.	K3
CO4	To know about the basic principles of blotting techniques in practical approach.	K4
CO5	Evaluate and create laboratory test analysis kit .	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	Preparation of Serum and plasma.	**3**
2	ABO Blood grouping (Rh typing) (Agglutination).	**3**
3	WIDAL test, ASO test , Pregnancy test (Agglutination),	**3**
4	Radial immune diffusion test, Rocket Immuno electrophoresis test	**3**
5	Ouchterlony double immune diffusion technique (ODD), (Precipitation test).	**3**
6	Counter current immune electrophoresis (CIE) and DOT ELISA.	**3**
7	Isolation and screening of industrially important enzymes (amylase) from microbe.	**3**
8	Enzyme production and assay (amylase).	**3**
9	Optimization of pH and temperature for enzyme production (amylase).	**3**
10	Immobilization of enzymes.	**3**

REFERENCES:

1. Janis Kuby Immunology, 1997. WH Freeman & Company, New York.
2. Tizard, 1995. Immunology IV Ed Saunders college publishers, New York.
3. Robert M.Coleman., 1992. Fundamental Immunology. 2 nd edition. Wim. C.Brown Publishers.
4. Eli Benjamini et al., 1991. Immunology A short course –Wiley Publishers, NY.

Course Code	22U4BTCP06	CORE IV LAB IN BIOSTATISTICS	Hours/ WK		Marks	
Credits	2					
Total Hours	30		T	P	Int	Ext
Max. Mark	100		-	3	40	60

Course Objectives:

The main objectives of this course are:

1. To learn basic methods of descriptive and inferential statistics and apply them to real scenarios.
2. The knowledge and the correct use of the statistical methods will allow students to deal with data variation, to organize and summarizes information, to make inference and communicate meaningful experimental results.

Course outcomes

On successful completion of the course, students will be able to:

CO1	Tounderstandandimplementtheprinciplesofasepticpracticesin Laboratory	K1
CO2	To gain knowledge on the media preparation and culturing the microorganism	K2
CO3	To identify the caliberation in lab instruments.	K3
CO4	To check the estimations of biomolecules like proteins.	K4
CO5	To understand and quantition of nucleic acids.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	Data input and error handling.	**3**
2	Measure and central tendency:- mean, median, mode.	
3	Measure and variability: Range: minimum and maximum:Interquartile range and standard deviation.	
4	Data manipulation: Select, filter, mutate, summarise, group by,arrange and join.	
5	Graph: Bar plot, scatterplot and box plot.	**3**
6	Correlation and Regression	**3**
7	Comparing mean: one sample:1] T-test(parametric),2] Wilcoxon test(non parametric)	**3**
8	Comparing the mean and paired sample:1]T-test,2]] Wilcoxon test	**3**
9	Comparing the mean of two independent groups: 1]T-test,2]] Wilcoxon test	**3**
10	Comparing the mean of more than two groups: 1] ANOVA: one way and two way(parametric). 2]Kruskal-Wallis (non parametric) alternative to one way anova.	**3**

REFERENCES:

1. An Introduction to Practical Biochemistry by Rodney Boyer (2003). Pearson Education.
2. Laboratory Manual of Biochemistry by J.Jayaraman (1988) Wiley Eastern
3. Practical Biochemsitry by Wilson and Walker (1994). Cambridge University Press
4. Handbook of Laboratory culture media, Reagents, Stains and Buffers by N. Kannan (2003), Panima Publishers, New Delhi
5. Calculations in Molecular Biology and Biotechnology. A Guide to Mathematics in the Laboratory by (Frank H. Stephenson) (2003) ACADEMIC PRESS An Imprint of Elsevier.

Course Code	20U5BTE01	ELECTIVE COURSES-I PHARMACEUTICAL BIOTECHNOLOGY	Hours/ WK		Marks	
Credits	3					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		3	-	25	75

Course Objectives:

The main objectives of this course are:

1. This paper encodes information on pharmacology, drug designing, sources and applications of drug discovery.
2. Students also understand the basic and applications of pharmacology and sources of drug and enable them to understand the concepts of rDNA technology in drug designing.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand the principles of pharmacology and its development.	K1
CO2	To understand principles of action of drugs and mechanism of action towards diseases	K2
CO3	To understand the concepts of developing therapeutic agents throughgenetic engineering principles.	K3
CO4	To explore the applications of pharmaceutical chemistry.	K4
CO5	Evaluate the drugs and medicine that the student comes across.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**INTRODUCTION TO PHARMACOLOGY**	**13 Hrs**

History & development in pharmacology. Principles of pharmacology. – Pharmacology in the 20th century – Drugs – Sources, dosage forms and routes of administration.

UNIT II	**DRUG NAMES & CLASSIFICATION SYSTEMS**	**13 Hrs**

General Principles of Drug action. Pharmacokinetics, Pharmaco dynamics, measurement of drug action. Antibacterial, antifungal, anti protozoal, antiviral, anti helmithic, anticancer, anti-inflammatory drugs.

UNIT III	**DIAGNOSIS AND CHEMOTHERAPY**	**14 Hrs**

Prenatal diagnosis: Amniocentesis, Fetoscopy, Non Invasive Techniques – Ultra Sonography.Diagnosis using protein & enzymes markers, DNA/RNA based diagnostics.

UNIT IV	**INTRODUCTION TO r-DNA TECHNOLOGY**	**15 Hrs**

Human Insulin, HGH, GRF, Erythropoietins, IFN, TNF, Interleukins, Clotting factor VIII. Synthetic therapy**:** Synthetic DNA, therapeutic ribozymes, synthetic drugs.

UNIT V	**PRODUCTION AND APPLICATIONS**	**15 HRS**

Probiotics, anticancer and anti- inflammatory agents. Biochips, biofilms and biosurfactants. Tissue Engineering, Recombinant vaccines and Cell adhesion based therapy.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. A Text Book of Biotechnology. R.C. Dubey. S.Chand& Co Ltd, New Delhi.
2. Pharmacology – H.P. Rang, M.M. Pale, J.M. Moore, and Churchill Livingston.
3. Basic Pharmacology – Foxter Cox. Butterworth"s 1980.
4. Pharmacology and Pharmacotherapeutics – R.S.Satoskar, S.D. Bhandhakam and S.S. Alinapue.
5. Pharmaceutical Biotechnology – S.S. Purohit4, 7Kaknani, Saleja.
6. Pharmacology – Mary J. Myuk, Richard A.Hoarey, Pamala Lippinwitt, Williams Edition.
7. Integrated pharmacology – Page, Curtis, Sulter, Walker, Halfman. Mosby Publishing Co.

Course Code	20U5BTE02	ELECTIVE COURSES-I TISSUE ENGINEERING	Hours/ WK		Marks	
Credits	3					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		3	-	25	75

Course Objectives:

The main objectives of this course are:

1. This paper deals with the use of combination of cells, engineering and materials methods, and suitable biochemical and physicochemical factors to improve or replace biological tissues.
2. Tissue engineering involves the use of tissue scaffold for the formation of new viable tissue for a medical purpose.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand the key topics in tissue engineering.	K1
CO2	To understand the stem cells and animal cells, processes, and strategies to regenerate or repair damaged tissues.	K2
CO3	To develop students ability to identify, formulate and adapt engineering solutions to unmet biological needs	K3
CO4	To give students a knowledge of how the biomedical industry is regulated and the route to market of for tissue engineered products	K4
CO5	To make the students evaluate and create new ideas in tissue engineering.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**INTRODUCTION TO TISSUE ENGINEERING**	**13 Hrs**

Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents. Measurement of tissue characteristics and physical properties..

UNIT II	**TISSUE TYPES AND TISSUE COMPONENTS**	**13 Hrs**

Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors.

UNIT III	**BIOMATERIALS**	**14 Hrs**

Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials. Applications of biomaterials.

UNIT IV	**STEM CELLS**	**15 Hrs**

Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers.

UNIT V	**STEM CELLS AND GENE THERAPY**	**15 Hrs**

Physiological models, tissue engineered therapies, product characterization. Preservation of stem cells: freezing and drying.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Bernhard O.Palsson,Sangeeta N.Bhatia,"Tissue Engineering", Pearson Publishers 2009.
2. Raphael Gorodetsky, Richard Schäfer. "Stem cell based tissue repair", Cambridge: RSC Publishing, c 2011.
3. John P. Fischer, Antonios G. Mikos, Joseph D. Br4o8nzino. "Tissue Engineering", CRC Press, 2012.
4. Larry L. Hench, Julian R. Jones. "Biomaterials, Artificial Organs and Tissue Engineering", CRC Press, 2005.
5. C. S. Potten, "Stem Cells", Academic Press, 1997.

Course Code	20U5BTS05	SBEC-III BIOINFORMATICS	Hours/ WK		Marks	
Credits	2					
Total Hours	30		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1.To make students on understanding the basic concepts biological soft wares and their applicability in enhancing the need based quality of living systems

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To understand basic knowledge of nucleic acid sequence databases.	K1
CO2	To understand the concepts of specialized databases.	K2
CO3	To understand the basic concepts of sequence analysis and sequence Alignment.	K3
CO4	To understand the concepts of gene prediction methods through *insilico* approaches.	K4
CO5	Evaluate and create programs in bioinformatics.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**BIOINFORMATICS**	**13 Hrs**

Biological Databases- Nucleic acid sequence databases – GenBank/NCBI, EMBL, and DDBJ. Protein sequence databases – UniprotKB and PIR, Structure databases – PDB, CATH and SCOP.

UNIT II	**SPECIALIZED DATABASES**	**13 Hrs**

BLOCKS, PRINTS and Pfam, Microarrays-Microarray data analysis, Proteomic data Analysis.

UNIT III	**SEQUENCE ANALYSIS**	**14 Hrs**

sequence alignment, Dot plot, pair wise Sequence Alignment- Local alignment and Global alignments- Dynamic programming algorithm for sequence alignment, Scoring matrices, gap Penalties.

UNIT IV	**MULTIPLE SEQUENCE ALIGNMENT**	**15 Hrs**

Scoring methods-clustal W- Phylogenetic Analysis- tree construction methods- Maximum likelihood and maximum parsimony- distance methods- Database similarity search- Basic Local Alignment search tool (BLAST).

UNIT V	**GENE PREDICTION METHODS**	**15 Hrs**

ORF finder, Restriction site analysis. Protein secondary structure prediction –Comparative Modeling -Drug Designing-- Molecular Docking.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. Bioinformatics: Sequence, Structure and Databanks: A Practical Approach (The Practical Approach Series, 236), Des Higgins (Editor), Willie Taylor. 1st edition, October 2000, Oxford University Press. ISBN: 978-0199637904.
2. Bioinformatics: Sequence and Genome Analysis, David W. Mount. 2nd edition, June 2004, Cold spring harbor laboratory press. ISBN: 978-0879697129
3. David, H. M. 2005. Bioinformatics. Second edn. CBS Publishers, New Delhi.
4. David, R., Westhead, J., Howard, P. and Ric4h9ard, M., and Twyman. Instant Notes-Bioinformatics Viva Books Private Limted, Chennai.
5. Gribskov, M., Devereux, J. 1989. Sequence analysis primer. Stockton Press.
6. Introduction to Bioinformatics, Teresa Attwood, David Parry-Smith, 1st edition,

May 2001, Pearson Education. ISBN: 978-8178085074

7. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition, Andreas D. Baxevanis, B. F. Francis Ouellette. 3nd edition, October 2004, A John Wiley & Sons, Inc., Publication. ISBN: 978-0471478782.
8. Seizberg, S. L., Searls, D. B. and Kasif, S. 1998. Computational methods in Molecular biology now comprehensive Biochemistry. Elsevier.

Course Code	20U5BTS06	SBEC-III CANCER BIOLOGY	Hours/ WK		Marks	
Credits	2					
Total Hours	30		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles of Biosafety guidelines and to understand concepts of intellectual property right and its types.
2. The students also gain added knowledge on ethical, legal and social considerations on implementing/marketing biotechnological products.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Understand the basic concepts of cancer biology and types of tumor.	K1
CO2	Understand the mechanisms of cancer development and chemical involved in carcinogenesis.	K2
CO3	Understand molecular mechanisms and genetic principles of oncogene expression.	K3
CO4	Acquiring the knowledge on developing drug discovery approach inthe management and detection of cancer.	K4
CO5	Evaluate the symptoms of cancer for people around them in early stage.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**FUNDAMENTALS OF CANCER BIOLOGY**	**13 Hrs**

Regulation of Cell cycle, Mutations that cause changes in signal molecules, effects on receptor, signal switches, tumor suppressor genes. Development and causes of cancer, Types of cancer, Benign and malignant tumor.

UNIT II	**PRINCIPLES OF CARCINOGENESIS**	**13 Hrs**

Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis.

UNIT III	**PRINCIPLES OF MOLECULAR BIOLOGY OF CANCER**	**14 Hrs**

Oncogenesis: Oncogenesis, identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth factors related to transformations.

UNIT IV	**PRINCIPLES OF CANCER METASTASIS**	**15 Hrs**

Clinical significances of invasion, heterogeneity of metastatic phenotype, three step theory of invasion, Proteinases and tumor cell invasion.

UNIT V	**NEW MOLECULES FOR CANCER THERAPY**	**15 Hrs**

Different forms of therapy, Chemotherapy, Radiation Therapy, Detection of Cancers, Prediction of Aggressiveness of Cancer, Advances in Cancer detection.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES:

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
3. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell ScientificPublications.
4. Ruddon.R.W.,Cancer Biology, Oxford University Press, Oxford, 1995.

Semester - VI

Course Code	22U6BTCO10	CORE – X BIOPROCESSTECHNOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		4	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles of fermentation techniques and applying them in the production value added products such as antibiotic, vitamins and organic acids.
2. The students also gain added knowledge on the production of agro based products for human welfare.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Understand the concepts of fermentation principles and its scope in downstream processing	K1
CO2	Understand the concepts of designing fermentor both in laboratory and pilot scale and its mode of operation	K2
CO3	Gaining added information on the production of value added products from microorganisms	K3
CO4	Propagate mass production of agriculturally important value added Products	K4
CO5	Evaluate and create agriculture product productions.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	BASICS OF BIOPROCESS TECHNOLOGY	13 Hrs

Introduction, Definition, Scope and applications of Bioprocess. Introduction to fermentation and downstream processing technology. Isolation and screening of industrially important microorganism. Strain improvement, preservation of microorganisms.

UNIT II	DESIGN OF FERMENTOR	13 Hrs

Fermentation types. Design of fermentor – parts and its functions. Types of Bioreactors (Air lift, cyclone, column, packed tower) Mixed bioreactor systems.

Monitoring and controlling Bioreactors (pH, temperature and dissolved oxygen), Instrumentation for process control - Heat and mass transfer, oxygen transfer mechanism. Principles of upstream processing – Media preparation, Inocula development and sterilization.

UNIT III	DOWN STREAM PROCESSING	14 Hrs

Basic principles of Down- stream processing – microbial cell disruption methods (Centrifugation, filtration fermentation broths). Cell separation techniques (Ultra filtration, Liquid-Liquid extraction) Chromatographic techniques: (Column & Ion exchange), Physical methods (Distillation, Fluid extraction and Electro dialysis). Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV	INDUSTRIAL BIOTECHNOLOGY	15 Hrs

Microbial synthesis and applications – organic acids (Citric acid & acetic acid), Enzymes (Amylase), Antibiotics (Penicillin & Streptomycin), Vitamins (ascorbic acid & B12) an amino acids (Lysine & Aspartic acid).

UNIT V	PRODUCTION OF AGRICULTURAL PRODUCTS	15 Hrs

Importance of micro algae and its cultivation (Spirullina& Chlorella). Mass production of Biofertilizer (Rhizobium & Azolla). Mushroom cultivation (Milk and button mushroom). Production and applications of Biopesticide (Bacillus thuringiensis).

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	5 Hrs

REFERENCES

1. Peppler H.J. and Perlman D. 2006. Microbial Technology: Microbial Processes, 2nd Edition, Vol I, Academic Press

2. Stanbury F, Whittaker A and Hall J.S. 1997. Principles of Fermentation Technology, Adithya Books, New Delhi.

3. Jogdand S.N. 2000. Medical Biotechnology, Himalayan Publishing House.

4. Jayanto A. 2006. Fermentation Biotechnology, Dominant Publishers and Distributors, New Delhi.

5. Cassida J.R. 2005. Industrial Biotechnology, New Age International (P) Ltd, New Delhi.

6. Juan A and Senjo A. 2007. Separation Process Biotechnology, Taylor & Francis group.

7. Patel A.H. 1997. Industrial Microbiology, Macmillan India limited.

8. Glazer A.N. and Nikaido, H. 2007. Microbial Biotechnology: Fundamentals of Applied Microbiology, 2nd Edition, Cambridge University Press.

9. Prescott C and Dunn G. 2006. Industrial Microbiology, Agrobios (India).

10. Purohit S.S. Saluja A.K. and Kakrani H.N. 2004. Pharmaceutical Biotechnology. 1st Edition, Agrobios (India).

Course Code	22U6BTC011	CORE – XI PLANT AND ANIMAL BIOTECHNOLOGY	Hours/ WK		Marks	
Credits	4		T	P	Int	Ext
Total Hours	75		5	-	25	75
Max. Mark	100					

Course Objectives:

The main objectives of this course are:

1. To make students on exposing plants technically, so as manipulate them for the production of disease free, nutritive elite plant varieties. In addition candidates are exposed to the use of vector based engineering of plant genome for the generation of genetically modified plants and food products.
2. To make students on understanding the concepts of biotechnological approaches in animals so as to produce therapeutically products from animal systems

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Know about basic aseptic conditions to be followed in plant tissue culture laboratory and preparing various tissue culture media.	K1
CO2	Understanding the genetic engineering techniques in plants and about natural gene transfer methods.	K2
CO3	Understanding the development of animal cell culture techniques and basic concepts of cell lines.	K3
CO4	Manipulating animal cell for genetic improvement by modern recombinant techniques.	K4
CO5	Knowing about the principles of ethical, legal and public issues on using genetically animals in producing value added products.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	PLANT TISSUE CULTURE TECHNIQUES	13 Hrs

History, Laboratory organization sterilization methods, types of media, media preparation, and plant growth regulators .Micro propagation, Callus induction. Cell culture techniques, Protoplast culture and fusion. Organogenesis and somatic embryogenesis. Haploid production of plants (embryo cultures).

UNIT II	GENETIC ENGINEERING IN PLANTS	13 Hrs

Selectable markers, Reporter genes and promoters used in plant vectors Genetic engineering & crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Agrobacterium mediated gene transfer (Ti plasmid and Ri plasmids) methods in plants.

UNIT III	BASICS OF CELL CULTURE	14 Hrs

Types of cell culture methods (Primary & secondary). Animal Cell lines (Primary & Continuous cell lines). Suspension culture and organ culture .Different types of animal cell culture media, growth supplements serum free media, Balanced salt solutions. Behavior of cells in culture cell division, Cell growth kinetics, Metabolism and estimation of cell number

UNIT IV	GENE TRANSFER METHODS AND ANIMAL PROPAGATION	15 Hrs

Microinjection, Embryonic stem cell gene transfer, Retroviral gene transfer. Transgenic animals (Production of transgenic Mice, Cow and Sheep). Animal viral vectors (SV40 virus and Retro virus). Baculo virus expression system. Artificial insemination, Embryo transfer techniques. Production and development of animal vaccines for FMD, BTD, Rabies and anthrax.

UNIT V	PUBLIC ASPECTS OF ANIMAL BIOTECHNOLOGY	15 Hrs

Ethical issues in Animal Biotechnology, Management aspects of Biotechnology and Genetic Engineering. Manipulation of animal growth using hormones and probiotics. Manipulating lactation and wool growth in sheep and Rabbits.

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	5 Hrs

REFERENCES

1. Plant cell culture, A practical approach, 2nd Edition, Edited by R.A. Dixon and R.A. Gonzales.
2. Plant Biotechnology: An introduction to genetic engineering by Adrian Slater, Nigel W.Scott, Mark R. Fowler. Oxford University, Press,2008.
3. Biochemistry and Molecular Biology of Plants Bod Buchananm Wilhelm Gruissem, Russell Jones. John Wiley & Sons,2002.
4. Molecular Biotechnology by Glick, B.R.andJ.J.Pasternak. Scond Edition, ASMpress, Washington, 1998.
5. Portne R.Animal Cell Biotechnology: Methods and Protocols, Second Edition, Humana Press,2007.
6. BabinkL.A. and PhilipsJ.P .Animal Biotechnology, Comprehensive Biotehcnology First Supplement, Pregamon press, Oxford, 1989.
7. RossantJ .and Pederson R.A.ExperimentalapproachestoMammalianEmbryonicDevelopment,Cambdrige University Press, Cambridge,1996.
8. IanGordon. Reproductive Technologies in farm animals,first edition,CABIInter.,2004.
9. LewisR.Human Genetics: Concept and applications. McGraw HillCompany,2003.
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Course Code	22U4BTCP07	CORE PRACTICALS– VII LAB IN BIOPROCESS TECHNOLOGY	Hours/ WK		Marks	
Credits	4					
Total Hours	75		T	P	Int	Ext
Max. Mark	100		-	5	40	60

Course Objectives:

The main objectives of this course are:

1. To make students exposing to practical principles of fermentation techniques and applying them in the production value added products such antibiotic, vitamins and organic acids. The students also gain added knowledge on the production of agro based products for human welfare.
2. To make students on exposing to practical principles of tissue culture media preparation,cell viability, sub culturing and viability assay techniques The candidate also shall know how to maintain and culture the microorganisms in laboratory and their biochemical identification mechanisms.

Course outcomes

On successful completion of the course, students will be able to:

CO1	Understand the basic concepts on the production of alcohol, organicacid and SCP production. Prepare animal cell media and its sterilization techniques.	K1
CO2	Understand in determining the microbial growth. To filter sterilizethe sensitive media ingredients and filtration technique.	K2
CO3	Estimating the production of single cell protein by biochemical method. Prepare suspension culture and cultivating viruses in Embryonated egg.	K3
CO4	Analyzing milk qualitatively and separating aflatoxin fungal species by chromatographic method. Observation of different types ofanimal cell lines.	K4
CO5	To understand and implement the principles of aseptic practices inLaboratory	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	Enumeration of microorganisms from bread	**5**
2	Production of alcohol from grapes	**5**
3	Production and estimation of citric acid from *Aspergillus* species	**10**
4	Estimation of alcohol from grapes.	
5	Production single cell protein from *Azolla* and *Spirullina.*	5
6	Immobilization of amylase by entrapment method	**10**
7	Determination of bacterial growth by growth curve method	**10**
8	Determination of Thermal Death point (TDP) of the bacterial sample.	**10**
9	Quality analysis of milk a. MBRT test and b. Rezasurin test	**10**
10	Analysis of fungal aflatoxin by TLC	**5**

REFERENCES

1. Juan A and Senjo A. 2007. Separation Process Biotechnology, Taylor & Francis group.
   Patel A.H. 1997. Industrial Microbiology, Macmillan India limited.
2. Glazer A.N. and Nikaido, H. 2007. Microbial Biotechnology: Fundamentals of Applied Microbiology, 2nd Edition, Cambridge U5n7iversity Press.
3. .Prescott C and Dunn G. 2006. Industrial Microbiology, Agrobios (India).
4. .Purohit S.S. Saluja A.K. and Kakrani H.N. 2004. Pharmaceutical Biotechnology. 1st Edition, Agrobios (India).

Course Code	22U4BTCP08	CORE PRACTICALS– VIII LAB IN PLANT AND ANIMAL BIOTECHNOLOGY	Hours/ WK		Marks	
Credits	4		T	P	Int	Ext
Total Hours	75		-	5	40	60
Max. Mark	100					

Course Objectives:

The main objectives of this course are:

1. To familiarize the student in various aspects of cell and molecular biology streams including cellular organization and their interactions in DNA replication, and protein biosynthesis and translational regulation
2. To develop comprehensive understanding on the complete cellular and molecular functions of cell organelles in terms of cell to cell interaction, gene regulation, cellular signaling.

Course outcomes

On successful completion of the course, students will be able to:

CO1	Acquire a complete knowledge about molecular marker-aided breeding and apply that for effective crop improvement.	K1
CO2	Obtain a comprehensive knowledge about the concepts of plant tissue culture and its applications.	K2
CO3	Gain fundamental knowledge instem cell biology and tissue engineering.	K3
CO4	Describe sources, selection, potential manipulations and challenges of using stem cells for tissue engineering.	K4
CO5	Explain significance, current status and future potential of tissue engineering.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

1	Isolation of genomic DNA from Plant.	**5**
2	Preparation of stock solutions for MS medium	**5**
3	MS medium preparation	**10**
4	Inoculation of explant-shoot tip, meristem tip	
5	Inoculation of explants-embryo.	5
6	Packing and sterilization of glass and plastic wares for cell culture.	**10**
7	Preparation of reagents and media for cell culture	**10**
8	Primer culture technique chicken embryo fibroblast.	**10**
9	Secondary culture of chicken embryo fibroblast.	**10**
10	Cultivation of continuous cell lines. vi. Quantification of cells by trypan blue exclusion dye	**5**

Reference:

1. Audric, G. and Ciel, D. 2010. Bioengineering: Principles, Methodologies and Applications (Biotechnology in Agriculture, Industry and Medicine), Nova Science Pub Inc.
2. Becker JM, Coldwell GA & Zachgo EA. 2007. Biotechnology – A Laboratory Course. Academic.
3. Brown TA. 2006. Gene Cloning and DNA Analysis. 5th Ed. Blackwell Publishing.
4. Sambrook J, Fritsch T &Maniatis T. 2001. Molecular Cloning – a Laboratory Manual.2nd Ed.
5. Freshney RI. (2005). Culture of animal cells: A manual of basic techniques, 5th Edition, John Wiley and Sons.
6. John R W Masters. (2000). Animal cell culture, 3rd Edition, Oxford University Press.
7. Florence PR. (2006). Animal Biotechnology, Dominant Publishers and Distributors.
8. Sandy Primrose, RichardTwyman and Bob Old. (2001). Principles of Gene Manipulation, 6th Edition, Blackwell Science Ltd. p: 174-319.

Course Code	20U6BTE03		Hours/	Marks

Credits	3	ELECTIVE –II	WK			
Total Hours	60	GENOMICS AND PROTEOMICS	T	P	Int	Ext
Max. Mark	100		3	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles of genome and its manipulating strategies endup with the development of novel candidate gene.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Understand the basic structure of genome map in prokaryotic andeukaryotic organisms.	K1
CO2	To understand the mapping of different regions of DNA and itsamplification protocols.	K2
CO3	To acquire knowledge on different tools used in the fields ofProteomics.	K3
CO4	To explore with the different application of proteomics in terms ofprotein mapping.	K4
CO5	Evaluate and create applications in proteomics.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	GENOMICS	12 Hrs

Overview of Genome anatomies. Prokaryotic Genome Organization: operons. Eukaryotic Genomes, Nuclear Genomes and gene families, Organelle genomes: origin, Repetitive DNA contents, Tandem repeats, Transposons and transposable elements.

UNIT II	DNA SEQUENCING METHODS	12 Hrs

Shot gun sequencing – Contig assembly. Techniques for gene location: ORF findings, Northern Hybridization, RT- PCR, RACE, S1 nuclease mapping, exon trapping. Transcriptome analysis: SAGE and Microarray technology.

UNIT III	GENOME MAPPING	10 Hrs

Genetic Mapping: RFLP, SSLP, SNP-Physical. Mapping, Restriction site Mapping: FISH, STS mapping. Human genome organization. Gene therapy for inherited disorders and infectious diseases and ethics.

UNIT IV	TOOLS OF PROTEOMICS	10 Hrs

The proteome – the life cycle of protein-analytical techniques. Protein separation: 1D PAGE, 2D-PAGE, RPHPLC, Protein digestion techniques: peptide analysis- MALDI-TOF-ESI, Tandem Mass analyzers, Peptide Mass finger printing.

UNIT V	APPLICATIONS OF PROTEOMICS	10 Hrs

Protein mining, SALSA algorithm for mining specific features. Protein expression profiling. Identifying protein- protein interactions. Mapping of protein modifications.

UNIT VI	VIDEO LECTURES, SEMINARS AND WEBINARS	6 Hrs

REFERENCES

1. Terence A Brown.(2002) Genomes, 2nd Edition, Bios Scientific Publishers.

2.Tom Strachan and Andrew P Read (1999) Human Molecular Genetics, 2nd edition, Bios Scientific Publishers.

3.Daniel C. Liebler (2002) Introduction to Proteomics, tools for the New biology- Humana press. Totowa, NJ.

4.Pennington.S, M. Dunn (2001) Proteomics: From Protein Sequence to Function 1 edition Bios Scientific Publishers.

Course Code	20U6BTE04	ELECTIVE –II BIOPHYSICS AND BIOINSTRUMENTATION	Hours/ WK		Marks	
Credits	3					
Total Hours	60		T	P	Int	Ext
Max. Mark	100		3	-	25	75

Course Objectives:

The main objectives of this course are:

1. To make students to deals with the basic instrumental principles leading to biological research outputs. It also describes the biophysical concepts of different biomolecular.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Explores student towards the biophysical properties of nucleic acids Proteins	K1
CO2	Acquiring knowledge with the basic concepts of chromatographic Techniques	K2
CO3	Acquiring knowledge with the basic concepts of spectroscopic Techniques	K3
CO4	Exploring towards the use of radiation principles in the field of biomedical science	K4
CO5	Evaluate and measure radioactive coumponds.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**BIOPHYSICS OF NUCLEIC ACIDS**	**12 Hrs**

Transitional angles and their ranges. The pseudo-rotation cycle, syn – anti orientation of glycosyl bond. Geometries of Watson- Crick and Hoogsteen base pairs.

UNIT II	**BIOPHYSICS OF PROTEINS**	**12 Hrs**

Amino acids – Conformations. Phi and Psi angles. Ramachandran plot. Peptide bond isomerisation. Disulphide bonds, electrostatic forces, van der waals interaction and hydrogen bonds.

UNIT III	**ANALYTICAL TECHNIQUES**	**10 Hrs**

Principles and applications of Chromatography (Paper, thin-layer, column, GC-MS, GLC, Ion exchange chromatography, HPLC). Principles and applications of spectroscopy. (UV- Vis, NMR, Raman spectroscopy, AAS and X-ray crystallography).

UNIT IV	**SEPARATION TECHNIQUES**	**10 Hrs**

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting

UNIT V	**RADIATION BIOPHYSICS**	**10 Hrs**

Basic concepts of radiography. Measurement of radioactivity: GM counter, Liquid and solid scintillation counter. Advantage and disadvantage of radio active compounds.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**6 Hrs**

REFERENCE.

1. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi
2. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency. Biophyscial chemistry – principles and Techniques- Upadhyay, Upadhyay Nath.1997
3. Biophysical chemistry – Cantor and Schinmel. 2002
4.Biophysical chemistry – principles and Techniques, Upadhyay, Upadhyay Nath.1997
5.Biophysics – Arora, First edition, Himalaya Publications, New Delhi
6. Palanivelu, P (2001). Analytical Biochemistry, and separation techniques, Tulsi Book Centre. Madurai.

Course Code	20U6BTS07	SBEC –III NANO BIOTECHNOLOGY	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

3. To make students in understanding the basic concepts of developing nanotechnology, so as to produce biologically generated value added products for the development of human welfare.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	Know basic concepts of nanotechnology and nano materials	K1
CO2	Know the concepts of fabrication of bio molecular structures	K2
CO3	Develop miniaturized nano elements	K3
CO4	Understand various applications of nanotechnology in the field medicine, health care and drug discovery	K4
CO5	Evaluate about the application of nano biotechnolpgy.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**NANOBIOTECHNOLOGY**	**8 Hrs**

Overview of Genome anatomies. Prokaryotic Genome Organization: operons. Eukaryotic Genomes, Nuclear Genomes and gene families, Organelle genomes: origin, Repetitive DNA contents, Tandem repeats, Transposons and transposable elements.

UNIT II	**NANOMATERIALS AND ITS PROPERTIES:**	**8 Hrs**

Carbon nanotubes and nanorods, Quantom dots, metal based nanostructures (Iron oxide nanoparticles), nanowires, polymer based nanostructures (dendrimers), Gold nanostructures (nanorods, nanocages, nanoshells), nanocomposites.

UNIT III	**BIOMOLECULAR NANOSTURUCTURES STUDY**	**8 Hrs**

Atomic Force Microscopy, Scanning Probe Electron Microscopy and Lithography. Nanoscale detection: Lab on a Chip. Fabrication of bionanochip & microarray technology.

UNIT IV	**MINIATURIZED DEVICES IN NANOBIOTECHNOLOGY**	**8 Hrs**

Types and applications; Nano biosensors: different classes, molecular recognition elements (MRE), transducing elements, applications of MRE in nanosensing of different analytes..

UNIT V	**APPLICATIONS OF NANOBIOTECHNOLOGY**	**8 Hrs**

Nanomedicine, Diagnosis and treatment of infectious diseases, cancer research and therapy, tissue engineering and regenerative therapy; Nanostructures in drug discovery & drug delivery.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCES

1. Nanobiotechnoogy: concepts, applications and perspectives. Christ of M. Niemayer, chad A. Mirkin, Wiley VCH publishers 2004.
2. Bionnotechnology: Lessons from Nature, David. S. Goodshell, Jhonwiley 2006.
3. Buddy, D.R. Allan, S.H. Frederick, J.S. and Jack, E.L. Biomaterials Sciences: An Introduction to Materials in Medicine. 2nd edition.
4. David, L.N. and Michael, M.C. (2006). Lehninger"s principles of Biochemistry. 4th edition.
5. David, S. and Goodshell, J. (2006). Bionanotechnology: Lessons from Nature.
6. Molecular Design and Synthesis of Biomaterials6·1(2005). Biological Engineering Division, MIT Open Course Ware.

Course Code	20U6BTS08	SBEC –III ENVIRONMENTAL BIOTECHNOLOGY	Hours/ WK		Marks	
Credits	2					
Total Hours	45		T	P	Int	Ext
Max. Mark	100		2	-	25	75

Course Objectives:

The main objectives of this course are:

3. This paper provides insight into environmental issues, relevant biotechnological concepts for facing environmental issues, available biotechnological applications in environmental issues, relevant policies. The course also tries to impart knowledge and skill in environmental biotechnology for sustainable development.

Course outcomes

On the successful completion of the course, student will be able to:

CO1	To provide knowledge in environmental impacts in biotechnology	K1
CO2	To understand the concepts in various bioremediation techniquesrelated environmental aspects	K2
CO3	To impart new thoughts about biotechnological applications on environmental issues	K3
CO4	To create awareness regarding the environmental policies for theimprovement of environmental safety	K4
CO5	Evaluate environmental significant.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

UNIT I	**BASIC CONCEPT OF ENVIRONMENT**	**8 Hrs**

Environment - basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management.

UNIT II	**MESUARMENTS OF POLLUTION**	**8 Hrs**

An overview of atmosphere, hydrosphere, lithosphere and anthrosphere - environmental problems. Environmental pollution - types of pollution, sources of pollution, measurement of pollution, methods of measurement of pollution, fate of pollutants in the environment, Bioconcentration, biogeomagnification.

UNIT III	**WASTE WATER TREATMENT**	**8Hrs**

Microbiology of waste water treatment, aerobic process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process - anaerobic digestion, anaerobic filters, up- flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industries

UNIT IV	**XENOBIOTIC COMPOUNDS**	**8 Hrs**

Xenobiotic compounds - organic (chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants) and inorganic (metals, radionuclides, phosphates, nitrates). Bioremediation of xenobiotics in environment - ecological consideration, decay behavior and degradative plasmids, molecular techniques in bioremediation

UNIT V	**ENVIRONMENTAL SIGNIFICANCE**	**8 Hrs**

Role of immobilized cells/enzymes in treatment of toxic compounds. Biopesticides, bioreactors, bioleaching, biomining, biosensors, biotechniques for air pollution abatement and odour control.Environmental significance of genetically modified microbes, plants and animals.

UNIT VI	**VIDEO LECTURES, SEMINARS AND WEBINARS**	**5 Hrs**

REFERENCE.

1. Wase water engineering - treatment, disposal and reuse, Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.
2. Environmental Chemistry, AK. De, Wiley Eastern Ltd, New Delhi.
3. Introduction to Biodeterioration, D.Allsopp and K.J. Seal, ELBS / Edward Arnold.
4. Bioremidation, Baaker, KH and Herson D.S., 1994. Mc.GrawHill Inc, NewYork.
5. Industrial and Environmental Biotechnology - Nuzhat Ahmed, Fouad M. Qureshi and Obaid Y. Khan, 2006. Horizon Press.
6. Environmental Molecular Biology, Paul. A, Rochelle, 2001.Horizon Press