

## **BACHELOR OF SCIENCE (BIOTECHNOLOGY) REGULATIONS**

### **ELIGIBILITY**

A candidate who has passed in Higher Secondary Examination with Life Science stream under Higher Secondary Board of Examination and as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent there to by the Academic Council, subject to such conditions as may be prescribed there to are permitted to appear and qualify for the **Bachelor of Biotechnology Degree examination** of this College after a course of study of three academic years.

### **OBJECTIVES OF THE COURSE**

The curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To demonstrate a substantial understanding of concepts in key areas of Biotechnology and its applications.
2. To supplement the academic input of students by way of seminars, conferences, guest lectures and industrial visits.
3. To describe the common methods and applications of biotechnology with regards to microorganisms, plants, animals and Pharma industries.

### PROGRAM OUTCOMES

On the successful completion of the program, the following are the expected outcomes.

<b>PO Number</b>	<b>PO Statement</b>
<b>PO1</b>	Students will be able to identify, analyze and understand problems related to biotechnology and finding valid conclusions with basic knowledge in biotechnology.
<b>PO2</b>	Graduates will be able to justify societal, health, safety and legal issues and understand his responsibilities in biotechnological practices.
<b>PO3</b>	Provide education that leads to comprehensive understanding of the principles and practices of biotechnology that will help to undertake any responsibility as an individual and as a team in a multidisciplinary environment.
<b>PO4</b>	Graduates will be able to demonstrate knowledge of project management when dealing with Biotechnology problems.
<b>PO5</b>	Students will possess hands-on technical skills necessary for supporting biotechnology research activity and empower students with the ability to think and solve problems in the field of biotechnology.

## SCHEME OF EXAMINATIONS

Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
Part - I							
17UT L11T 17UHL11H 17UML11M 17UFL11F	Tamil-I/ Hindi-I/ Malayalam-I/ French - I	5	3	25	75	100	3
Part - II							
17UEG12G	English - I	5	3	25	75	100	3
Part - III							
17UBT13A	Core -I: Cell and Molecular Biology	5	3	25	75	100	4
17UBT13B	Core - II: Introductory Biotechnology	5	3	25	75	100	4
17UBT13P	Core Practical- I: Cell Biology	4	5	20	30	50	2
17UBT1AA	Allied - I: Biomolecular Chemistry	4	3	20	55	75	3
Part - IV							
17UFC1FA	Environmental Studies	2	2	-	50	50	2
		30				575	21
Second Semester							
Part - I							
17UT L21T 17UHL21H 17UML21M 17UFL21F	Tamil-II/ Hindi-II/ Malayalam-II/ French - II	5	3	25	75	100	3

10/11/28  
BoS Chairman/HoD  
Department of Biotechnology  
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B.Sc- Biotechnology (Students admitted from 2017-2018 onwards)

Part - II							
17UEG22G	English - II	5	3	25	75	100	3
Part - III							
17UBT23A	Core -III: Principles of Genetics	5	3	25	75	100	4
17UBT23P	Core Practical - II: Genetics	5	5	20	30	50	2
17UBT2AA	Allied -II: Biodiversity	4	3	20	55	75	3
17UBT2AP	Allied Practical - I: Biodiversity	4	5	20	30	50	2
Part - IV							
17UFC2FA	Value Education: Human Rights	2	2	-	50	50	2
		30				525	19
Third Semester							
Part - I							
17UTL31U 17UML31M 17UHL31H 17UFL31F	Tamil-III/ Hindi-III/ Malayalam-III/ French - III	4	3	25	75	100	3
Part - II							
17UEG32G	English - III	4	3	25	75	100	3
Part - III							
17UBT33A	Core -IV: Microbiology	4	3	20	55	75	4
17UBT33P	Core Practical -III: Microbiology	4	5	20	30	50	2
17UBT3AA	Allied - III: Biochemistry	4	3	20	55	75	3
17UBT3AP	Allied Practical - II: Biochemistry	4	5	20	30	50	2
17UBT3SA	Skill Based Subject - I: Computational and Bioinformatic Skills*	2	-	-	50	50	2
Part-IV							
17UFC3FA 17UFC3FB 17UFC3FC 17UFC3FD 17UFC3FE	Tamil/ Advanced Tamil (OR) Yoga for Human Excellence/Women's Rights/Constitution of India	2	2	-	50	50	2
	NMEC-I:	2	2	-	50	50	2
		30				600	23

B.Sc- Biotechnology (Students admitted from 2017-2018 onwards)

<b>Fourth Semester</b>							
<b>Part - I</b>							
17UTL41U 17UHL41H 17UML41M 17UFL41F`	Tamil-IV/ Hindi-IV/ Malayalam-IV/ French - IV	4	3	25	75	100	3
<b>Part - II</b>							
17UEG42G	English - IV	4	3	25	75	100	3
<b>Part - III</b>							
17UBT43A	Core -V: Immunology	5	3	25	75	100	4
17UBT43P	Core Practical - IV: Immunology	5	5	20	30	50	2
17UMT4AC	Allied -IV: Mathematics	4	3	20	55	75	3
17UBT4SA	Skill Based Subject-II: Molecular Techniques	4	3	20	55	75	4
<b>Part - IV</b>							
17UFC4FA/ 17UFC4FB/ 17UFC4FC	Tamil/ Advanced Tamil (OR) General Awareness	2	2	-	50	50	2
	NMEC- II:	2	2	-	50	50	2
		<b>30</b>				<b>600</b>	<b>23</b>
<b>Fifth Semester</b>							
<b>Part - III</b>							
17UBT53A	Core - VI: Recombinant DNA Technology	4	3	25	75	100	4
17UBT53B	Core -VII: Microbial Biotechnology	4	3	25	75	100	4
17UBT53C	Core -VIII: Plant Biotechnology	4	3	25	75	100	4
17UBT53P	Core Practical - V: rDNA, Microbial and Plant Biotechnology	6	5	20	30	50	3
	Elective -I:	4	3	20	55	75	4
17UBT5SA	Skill Based Subject- III: Entrepreneurial Biotechnology	4	3	20	55	75	3
17UBT5SB	Skill Based Subject- IV: Pharmaceutical Biotechnology	4	3	20	55	75	3

Part - IV							
17UBT53T	Internship**	Grade A to C					
		30				575	25
Sixth Semester							
Part - III							
17UBT63A	Core -IX: Animal Biotechnology	4	3	25	75	100	4
17UBT63B	Core - X: Environmental Biotechnology	4	3	25	75	100	4
17UBT63C	Core -XI: Nano Biotechnology	4	3	25	75	100	4
17UBT63D	Core-XII: Bioethics, Biosafety and IPR	4	3	20	55	75	4
17UBT63P	Core Practical - VI: Animal, Environmental and Nano Biotechnology	6	5	20	30	50	3
	Elective- II	4	3	20	55	75	4
	Elective- III	4	3	20	55	75	4
Part -V							
17UEX65A	Extension Activity	-	-	50	-	50	2
		30				625	29
Grand Total						3500	140

\* - The candidate must submit hard copies, making use of all the advanced formatting in word document (Formal Letters) and excel (Tables, Graph with calculations) with his/her Register Number as watermark. Concerned to E-mail, candidate must create a new mail ID from which they would send CC and Bcc, group mailing of official mails must be submitted as a printed version. A soft copy of power point slide must be designed using all the video and audio effects with the candidate himself appearing for the video shoot. Printed version of Downloaded Nucleic acid sequence, Protein structures and construction of Phylogenetic tree should be submitted. The performance of the candidate will be evaluated by External and Internal Examiner based on Report submitted on above mentioned contents and presentation.

**\*\*** - Students must undergo training in well reputed institution/company for not less than 15 days during IV Semester Summer Vacation. Evaluation of the Report will be done by the Internal and External Examiners in the V Semester. Based on their performance Grade will be awarded as A To C. (75 marks and above - A Grade, 60 - 74 marks - B Grade, 40 - 59 marks - C Grade, Below 40 marks - Reappear (RA)).

**ELECTIVE - I**

(Student shall select any one of the following subject as Elective-I in Fifth semester)

S.No	Subject Code	Name of the Subject
1.	17UBT5EA	Fundamentals of Bioinformatics
2.	17UBT5EB	Basics of Clinical Trials

**ELECTIVE - II**

(Student shall select any one of the following subject as Elective-II in Sixth semester)

S.No	Subject Code	Name of the Subject
1.	17UBT6EA	Marine Biotechnology
2.	17UBT6EB	Food and Dairy Technology

**ELECTIVE - III**

(Student shall select any one of the following subject as Elective-III in Sixth semester)

S.No	Subject Code	Name of the Subject
1.	17UBT6EC	Bioprospecting
2.	17UBT6ED	Forensic Biotechnology

**NON MAJOR ELECTIVE COURSES (NMEC)**

The department offers the following two papers as Non Major Elective Course for other than the Biotechnology students.

Student shall select the following subject as Non Major Elective Course during their third and fourth semester

S.No	NMEC	Subject Code	Name of the Subject
1.	I	17UED34E	Mushroom Technology
2.	II	17UED44E	Apiculture



**Total Credit Distribution**

Subjects	Credits	Total		Credits	Cumulative Total
Part I: Tamil	3	4x 100 =	400	12	24
Part II: English	3	4x 100 =	400	12	
Part III:					
Core Theory	4	10 x 100	1000	40	102
Core Theory	4	2 x 75	150	08	
Core Practicals	3	2 x 50 =	100	06	
Core Practicals	2	4 x 50 =	200	08	
Allied Theory	3	4 x 75 =	300	12	
Allied Practicals	2	2 x 50 =	100	04	
Elective	4	3 x 75 =	225	12	
Skill Based Subjects	4	1 x 75 =	75	04	
Skill Based Subjects	3	2 x 75=	150	06	
Skill Based Subjects	2	1 x 50=	50	02	
Part IV:					
Languages & Others	2	4 x 50 =	200	08	12
NMEC	2	2 x 50 =	100	04	
Part V:					
Extension Activity	2	1 x 50 =	50	02	02
Total			3500	140	140

### **FOR COURSE COMPLETION**

Students have to Complete the following Subjects:

1. Language papers (Tamil/Malayalam/French/Hindi, English) in I, II, III and IV semester.
2. Environmental Studies and Human Rights in I and II semester respectively.
3. Allied papers in I, II, III and IV semesters.
4. Two Non Major Elective Courses in III and IV semester.
5. Four Skill Based Courses in III, IV and V semester.
6. Extension activity in VI semester
7. Three Elective papers in the Fifth and Sixth semesters.
8. One Internship training in IV Semester.

**Earning Extra credits is not mandatory for course completion**  
**Extra credits**

<b>Part</b>	<b>Subject</b>	<b>Papers</b>	<b>Credit</b>	<b>Total credits</b>	<b>Papers</b>
<b>1.</b>	BEC/ Self study courses	1 papers	1	<b>1</b>	<b>1</b>
<b>2.</b>	Hindi / French/ Other foreign Language approved by certified Institutions	1 Course	1	<b>1</b>	<b>-</b>
<b>3.</b>	Type Writing / Short Hand Course	1 Course	1	<b>1</b>	<b>-</b>
<b>4.</b>	Diploma/certificate/CP T/ACS Inter/ NPTEL Course	1 Course	1	<b>1</b>	<b>-</b>
<b>5.</b>	Representation - Academic/Sports /Social Activities/ Extra Curricular / Co-Curricular activities at University/ District/ State/ National/ International level	1	1	<b>1</b>	
<b>Total</b>		<b>4</b>		<b>5</b>	<b>1</b>

**Rules:**

The students can earn extra credit only if they complete the above during the course period (I to V semester) and based on the following criteria. Proof of Completion must be submitted in the beginning of VI Semester. (Earning Extra credits is not mandatory for Course completion)

1. Student can opt BEC course/ Self study course to earn one credit. They have to Enroll and complete any one of the course during their course period before fifth semester (I sem to V sem).

**Self study paper offered by Biotechnology Department**

S. No.	Semester	Course Code	Course Title
1.	Semester I to V	17UBTSS1	Environment, Health And Management
2.		17UBTSS2	Biofertilizer Technology

2. Student can opt Hindi/ French/ Other foreign Language approved by certified Institutions to earn one credit. The certificate (Hindi) must be obtained from **Dakshina Bharat Hindi Prachar Sabha** and He/ she has to enroll and complete during their course period (**first to fifth semester**)
3. Student can opt for Type writing /short hand course to earn one credit extra. He/she has to enroll and complete the course during their course period to obtain certificate through **Tamil Nadu Board of Technical Education**
4. Student can opt for Diploma/certificate/CPT/ACS Inter/ NPTEL Course to earn one credit extra. Student who opt for Diploma/ Certificate course have to enroll any diploma/certificate course offered by Bharathiar University through our Institution. Student who opt for CPT/ ACS/CMA have to enroll and complete at foundation level during the course period. The course content of which shall be equivalent to that prescribed by ICAI/ICMA/ICSI. Students who opt for NPTEL course should complete certificate through NPTEL.

5. Award Winners in Academic/ Representation in Sports /Social Activities/ Extra Curricular/ Co-Curricular Activities at University/ District/ State/ National/ International level can earn one credit extra.

<b>17UBT13A</b>	<b>CORE- I: CELL AND MOLECULAR BIOLOGY</b>	<b>SEMESTER - I</b>
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**Total Credits: 4**  
**Hours Per Week: 5**

**PREAMBLE:**

1. To understand cellular organization, transport of molecules, cell interactions and signalling.
2. To describe gene expression and regulation.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Learn the fundamental concepts in the structure and functioning of a cell and membrane transport	K1
CO2	Interpret precisely the diversified roles of cytoskeletal filaments and infer the cascade of events in signal transduction and their	K1, K2
CO3	Discuss and distinguish the replication of prokaryotic and eukaryotic DNA.	K1, K2
CO4	Explain the synthesis of RNA and post-transcriptional modification and protein synthesis.	K1, K2
CO5	Understand the gene regulation, DNA damage and repair mechanisms.	K1, K2

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	S	M	S	S	M
CO3	S	M	S	S	M
CO4	S	M	S	S	M
CO5	S	M	S	S	M

S-Strong; M-Medium; L-Low

<b>17UBT13A</b>	<b>CORE- I: CELL AND MOLECULAR BIOLOGY</b>	<b>SEMESTER - I</b>
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**Total Credits: 4**  
**Hours Per Week: 5**

## **UNIT - I**

### **Cell Architecture and Cell Division**

Discovery of Cell and Cell theory, Chemical composition of cell. Structural organization of prokaryotic and eukaryotic cells; membrane bound organelles and non-membrane bound organelles. Cell cycle, Cell division (mitosis, meiosis) and Regulation. Cell communication and its types -Extracellular and intracellular signaling molecules.

## **UNIT - II**

### **Membrane Architecture and Transport**

Cell membrane and chemical compositions. Models of membrane structure - Lipid Mono layer, Lipid bilayer, Protein Lipid sandwich, Unit Membrane and Fluid Mosaic Model. Factors affecting Membrane fluidity and permeability, Solute transport by Simple diffusion, Facilitated diffusion and Active transport.

## **UNIT - III**

### **Replication of DNA and regulation**

DNA replication - Experimental proof for Semiconservative method, Mechanism of DNA replication, Enzymes in replication. Differences between Prokaryotic and eukaryotic replication. Replication model - Theta, Strand displacement and Rolling circle model. DNA Repair- Nucleotide excision, Base excision, Mismatch repair, Photo-reactivation, SOS and recombination repair. Regulation of DNA replication.

## UNIT - IV

### Transcription and regulation

Features of promoters, enhancers, activators and repressors. RNA polymerases and Types; Transcription in prokaryotes and eukaryotes. Antisense RNA, RNA interference (RNAi), hn RNA, Si RNA, Sn RNA and Micro RNA. Post-transcriptional modifications; RNA Splicing, Polyadenylation and Capping, RNA editing. Prokaryotic transcriptional regulation – *lac* operon.

## UNIT - V

### Translation and regulation

Genetic code – codon and anticodon concepts, wobble hypothesis, translation in prokaryotes and eukaryotes. Post translation modifications – Phosphorylation, Deformylation, Glycosylation, Acetylation, Amidation, Lipid attachment, S - Nitrosylation and Disulfide bond formation. Translational inhibitors.

### TEXT BOOKS:

1. *Bruce Alberts*. 1998. **Essential Cell Biology**. 1<sup>st</sup> edition. Garland Publishers.
2. *De Roberties*. 2003. **Cell and Molecular Biology**. 8<sup>th</sup> edition. EDP Lippincott Williams.
3. *Lodish, H. & Baltimore. D.* 1994. **Molecular cell Biology**. 2<sup>nd</sup> edition. American Scientific Books.
4. *Gerald Karp*. 2002. **Cell and Molecular Biology**. 3<sup>rd</sup> edition. John Wiley Sons.



**REFERENCE BOOKS:**

1. *Lewin, B.* 2004. **Genes V.** Oxford University press.
2. *Freifelder, D. and Malacinski, G. M.* 1996. **Essential of Molecular Biology**, 2<sup>nd</sup> edition. Panima Publishing Co., New Delhi.

<b>17UBT13B</b>	<b>CORE - II : INTRODUCTORY BIOTECHNOLOGY</b>	<b>SEMESTER - I</b>
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**Total Credits: 4**  
**Hours Per Week: 5**

**PREAMBLE:** To understand the basics and branches of Biotechnology, Applications of Biotechnology in different fields and their career opportunities .

### **COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Recognize the fundamental concepts in Biotechnology and its scope	K1
CO2	Interpret precisely the diversified roles of Biotechnology in various fields	K1, K2
CO3	Discuss and distinguish the different branches of Biotechnology. Explain various organization of biotechnology in global level.	K1, K2
CO4	Highlight the various biotechnology products available commercially	K1, K2, K3
CO5	Overview about public concerns and solutions	K1, K2, K3

### **Mapping with Programme Outcomes**

COs/Pos	PO1	PO2	PO3	PO4	PO5
CO1	W	S	S	S	S
CO2	M	S	S	S	S
CO3	M	S	S	M	S
CO4	W	S	M	S	S
CO5	M	S	M	S	S

S-Strong; M-Medium; L-Low

<b>17UBT13B</b>	<b>CORE II: INTRODUCTORY BIOTECHNOLOGY</b>	<b>SEMESTER - I</b>
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**Total Credits: 4**  
**Hours Per Week: 5**

## **CONTENTS**

### **UNIT - I**

#### **Basic concepts of Biotechnology**

Definition of Science and Technology. Biotechnology – Definition, Milestones, Branches, Scope and Applications. Interdisciplinary nature of Biotechnology – Role of Cell Biology, Microbiology, Biochemistry, Molecular Biology, Genetics, Biodiversity etc.,

### **UNIT - II**

#### **Role of Biotechnology**

Biotechnology in various fields - Red, Green, Blue and White Biotechnology - Agriculture, Aquaculture, Sericulture, Food and Beverages, Medicine and Health Care, Animal Breeding, Textile Industries, Dairy Industries, Environment, Molecular Diagnosis, Forensic Sciences, Bioprospecting, Biodiversity Conservation, Nanotechnology etc.,

### **UNIT-III**

#### **Multidisciplinary aspects of Biotechnology**

Biotechnology Institutions in India. Funding agencies and opportunities in India. Biotechnology - Global Scenario and Entrepreneurship. Growth of Biotechnology Companies in India. Career Opportunities in Biotechnology. Role of Computers in Biotechnology. Journals in Biotechnology.

## UNIT-IV

### **Biotechnology Products in human welfare**

Humulin, Somatostatin, HBs Antigen Vaccine, *Bt* Cotton, Factor VIII, Erythropoietin, Ig F, GFP, Biodiesel, Fermented Foods, Cosmetic Products, Bioinoculants, Agricultural Products, Nutraceutical Products, Biopolymers, Biomaterials and implants. Role of Patent for Product development.

## UNIT-V

### **Biotechnology in public concern**

Bioethics and Biosafety concerns in Biotechnology. Socio economical and ethical issues in Biotechnology – GMO crops, Cloning, Transgenics, Human Genome Project. Roles and responsibilities of Ethical committee and Institutional Review Board (IRB)/ Ethical Review Board (ERB)

### **TEXT BOOKS:**

1. *Bernard R. Glick, Jack J. Pasternak.* 2010. **Molecular Biotechnology: Principles and Applications of Recombinant DNA**, ASM press, U.S.A
2. *S.C. Rastogi and Shivani Rastogi.* 2006. **Introduction to Biotechnology**, CBS Publications.

### **REFERENCE BOOKS:**

1. *Ed Harlow, David Lane.*1988. **Antibodies Laboratory Manual**, Cold Spring Harbor, Laboratory Press.
2. *Judith A. Scheppler, Patricia E. Cassin and Rosa M. Gambier.* 2000. **Biotechnology explorations: Applying the fundamentals.** American Society for Microbiology.
3. <https://thunderbooks.files.wordpress.com/2009/05/introduction-to-biotechnology-and-genetic-engineering-infinity-2008.pdf>

<b>17UBT13P</b>	<b>CORE PRACTICAL I: CELL BIOLOGY</b>	<b>SEMESTER - I</b>
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**Total Credits: 2**  
**Hours Per Week: 4**

### **CONTENTS**

1. Demonstration of Basic Laboratory Practices – Sterilization, Decontamination, Glassware maintenance, Fumigation, Biosafety measures
2. Demonstration of Weighing Balance, pH meter, Colorimeter, Laminar Air Flow Chamber, Hot Air Oven, Centrifuge, Incubator, Microscope
3. Calculations of Molarity, Normality and Percentage Solution
4. Preparation of buffer in different pH - Phosphate, Acetate, Tris buffer
5. Preparation of equilibrated phenol
6. Simple staining of Bacteria
7. Microscopic observation of Monocot and Dicot Leaf, Root and Stem section
8. Staining of plant cells – Onion epidermal cells
9. Staining of starch granules
10. Cell counting using Haemocytometer
11. Blood smear preparation for blood cell identification
12. Mitotic preparation from onion root tip
13. Estimation of Chlorophyll.

**REFERENCE BOOKS:**

1. *Janarthanan, S. and Vincent, S.* 2007. **Practical Biotechnology - Methods and Protocols.**
2. *Jeffery M Becker., Guy A Caldwell. and Eve Ann Zachgo.* 2007. **Biotechnology - A laboratory Course.** 2<sup>nd</sup> edition. Academic Press.
3. *Joseph Sambrook, Michael R. Green.* 2012. **Molecular Cloning: A Laboratory Manual.** 4<sup>th</sup> edition. Cold Spring Harbor.
4. *John Davey, Michael Lord.* 2003. **Essential Cell Biology Volume 1: Practical Approach.** 1<sup>st</sup> edition. OUP Oxford.

<b>17UBT1AA</b>	<b>ALLIED I: BIOMOLECULAR CHEMISTRY</b>	<b>SEMESTER - I</b>
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**Total Credits: 3**  
**Hours Per Week: 4**

**PREAMBLE:**

To familiarize with chemistry of different Biomolecules and their importance.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Know the principles and laws governing biomolecules and the importance of water and its properties	K1, K2
CO2	Understand the classification, structure and occurrence of carbohydrates	K1, K2
CO3	Gain information on the classification, structure and functions of aminoacids and proteins	K1, K2
CO4	Know the classification, structure and functions of lipids and comprehend the knowledge on enzymes	K1, K2
CO5	Understand the classification, structure and functions of nucleic acids	K1, K2

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	S	M	S	S	M
CO3	S	M	S	S	M
CO4	S	M	S	S	M
CO5	S	M	S	S	M

S-Strong;M-Medium;L-Low

<b>17UBT1AA</b>	<b>ALLIED I: BIOMOLECULAR CHEMISTRY</b>	<b>SEMESTER - I</b>
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**Total Credits: 3**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Introduction to Biomolecular chemistry**

Water- Chemical properties -Function as medium of cellular reactions and activities - Ionization of water - Weak acids and weak bases - Buffers - Buffering in biological systems. Chemical bonds and its types (Covalent and Non covalent bonds). Principles of Bioenergetics- Laws of thermodynamics and their applications in biological system – Entropy and Enthalpy - Standard free energy changes.

### **UNIT - II**

#### **Carbohydrates**

Definition, classification, stereo isomeric forms, structure, functions and reactions of biologically important carbohydrates viz. monosaccharide- glucose, fructose, mannose, galactose; Disaccharides – sucrose, lactose, maltose, cellobiose; structural and storage polysaccharides- starch, glycogen, cellulose, chitin and peptidoglycans.

### **UNIT - III**

#### **Amino acid, peptide and proteins**

Classification, structure and properties of amino acids. Biologically important amino acids. Protein-primary, secondary, tertiary and quaternary structures. Biologically significant Proteins and its functions.



## UNIT - IV

### Lipids, Enzymes, Vitamins and Coenzymes

Definition and nomenclature of Fatty acids and their types. Structure and biological functions of lipids. Enzymes as biocatalysts; classification of enzymes, active site and mechanism of enzyme action, Inhibitors, allosteric enzymes. Structure and functions of Water and Fat soluble Vitamins.

## UNIT V

### Nucleic acids

Building blocks of nucleic acids - Purines, Pyrimidine. DNA- double helix structure, properties and function. Forms of DNA - A, B and Z. RNA- structure and functions of m-RNA, t-RNA and r-RNA.

### TEXT BOOKS:

1. *Nelson.D.L, Cox. M. M.* 2004. **Lehninger's Principle of Biochemistry**. 4<sup>th</sup> edition. Freeman Publisher.
2. *Murray. R.K, Granner. D.K, Mayes. P.A, Rodwell. V.W.* 2006. **Harper's Biochemistry**. 27<sup>th</sup> edition. McGraw Hill Publisher.
3. *Bhutani S. P.* 2010. **Chemistry of Biomolecules**. CRC Press.

### REFERENCE BOOKS:

1. *Trevor Palmer, Philip Bonner.* 2008. **ENZYMES: Biochemistry, Biotechnology, Clinical Chemistry**. East-West Press.
2. *Berg.J.M, Tymoczko.J.L, Stryer, L.* 2006. **Biochemistry**. 6th edition. Freeman Publisher.
3. *Adams. R.L, Knowler.J.Leader. D.P.* 1998. **Biochemistry of Nucleic Acids**. Cambridge Univ. Press,

<b>17UBT23A</b>	<b>CORE III: PRINCIPLES OF GENETICS</b>	<b>SEMESTER - II</b>
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**Total Credits: 4**  
**Hours Per Week: 5**

**PREAMBLE:**

- To study the Mendelian and non Mendelian models of inheritance that govern passage of genetic traits across generation

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the history and concept of Mendelian laws	K1,K2
CO2	Know the structure of chromosome, gene and its interaction	K1,K2
CO3	Identify with the natural horizontal gene transfer methods	K1,K2
CO4	Recognize chromosomal variations and genetic disorders	K1, K2 &K3
CO5	Realize the importance of pedigree analysis and genetic counseling	K1, K2 &K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	S
CO2	S	M	M	M	S
CO3	S	M	M	M	S
CO4	S	M	M	M	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT23A</b>	<b>CORE III: PRINCIPLES OF GENETICS</b>	<b>SEMESTER - II</b>
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**Total Credits: 4**  
**Hours Per Week: 5**

## **CONTENTS**

### **UNIT - I**

#### **Mendelian & Non Mendelian Inheritance:**

History of Genetics, Mendel's work: Monohybrid Experiment, Dihybrid Experiment, Back Cross and Test Cross. Chromosomal theory of Inheritance, Extranuclear inheritance (mitochondrial, chloroplast), Maternal inheritance, Uniparental inheritance.

### **UNIT- II**

#### **Concept of Gene, Alleles and Chromosome**

Gene vs Allele, Multiple Alleles, Pseudo alleles, Gene Interactions: Allelic (Co-Dominance, Incomplete Dominance, Pseudo dominance), Non Allelic (Epistasis and Lethal genes). Concept of loci on Chromosome, Structure of Prokaryote and Eukaryote chromosome, Karyotyping.

### **UNIT- III**

#### **Chromosomal Variations and Abberations**

Mutation- Physical and Chemical, Numerical - Euploidy and Aneuploidy; Structural - deletion, duplication, inversion and translocation. Single Gene Disorders : Autosomal Dominant - Achondroplasia, polycystic kidney, Autosomal Recessive - Cystic fibrosis, Sickle cell Anaemia, X- Dominant - Rett syndrome, X linked recessive - Haemophilia, Trinucleotide repeat syndromes - Huntington's, Multifactorial - Cleft lip and palate.

## UNIT- IV

### Natural Horizontal Gene Transfer Methods

Genetic analysis of bacteria - Bacterial transformation, Conjugation (sex factor, Hfr strain, F' factor), Transduction in Bacteria (General and Specialized), Linkage and Crossing over, Recombination- Holliday model.

## UNIT- V

### Transposons and Population Genetics

Model organism for genetic analysis of development- *Drosophila* & *Arabidopsis*. Transposable elements of Prokaryotes (IS Elements, Composite and Tn3 Family) and Eukaryotes (Maize transposable elements). Gene frequency, Calculation of Gene frequency, Hardy - Weinberg law, Pedigree analysis, Genetic Counseling.

### TEXT BOOKS:

1. Strickberger, M. W. 2013. **Genetics**. 3<sup>rd</sup> edition. Prentice Hall College Division, New Delhi.
2. Gardner, E.J. 1991. **Principles of Genetics**. 8<sup>th</sup> edition. John Wiley and Sons Inc, New York.
3. Winter, P.C., Hickey, G. I. and Fletcher, H.L. 2000. **Genetics**. 1<sup>st</sup> edition. Viva Books Pvt Ltd.
4. Brown, T. A. 1999. **Genetics**. 3<sup>rd</sup> edition. Chapman and Hall.

### REFERENCE BOOKS:

1. S.R. Maloy, J.E. Cronan, D. Friefelder, 1994. **Microbial Genetics**. 2<sup>nd</sup> Edition. Jones and Bartlett Publishers.
2. N. Trun and J. Trempy, 2004. **Fundamental Bacterial Genetics**, Blackwell publishing.
3. Strachan T and Read A P, 2006. **Human molecular genetics**. 3<sup>rd</sup> Edition. Wiley Bios.

<b>17UBT23P</b>	<b>CORE PRACTICAL II: GENETICS</b>	<b>SEMESTER - II</b>
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**Total Credits: 2**  
**Hours Per Week: 5**

### **CONTENTS**

1. Problem solving in Monohybrid and Dihybrid cross
2. Isolation of Auxotrophic Mutants / Antibiotic Resistant by Gradient plate technique
3. Sex chromatin observation from Buccal smear
4. Effect of UV radiation on bacterial growth
5. Bacterial Transformation
6. Bacterial Conjugation
7. Determination of Phage Titre
8. Problem solving in Pedigree Analysis
9. Determination of Thermal death time
10. Determination of gene frequency using Hardy Weinberg law.
11. Isolation of DNA from cheek cells.
12. Agarose Gel Electrophoresis.

### **REFERENCE BOOKS:**

1. *Joseph Sambrook, Michael R. Green.* 2012. **Molecular Cloning: A Laboratory Manual.** 4<sup>th</sup> edition. Cold Spring Harbor.
2. *Thomas R. Mertens and Robert L. Hammersmith.* 1997. **Genetics Laboratory Investigations.** 11<sup>th</sup> edition. Benjamin Cummings.

<b>17UBT2AA</b>	<b>ALLIED II: BIODIVERSITY</b>	<b>SEMESTER - II</b>
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**Total Credits: 3**  
**Hours Per Week: 4**

**PREAMBLE:**

To study the diversity and conservation of organisms and to know the importance of diversity.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the nature, concept and definition of Biodiversity, conservation strategies.	K1, K2
CO2	Familiarize with Global patterns of Biodiversity	K1,K2
CO3	Focus on Biodiversity & major biomes of world	K1,K2
CO4	Highlight Biodiversity for Sustainable Development	K1,K2
CO5	Awareness on Ethics of Conservation	K2,K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	S	M	S	S	M
CO3	S	M	S	S	S
CO4	S	M	S	S	S
CO5	S	M	S	S	S

S-Strong; M-Medium; L-Low

17UBT2AA	ALLIED II: BIODIVERSITY	SEMESTER - II
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**Total Credits: 3**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Biodiversity – Concept, definition and types**

Species diversity, ecosystem diversity, genetic diversity, Magnitude of biodiversity, distribution of biodiversity, assessment of biodiversity, utilization of biodiversity.

### **UNIT - II**

#### **Global patterns of Biodiversity**

Cataloging and Discovering Species, Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns (Local Endemics, Sparsely Distributed Species, Migratory Species), GAP Analysis. The species & individual in the ecosystem - a) Habitat & niche b) Ecological equivalence c) Biological clock d) Basic behavioral patterns

### **UNIT - III**

#### **Biodiversity Threats and Conservation**

Specific flora & fauna. Biodiversity & Conservation – Overexploitation threatening living species, rare and endangered species. International Trade, Threats to Biodiversity - Animals threatened by International trade, Problems in Controlling International Trade (Enforcement, Reservations, Illegal Trade), Free Trade & the Environment, Free Trade & Conservation, etc., *In situ* and *ex situ* conservation.

## **UNIT - IV**

### **Biodiversity for Sustainable Development**

Sustainable management of biodiversity: International and regional policies. Biodiversity Act, National Biodiversity Board and other organizations worldwide. International conventions and treaties on conservation. Zoological Survey of India, Botanical Survey of India, Forest Research Institute, Central Marine Fisheries Research Institute.

## **UNIT - V**

### **Ethics of Conservation**

Values of Biodiversity, Biopiracy, Hybridized plants, GM crops (benefits & criticism), Economic Value of Biodiversity & Legal, Ethical and Conservation issues related to uses of biodiversity, Global Conservation Issues. Patent issues.

### **TEXT BOOKS:**

1. *Krishnamurthy K V.*2003. **Textbook of Biodiversity.** 1<sup>st</sup> edition. Science Publisher.
2. *Narendran, T. C.* 2006. **An Introduction to Taxonomy.** Zoological Survey of India, Kolkata.
3. *Singh, G.*2008. **Plant Systematics: Theory and Practice.** Oxford & IBH Publishing Co. Pvt. Ltd.
4. *Joanne M. Willey, Linda M. Sherwood.* 2011. **Prescott's Microbiology.** 8<sup>th</sup> edition. McGraw Hill Education.

### **REFERENCE BOOKS:**

1. *Negi, S.S.* 1993. **Biodiversity and its Conservation in India.** 1<sup>st</sup> edition. Indus Publishing Co.



2. *Mike J Jeffries*. 2006. **Biodiversity and Conservation**. 1<sup>st</sup> edition. Routledge.
3. *Michael I. Jeffery, Jeremy Firestone, Karen Bubna-Litic*. 2008. **Biodiversity Conservation, Law and Livelihoods**. 1<sup>st</sup> edition. Cambridge University Press.

<b>17UBT2AP</b>	<b>ALLIED PRACTICAL II: BIODIVERSITY</b>	<b>SEMESTER - II</b>
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**Total Credits: 2**  
**Hours Per Week: 4**

### **CONTENTS**

1. Morphology and classification of 10 medicinally important plants.
2. Morphology and classification of 10 economically important insects.
3. Morphology and classification of 10 economically important algae.
4. Morphology and classification of 10 industrially/medically important bacteria.
5. Morphology and classification of 10 industrially/medicinally important fungi.
6. Study of morphological features of a bird.
7. Morphological features of a fish.
8. Preparation of Herbaria – Five families (1 Plant from each family) with Authentication from authorized agencies.
9. Field visits to nearby Zoo, Forest, Nursery, and Culture collection center – Herbaria/Botanical Garden.
10. Introduction to Biodiversity Database - IBIN.
11. Comparison of Mitochondrial genome using Bioinformatics tools.
12. Species richness by line and plot analysis.
13. Prepare an audio-visual presentation about conservation to the youth & general public on some environment issues (e.g. Destruction of local biodiversity site like lakes, ponds or a forest patch, Human-wildlife conflict, Developmental activity that has potential threat to local biodiversity.) Minimum of 10 minutes duration.

**REFERENCE BOOKS:**

1. *David Lindenmayer, Mark Burgman.* 2005. **Practical Conservation Biology**. CSIRO Publishing, Australia.
2. *Primack, R.* 2006. **Essentials of Conservation Biology**. Sinauer Associates, Inc., USA.

<b>17UBT33A</b>	<b>CORE IV: MICROBIOLOGY</b>	<b>SEMESTER - III</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

- Define the science of microbiology and general techniques used in the study of microorganisms.
- Describe various beneficial activities of microorganisms to humans.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the fundamental concepts of microbiology	K1
CO2	Know the basics of media preparation and different sterilization techniques	K1, K2
CO3	Distinguish different phases in microbial growth and learn about nutritional classification	K2, K3
CO4	Discuss the structure, reproduction and the causative diseases of bacteria	K2, K3
CO5	Discuss the structure, reproduction and the causative diseases of virus	K2, K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	M	S	S	S
CO3	M	M	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT33A</b>	<b>CORE - IV: MICROBIOLOGY</b>	<b>SEMESTER - III</b>
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**Total Credits: 4**

**Hours / Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Basic concepts of Microbiology**

History of Microbiology & Microscopy: Biogenesis Vs Abiogenesis, Contributions of Louis Pasteur, Robert Koch, Edward Jenner, Alexander Fleming. Light microscopy –Bright, Dark Field, Phase contrast, Fluorescence. Electron Microscopy – Scanning Electron Microscope(SEM), Transmission Electron Microscope(TEM).

### **UNIT - II**

#### **Media Preparation and Sterilization Techniques**

Sterilization: Definition – Methods of sterilization -: Physical methods – Dry Heat( Hot Air Oven), Moist Heat(Autoclave), Cold sterilization and Chemical methods of sterilization. Culture Media – Definition – Different types of classification of media.

### **UNIT - III**

#### **Growth phases of microbes and their nutritional classification**

Microbial Growth – Growth curve, Determination of Generation Time, Measurement of Growth – Viable count, Turbidometry and Direct Cell count. Nutritional classification of microbes.

## UNIT IV

### **Bacteria – Structure and its causative diseases**

Bacterial Structure, Reproduction of Bacteria. Diseases caused by *Mycobacterium tuberculosis* (Tuberculosis), *Salmonella typhi* (Typhoid), *Vibrio cholera* (Cholera), *Clostridium tetani* (Tetanus) and *Staphylococcus aureus* (Skin Infections).

## UNIT V

### **Virus – Structure and its causative diseases**

Virus structure, Classification (Baltimore), Reproduction – Generalized and Specialized, Diseases caused HIV (AIDS), Hepatitis B Virus (Jaundice), *Varicella zoster* (Chicken Pox), H1N1 Virus (Swine Flu) and *Polio myelitis* (Polio).

### **TEXTBOOKS:**

1. *Atlas M, Ronald. 1995. Principles of Microbiology. McGraw - hill Inc.*
2. *Michael Pelzar Jr.,. Microbiology. 5<sup>th</sup> edition. McGraw Hill Education (India) Pvt Ltd.*

### **REFERENCE BOOKS:**

1. *Prescott, L. M., John P. Harley, Donald A. Klein. 2004. Microbiology. 6<sup>th</sup> edition. McGraw-Hill Science Publication.*
2. *Gerard J. Tortora. 2012. Microbiology: An Introduction, 11<sup>th</sup> edition. Benjamin Cummings Publishers.*

<b>17UBT33P</b>	<b>CORE PRACTICAL- III: MICROBIOLOGY</b>	<b>SEMESTER - III</b>
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**Total Credits: 2**  
**Hours Per Week: 4**

### **CONTENTS**

1. Isolation of Bacteria from Soil.
2. Isolation of Fungi from Soil.
3. Isolation of Actinomycetes from soil.
4. Methods of Streaking.
5. Staining Techniques
  - a. Gram
  - b. Lacto phenol Cotton Blue
  - c. Negative
  - d. Endospore
6. Antibiotic Sensitivity Test.
7. Bacterial growth Curve by Turbidometry method.
8. Phenol co-efficient.
9. Observation of *Penicillium*, *Aspergillus niger*, *Rhizobium*, *Mucor*.
10. Slide culture technique.
11. Demonstration – 16S rDNA Sequencing.
12. Methylene Blue Reduction test.

### **REFERENCE BOOKS:**

1. *Cappuccino*. 2005. **Microbiology: A Laboratory Manual**, Pearson Education.
2. *Kannan, N.* 2002. **Laboratory Manual in General Microbiology**. Panima Publishers.

<b>17UBT3AA</b>	<b>ALLIED PAPER III: BIOCHEMISTRY</b>	<b>SEMESTER - III</b>
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**Total Credits: 3**  
**Hours Per Week: 4**

**PREAMBLE:**

- To learn the structure, function & interrelationship of various bio molecules & consequences of deviation from normal.
- To study the integration of the various aspects of metabolism & their regulatory pathways.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of biomolecules and basic biochemical pathways	K1, K2
CO2	Know the classification, structure, properties and metabolism of aminoacids and protein	K1, K2
CO3	Discuss the classification, structure, properties, biosynthesis and oxidation of lipids	K1, K2
CO4	Learn the classification, structure, functions of nucleic acids and metabolism of nucleotides	K1, K2
CO5	Understand the classification of enzymes, Mechanism of action and enzyme kinetics	K2, K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	S	S
CO3	S	S	M	S	S
CO4	S	S	M	S	S
CO5	S	M	S	S	S

S-Strong; M-Medium; L-Low



17UBT3AA	ALLIED PAPER III : BIOCHEMISTRY	SEMESTER - III
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Total Credits: 3  
Hours Per Week: 4

## CONTENTS

### UNIT - I

#### Basic concepts of Biomolecules

Biomolecules – chemical composition and bonding, properties of water, acids, gases and buffer – Carbohydrates – Structure and classification of mono, di and polysaccharides, Glycolysis – Kreb's cycle – Gluconeogenesis – HMP pathway

### UNIT- II

#### Metabolism of Protein

Protein – Classification and Properties – four levels of protein structure & conformations, Ramachandran Plot, Structural categories of proteins. Relationship between structure and function, Properties, Bio synthesis, Properties and Metabolism of amino acids (Glycine and Tryptophan).

### UNIT-III

#### Metabolism of Lipids

Lipids: Nomenclature, Classification and biological significance. Simple Lipids and Compound lipids. Synthesis and metabolism of fatty acids ( $\beta$  Oxidation of fatty acids). Cholesterol Biosynthesis – Glyoxalate cycle

### UNIT- IV

#### Metabolism of Nucleic acids

Classification, structure, functions and reactions of nucleic acids, Biosynthesis of Purines and pyrimidines - De novo pathway, Salvage pathway, Regulation and Metabolism of Purine and pyrimidine.

## UNIT -V

### Enzyme kinetics

Enzymes: Nomenclature and Classifications of enzyme. Coenzymes, Abzymes, Ribozymes. Mechanism of enzyme actions - Active site, Lock and Key model & Induce fit Hypothesis, Enzyme substrate complex formation. Kinetics: Derivation of Michaelis- Menton equation, Activators, Types of inhibitions - Competitive, Non Competitive, Uncompetitive, Feedback and Allosteric.

### TEXTBOOKS:

1. *Geoffery L Zubay*. 1995. **Principles of Biochemistry**. 1<sup>st</sup> edition. WCB publishers.
2. *Ambika Shanmugam*. 2012. **Fundamentals of Biochemistry**, 7<sup>th</sup> edition. Lippincott Williams & Wilkins.

### REFERENCE BOOKS:

1. *Lehninger Albert. L , Nelson David. L and Cox Michael M*,1993. **Principles of Biochemistry**. 2<sup>nd</sup> edition. CBS Publishers And Distributors, New Delhi.
2. *Voet, D. and Voet, J. G.* 1995. **Fundamentals of Biochemistry**. 2<sup>nd</sup> edition. John Wiley and sons inc.

17UBT3AP	ALLIED PRACTICAL - II: BIOCHEMISTRY	SEMESTER - III
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Total Credits: 2  
Hours Per Week: 4

### CONTENTS

1. Estimation of Glucose by Anthrone method.
2. Estimation of Fructose by Dinitro Salicylic Acid method.
3. Estimation of Amino Acids by Ninhydrin method.
4. Estimation of Ascorbic acid by DNPH method.
5. Estimation of DNA by Diphenylamine method.
6. Estimation of RNA by Orcinol method.
7. Estimation of Protein by Lowry's method.
8. Estimation of Protein by Bradford's method.
9. Identification of Carbohydrate (Glucose, Galactose and Starch) by Phenylhydrazine method.
10. Separation of Amino acids by Paper Chromatography.
11. Separation of Amino acids by Thin layer Chromatography.
12. Estimation of Amylase.

### REFERENCE BOOK:

1. *Sadasivam, S. and Manickam, A.* 1996. **Biochemical Methods**, New Age International.

<b>17UBT3SA</b>	<b>SKILL BASED SUBJECT - I: COMPUTATIONAL AND BIOINFORMATIC SKILLS</b>	<b>SEMESTER - III</b>
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**Hours Per Week : 2**

**Total Credits: 2**

## **UNIT - I**

### **MS - Office**

Microsoft Word – Introduction - Basics in using MS Word - Formatting – Advanced features - Applications of MS Word. MS Power Point – presentation creation - Add visual enhancements - work with slides and slide text - add animations. MS Excel - Introduction – What is new in Excel – Tools in Excel –Calculations and operations – Formatting – Charts – Macros – advanced Excel usage. E - mail formats and ethics.

## **UNIT - II**

### **Video Tutorials**

Introduction to apps – downloading of apps – types – using app for documentary creation – creating short video lectures using apps to edit- applications of apps – advanced apps. Introduction of apps for audio effects – development of video screening with various effects.

## **UNIT - III**

### **Biological Databases**

Introduction - Scope – Types – Applications. Information retrieval from Biological Databases. Phylogenetic basics – Molecular Evolution and Molecular Phylogenetic - Terminology - Gene Phylogeny versus Species Phylogeny - Forms of Tree Representation – Procedure.

**TEXT BOOKS:**

1. *Joan Lambert and Joyce Cox, 2013. Microsoft Word 2013.* Microsoft Press.
2. *Joan Lambert and Joyce Cox, 2013. Microsoft PowerPoint 2013.* Microsoft Press.
3. *Curtis D.Frye, 2013. Microsoft Excel 2013.* Microsoft Press.
4. *A H Wood, T.K. Parry Smith D. 2001. Introduction to Bioinformatics.* Pearson Education Asia.
5. <https://animoto.com>
6. <https://videohive.net>

<b>17UBT43A</b>	<b>CORE PAPER- V: IMMUNOLOGY</b>	<b>SEMESTER - IV</b>
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**Total Credits: 4**  
**Hours Per Week: 5**

**PREAMBLE:**

- To learn the cells of immune system
- To impart knowledge on different techniques in immunology.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the fundamental concepts in immunology	K1
CO2	Know the basics of Immune Response and Transplantation Technology	K1, K2
CO3	Discuss and distinguish different antigen antibody interactions, Allergic reactions and Tumour immunology	K2, K3
CO4	Learn about different antibody production techniques	K2, K3
CO5	Awareness on types of vaccines and its significance	K2, K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	S
CO2	S	S	S	S	S
CO3	M	S	S	S	S
CO4	M	M	S	S	S
CO5	M	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT43A</b>	<b>CORE PAPER- IV: IMMUNOLOGY</b>	<b>SEMESTER - IV</b>
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**Total Credits: 4**  
**Hours Per Week: 5**

## **CONTENTS**

### **UNIT - I**

#### **Basic concepts of Immunology**

History and scope of immunology - types of immunity - primary and secondary lymphoid organs - immunoglobulin structure - function and synthesis; memory cells, idiotypic network, lymphocyte differentiation.

### **UNIT - II**

#### **Types of immune response**

Complement systems - structure and function of MHC class I and II molecules - antigen recognition and presentation - Humoral and Cell mediated immune responses - immune suppression and immune tolerance - Transplantation immunology- Graft rejection.

### **UNIT - III**

#### **Hypersensitivity and Tumor immunology**

Antigen- antibody reaction, Hypersensitivity - IgE mediated, antibody mediated, immune complex mediated and delayed type hypersensitivity. Tumor immunology- tumor associated antigens, Immune response to tumor. Auto immune disorders.

### **UNIT - IV**

#### **New Generation Antibodies**

Hybridoma and monoclonal antibody production, immune diagnosis and applications - human monoclonal antibodies, catalytical antibodies - complement fixation - assessment of immune complexes in tissues.

## **UNIT- V**

### **Vaccinology**

Vaccines- Immunization types- Vaccine types- live attenuated vaccines, killed vaccines and purified polysaccharide vaccines- toxoid vaccines - recombinant vaccines and DNA vaccines.

### **TEXT BOOKS:**

1. *Kuby, J.* 2003. **Immunology**. 5<sup>th</sup> edition. W.H. Freeman and Company.
2. *Rao, C.V.* 2002. **Textbook of Immunology**. 1<sup>st</sup> edition. Narosa Publishing House.

### **REFERENCE BOOKS:**

1. *Ivan Riot.* 1988. **Essentials of Immunology**. 6<sup>th</sup> edition. Blackwell Scientific Publications.
2. *Tizard.* 1995. **Immunology**. 4<sup>th</sup> edition. Saunders college publishers.



<b>17UBT43P</b>	<b>CORE PRACTICAL - IV: IMMUNOLOGY</b>	<b>SEMESTER - IV</b>
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**Total Credits: 2**  
**Hours Per Week: 5**

### **CONTENTS**

1. Methods of Animal Handling
2. Methods of immunization
3. Blood grouping and Rh typing
4. Preparation of Serum
5. Precipitin ring test
6. Single Radial Immuno diffusion
7. Double Radial Immuno diffusion
8. Immuno electrophoresis
9. Rocket Immuno electrophoresis
10. WIDAL Test
11. ELISA
12. HCG test
13. Preparation of Immunoglobulin.

### **REFERENCE:**

1. *Ivan Lefkovits.* 1996. **Immunology Methods Manual: The Comprehensive Sourcebook of Techniques.** 1<sup>st</sup> edition. Academic Press Inc.
2. *Jack Bradshaw, L.* 1995. **Laboratory Immunology.** 2<sup>nd</sup> Edition. Saunders College Publishing.

<b>17UMT4AC</b>	<b>MATHEMATICS</b>	<b>SEMESTER - IV</b>
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**Total Credits :3****Hours Per Week: 4****PREAMBLE:**

1. To understand the basic concepts of Mathematics and applications of Statistical and Numerical Techniques of Mathematics.

**COURSE OUTCOMES**

In the successful completion of the course, student will be able to

CO Number	CO Statement	Knowledge Level
CO 1	Learn about Set Theory	K1
CO 2	Learn about Matrices	K1
CO 3	Apply Statistical Techniques for data collection	K2
CO 4	Solve the problems related to Measures of central tendency	K2
CO 5	Solve the problems related to Probability	K3

**Mapping with Programme Outcomes**

COS/POS	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	M	S	S	S
CO 2	S	S	M	S	S
CO 3	M	S	S	S	S
CO 4	M	S	S	S	S
CO 5	M	S	S	S	S

S- Strong; M-Medium; L-Low

17UMT4AC	MATHEMATICS	SEMESTER - IV
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**Total Credits :3**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

Set Theory - Definition - Notations - Description of sets- Types of sets - Venn Diagrams - Set operations - Laws and properties of sets - Number of elements (Sums involved in two sets only) -Permutation - Combination.

### **UNIT - II**

Matrix: Basic Concepts - Types of Matrices - Addition and Multiplication of Matrices - Determinants - Crammer's Rule - Inverse of a Matrix - Matrix Method - Rank of Matrix.

### **UNIT- III**

Statistics: Meaning - Definition - Collection of data - Classification and Tabulation - Diagrammatic Representation and Graphical Representation.

### **UNIT- IV**

Measures of Central Tendency: Mean - Median - Mode - Measures of dispersion : Range - Standard deviation.

### **UNIT- IV**

Interpolation - Binomial, Newton's and Lagrange's methods - Probability - Concept and Definition - Addition and Multiplication theorems of Probability (Statement only) - Simple problems based on Addition and Multiplication theorems only.

**TEXT BOOKS:**

1. *Navnitham, P.A.* 2013. **Business Mathematics & Statistics.** Jai Publishers, Trichy

**REFERENCE BOOKS:**

1. *Gupta, S.P. and Gupta, M.P.* 2002. **Business Statistics.** Sultan Chand and Sons.
2. *Venkataraman , M.K.* 2004. **Numerical Methods in Science & Engineering .NPC.** Revised Edition.

<b>17UBT4SA</b>	<b>SKILL BASED SUBJECT-II: MOLECULAR TECHNIQUES</b>	<b>SEMESTER - IV</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

1. To study the function and application of several common measurement systems used in Biotechnology.
2. To learn the technical vocabulary associated with instrumentation and design and basic signal analysis

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the Principle and the types of Centrifugation	K2, K3
CO2	Classifying the chromatographic techniques and analyzing its applications	K3, K4
CO3	Imparts knowledge on the Electrophoresis and Blotting Techniques	K3, K4, K5
CO4	Focus on Spectroscopic Techniques and it's applications	K4, K5
CO5	In depth understanding of Radio-isotopic Techniques and its applications	K4, K5

**Mapping with Programme Outcomes**

COs/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

17UBT4SA	<b>SKILL BASED SUBJECT-II: MOLECULAR TECHNIQUES</b>	<b>SEMESTER - IV</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Centrifugation**

Sedimentation Principle, Types of rotors, Preparative and Analytical Centrifuges, Density Gradient Centrifugation, Differential centrifugation.

### **UNIT - II**

#### **Chromatography Techniques**

Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC.

### **UNIT - III**

#### **Electrophoresis Techniques**

Theory and Application of PAGE, Agarose Gel Electrophoresis, 2D gel electrophoresis, Iso-electric Focusing, Immuno diffusion, Immuno Electrophoresis, ELISA, RIA, Southern, Northern and Western Blotting.

### **UNIT -IV**

#### **Spectroscopic Techniques**

Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, MS, NMR, ESR, Atomic Absorption Spectroscopy.

## UNIT - V

### Radio-isotopic Techniques

Introduction to Radioisotopes and their Biological Applications, Radioactive Decay - Types and Measurement, Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, Autoradiography.

### TEXT BOOKS:

1. *Sawhney, S.K. & Randhir Singh.* 2006. **Introductory Practical Biochemistry**. 3<sup>rd</sup> edition. Narosa publishing House.
2. *Boyer, Rodney F Benjamin and Cummins.* 2001. **Modern Experimental Biochemistry**, 2<sup>nd</sup> edition. Pearson Education.

### REFERENCE BOOKS:

1. *Freifelder, D.* 1982. **Physical Biochemistry: Application to Biochemistry and Molecular Biology**. 2<sup>nd</sup> edition. W. H. Freeman Publishers.
2. *Walker, J. & Wilson, K.* 2000. **Principle & Technique - Practical Biochemistry**, 5<sup>th</sup> edition. Cambridge university press.

<b>17UBT53A</b>	<b>CORE - VI: RECOMBINANT DNA TECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To understand the guidelines for Recombinant DNA Technology research which involves all the molecular Biology techniques and to study about different Cloning techniques.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the steps in recombinant DNA preparation, introduction and selection	K1,K2
CO2	Explain the features of various types of bacterial cloning vectors	K1, K2
CO3	Explain the features of various types of cloning vectors for yeast, animal and plants	K1,K2
CO4	Describe and apply various molecular techniques	K2, K3
CO5	Demonstrate the different applications of recombinant based products	K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	M	M	M
CO3	S	S	M	M	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low



17UBT53A	<b>CORE - VI: RECOMBINANT DNA TECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Fundamentals of recombinant DNA technology**

History and scope of rDNA technology, Strategies of cloning, Cutting and Joining of DNA- Linkers and Adapters, other enzymes involved in cloning, Features of host cell. Selectable and Screenable markers used in recombinant DNA technology.

### **UNIT - II**

#### **Cloning vectors for Bacteria**

Plasmids - properties of plasmid, types of plasmids, plasmid compatibility and incompatibility, copy number and its control. Features of Bacterial Vectors, *E.coli* vectors- pBR322 and pUC vectors, Bacterial Artificial Chromosome (BAC). Cloning in *Bacillus*.

### **UNIT - III**

#### **Viral vectors and other special vectors**

Viral Vectors Lambda Phage vectors, cosmid, phagemid, M13. Yeast vectors – YIP, YEP, YRP and YAC. Animal vectors- SV40 Vectors, Retroviral and Baculo viral vectors. Plant Vectors- Ti plasmid as a gene vector, expression vectors and shuttle vectors.

### **UNIT - IV**

#### **Molecular techniques and their applications**

Construction of cDNA and genomic DNA libraries. PCR and its types. DNA Sequencing, Probes - probe construction and labeling. Introduction

of cloned genes into cell - transformation, particle bombardment, liposome mediation, and electroporation. Blotting techniques Southern, Western and Northern blotting. Micro array.

## **UNIT - V**

### **Applications of Recombinant DNA based products**

Recombinant DNA based products - Humulin, Somatotropin, Erythropoietin, Tissue Plasminogen activator, Factor-VIII and Interferon. Ethical issues in GM products, Institutional Animal Ethics Committee, Recombinant DNA Advisory Committee and Institutional Bio safety Committee.

### **TEXT BOOKS:**

1. *Brown, T. A.* 1998. **Introduction to Gene Cloning**. 3<sup>rd</sup> edition. Stanley Thornes Publishing Ltd.
2. *Primrose, S. B.* 2003. **Principles of Gene Manipulation**. 6<sup>th</sup> edition. Blackwell Science Ltd.

### **REFERENCE BOOKS:**

1. *Ernst, L. Winnacker.* 2003. **From Genes to Clones**. 2<sup>nd</sup> edition. Panima Publishing Corporation.
2. *James, D. Watson.* 2001. **Recombinant DNA technology**. 2<sup>nd</sup> edition. WH Freeman and company.

<b>17UBT53B</b>	<b>CORE - VII: MICROBIAL BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

### **PREAMBLE:**

To recognize the fundamentals of Microbial Biotechnology and to analyze the bioprocess paradigm: Scale-down, bioprocess simulation and economics, sterilization in biological manufacturing.

### **COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic principles of Biotechnology	K1
CO2	Explain the features of various types of fermenters	K1, K2
CO3	Explain the production and development of microbial products	K1,K2
CO4	Understand the application of microbes in agricultural techniques	K2, K3
CO5	Demonstrate microbial product testing and finishing	K3

### **Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	S	M	S	M	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

17UBT53B	<b>CORE - VII: MICROBIAL BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Basics of Microbial Biotechnology**

History and scope of Microbial biotechnology, basic principles of microbial biotechnology. Strategies for Microbial product development - Microbial biomass, enzymes, metabolites, recombinant products, transformation process. Upstream and Downstream processing

### **UNIT - II**

#### **Fermentation techniques**

Fermentation - Types of fermentations- Aerobic and anaerobic fermentation, Submerged and solid state fermentation. Basic structure and types of fermentor. Submerged fermentation types - Batch, continuous and fed batch - CSTR, Tower fermenter, Jet loop, Air lift, Bubble column, Packed bed. Solid state fermentation types - Tray fermenter, Column fermenter, and Drum fermenter. Factors affecting submerged and solid state fermentation.

### **UNIT - III**

#### **Microbial Product development**

Recent developments in the production of valuable microbial products - organic acids (Citric acid, Lactic acid and Acetic acid), aminoacids (Glutamic acid, lysine and Tryptophan), probiotics, healthcare products ( $\beta$  Lactam Antibiotics, Peptide antibiotics, Vitamin B12 and Riboflavin) and edible biomass.

## UNIT - IV

### Microbes in agriculture

Microbes in agribiotechnology ( livestock and transgenic plants); Bio-insecticides, biofertilizer, Bio-inoculants manufacture. Microbes in production of alternative energy; Bioprospecting of microbial endophytes.

## UNIT - V

### Product regulations

Finished Product Testing - Writing product specifications - Conditions and options for finished product testing, distributors – product storage - packaging, distribution. Definition of GMP, Principles and Importance of GMP, Quality management, Personnel, Risk management, Quality control, Documentation, Inspections. GMP regulations - USFDA, Europe, Japan, ICH, PICS/S, WHO.

### TEXT BOOKS:

1. Glazer. 2008. **Microbial Biotechnology**. 2<sup>nd</sup> edition. Cambridge University Press
2. Jose Luis Barredo. 2005. **Microbial Enzymes and Biotransformations**. Humana Press
3. Varun Shastri. 2006. **Industrial Biotechnology**. 1<sup>st</sup> Edition. Isha Press.

### REFERENCE BOOKS:

1. Stanbury, A. H., Whittaker, A and Hall, S. J. 1995. **Principles of fermentation Technology**. 2<sup>nd</sup> edition. S.J. Pergamon Press.
2. El-Mansi, E.M.T, Bryce, C. F., A, Arnold L. Demain, and Allman, A.R. 2011. **Fermentation Microbiology and Biotechnology**. 3<sup>rd</sup> edition. CRC Press.
3. Reddy M Vijaya Bhaskara, Sasikala P ,Dileep Kumar Reddy P. 2013. **Agriculture Microbiology**. 1<sup>st</sup> Edition. Lambert Academic Publishing.

<b>17UBT53C</b>	<b>CORE - VIII: PLANT BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To provide a fundamental knowledge in Plant Molecular Biotechnology and its application in laboratory settings

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Impart knowledge on basics of plant tissue culture and its requirements	K1
CO2	Acquire knowledge about the gene transfer techniques and applications	K1, K2
CO3	Understand the genetic engineering and gene modification in agriculture	K3
CO4	Gain insight about valuable secondary metabolites, its production and purification	K2, K3
CO5	Highlight the applications of plant biotechnology in the modern era	K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	S
CO3	S	S	S	M	S
CO4	S	M	S	M	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

17UBT53C	<b>CORE - VIII: PLANT BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Plant tissue culture**

Tissues culture media - Composition and its preparation. Plant Tissue Culture applications- Micropropagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture and fusion, Somoclonal variation, artificial seeds, hardening.

### **UNIT - II**

#### **Gene transfer**

Plant transformation technology- Ti and Ri plasmids, binary & co-integrated vector systems; viral vectors and their applications; 35S and other promoters; genetic markers-reporter genes- virulence genes- Cloning Strategies- Gene transfer methods in plants- Direct DNA transfer methods, Agrobacterium mediated nuclear transformation.

### **UNIT - III**

#### **Plant Genetic Engineering**

Applications of Plant Genetic Engineering – crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Genetic modification in Agriculture - transgenic plants, genetically modified foods, ecological impact of transgenic plants.

## **UNIT - IV**

### **Secondary metabolites**

Secondary metabolic pathways in plants. Industrial phytochemical products from plants- Alkaloids, Biodegradable Plastics, Therapeutic proteins, antibodies, plant vaccines, herbal drugs, bioethanol and biodiesel.

## **UNIT - V**

### **Plant biotechnological application**

Extraction & purification of phyto-chemicals. phytoremediation; Green house and green home technology. Molecular pharming; Applications for producing fine chemicals, drugs, and alternative fuels, herbicide and pest resistant plants, ethical issues relating to plant breeding.

### **TEXT BOOKS:**

1. *Chawla, H. S.* 2013. **Introduction to Plant Biotechnology**. 3<sup>rd</sup> edition. Oxford & IBH publishing company.
2. *Razdan, M. K.* 2002. **Introduction to Plant tissue culture**. 2<sup>nd</sup> edition. Oxford & IBH publishing company.

### **REFERENCE BOOKS:**

1. *Grierson, D. and Covey, S.V.* 1988. **Plant Molecular Biology**. 2<sup>nd</sup> edition. Blackie Publishers.
2. *Bhojwan, S. S.* 1996. **Plant tissue culture - Theory and Practice**. 1<sup>st</sup> edition. Elsevier Publishers.



17UBT53P	<b>CORE PRACTICAL - V: rDNA, MICROBIAL AND PLANT BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 3  
Hours Per Week: 6**

### **CONTENTS**

1. Isolation of Genomic DNA from bacteria
2. Isolation of Plasmid DNA from bacteria
3. Isolation of Genomic DNA from Plant Tissue
4. Isolation of Genomic DNA from Animal Tissue
5. Southern blotting
6. Western blotting
7. PCR
8. Restriction Digestion and Ligation
9. Screening of Antibiotic producing microorganism
10. Screening of Amylase producing microorganism
11. *In vitro* germination of seeds
12. Micropropagation
13. Callus induction
14. Artificial seed production

### **REFERENCE BOOKS:**

1. *Satish Kumar Sinha*. 2012. **Plant tissue culture: Theory and Practice**. 1<sup>st</sup> edition. Oxford University Press.
2. *Choudhary, S. S, Choudhary, P. and Choudhary, S.K.* 2005. **Laboratory guide in biosciences**. 2<sup>nd</sup> edition. Kalyani publishers.

<b>17UBT5EA</b>	<b>ELECTIVE- I: FUNDAMENTALS OF BIOINFORMATICS</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To provide a fundamental knowledge in bioinformatics and its applications in bioscience.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Impart knowledge on basics of bioinformatics and importance of multidisciplinary concept.	K1
CO2	Acquire knowledge on different databases and their characteristics	K1, K2
CO3	Gain insight on sequence alignment and gene finding and some related tools.	K1, K2, K3
CO4	Understand protein structures and related databases and visualization tools.	K2
CO5	Highlight the applications of bioinformatics to drug discovery.	K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	M	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	M
CO5	M	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT5EA</b>	<b>ELECTIVE- I: FUNDAMENTALS OF BIOINFORMATICS</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Introduction**

Bioinformatics-definition, history; computer - system, topology and peripherals for communication; Internet - basics, connection, web browsing and URL

### **UNIT - II**

#### **Data bases**

Nucleic acid sequence data bases (NCBI, EMBL, DDJB), Protein sequence data base-SWISS-PORT, data base searching - BLAST.

### **UNIT - III**

#### **Sequences and Phylogenetics**

Alignments local, global, pairwise & multiple sequences; analysis phylogenetics - CLUSTAL, PHYLIP & UPGAMAS. Gene finding and gene scan.

### **UNIT - IV**

#### **Protein prediction**

Physical properties, secondary structure, alpha & beta structure, motifs, tertiary structures, specialized structure and function. Molecular visualization - protein conformation and visualization tool (RASMOL).

## UNIT - V

### Drug discovery

Role of bioinformatics in drug discovery, target discovery, lead discovery, microarray, docking and prediction of drug quality. Bioinformatics companies.

### TEXT BOOKS:

1. *AH wood, T.K. Parry smith D.*2001. **Introduction to Bioinformatics.** Pearson education Asia.
2. *Rastogi S C.* 2008. **Bioinformatics Methods and Applications: Genomics Proteomics and Drug Discovery.** 3<sup>rd</sup> edition, PHI Learning Pvt. Ltd., India.

### REFERENCE BOOKS:

1. *Mount D.* 2004. **Bioinformatics: Sequence and Genome Analysis.** 2<sup>nd</sup> edition, University of Tuscan Press.
2. *Ouellette B F F. and Baxevanais A D.* 2004. **Bioinformatics: A practical Guide to the Analysis of Genes and Proteins.** 3<sup>rd</sup> edition, Wiley, John & sons.

<b>17UBT5EB</b>	<b>ELECTIVE- I : BASICS OF CLINICAL TRIALS</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To learn about the regulations in Clinical trials and its guidelines.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the Pre and Post Clinical Studies	K1,K2
CO2	To understand about the regulations and guidelines in clinical research	K1,K2
CO3	Understand the concepts about clinical research on Humans	K2,K3
CO4	Know the protocols and Standardization methods	K2,K3
CO5	Comprehend information's regarding clinical trials	K2,K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	S	S	S	M	S
CO3	S	S	M	M	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT5EB</b>	<b>ELECTIVE - I: BASICS OF CLINICAL TRIALS</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Preclinical Studies**

Introduction to Pharmaceutical Industry, Preclinical studies - Preclinical technology. Phase I, Phase II A and B, Phase III A and B, Phase IV and Types of Post marketing, surveillances.

### **UNIT - II**

#### **Food and Drug Administration**

FDA Regulations for Clinical Trials, FDA Guidelines and Information Sheets, FDA Compliance Program Guidance Manuals, FDA Bioresearch Monitoring Program (BIMO).

### **UNIT - III**

#### **Ethical Guidelines**

Ethical Guidelines for Biomedical Research in Human Subjects, Central Ethics committee on Human Research (CECHR), Clinical research regulation DCGI.

### **UNIT - IV**

#### **Good Clinical Practice**

History of GCP, ICH Guidelines for Good Clinical Practice, Central Drugs Standardization and Control Organization, Government of India, Schedule Y.

## UNIT - V

### Case Report Form

CRF design, Informed Consent Documents - Subject Information Sheet and Informed Consent Form, Ethics Committee Approvals.

### TEXT BOOKS:

1. *Allan Hackshaw*. 2009. **A Concise Guide to Clinical Trials**. 1<sup>st</sup> edition. Wiley Publishers.
2. *Richard Chin* and *Bruce Y. Lee*. 2008. **Principles and Practice of Clinical Trial Medicine**. 1<sup>st</sup> edition. Academic Press.

### REFERENCE BOOKS:

1. *Sandy Weinberg*. 2009. **Guide Book for Drug Regulatory Submissions**. 1<sup>st</sup> edition. John Wiley & sons.
2. *Haynes, R.B., Sackett, D.L., Guyatt, G.H., and Tugwell, P.* 2005. **Clinical Epidemiology: How to Do Clinical Practice Research**. 3<sup>rd</sup> edition. Lippincott- Williams and Wilkins.

<b>17UBT5SA</b>	<b>SKILL BASED SUBJECT - III: ENTREPRENEURIAL BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To learn about the entrepreneurial opportunities in Biotechnology and to study the good laboratory procedure and practices, standard operating procedures for biotechnology research

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of Entrepreneurship	K1,K2
CO2	Know about the business opportunities in plant tissue culture companies	K1, K2
CO3	Understand the various farming technique and its certification procedures	K1, K2
CO4	Learn about business scope in commercial important products like Biofertilizer, Biopesticide, Vermicompost etc	K1, K2
CO5	Application of Biopharmaceutical products, IPR and product safety	K1, K2,K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low



<b>17UBT5SA</b>	<b>SKILL BASED SUBJECT - III: ENTREPRENEURIAL BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Introduction**

Concept of Entrepreneurship, Definition, characteristics of entrepreneurship, Types of entrepreneurship. Startup process. Business identification, Project plan, Source of fund, production and marketing. Importance of ROC, Risk involved in entrepreneurship.

### **UNIT - II**

#### **Opportunities in PTC**

Business opportunities in Plant Tissue Culture - Banana, Bamboo, Sugarcane and Orchids like Carnation and Gerbera. Important PTC companies in India.

### **UNIT - III**

#### **Procedures and Certification in Organic farming**

Organic farming- Methods, Standards, Market potential and products impact. Tamilnadu Organic Certification Department (TNOCD) - process of organic certification, TNOCD certified products.

### **UNIT - IV**

#### **Commercialization**

Business scope for Biofertilizer, Biopesticide, Vermicompost, Mushroom, Single Cell Protein, Apiculture, Dairy products (Example with one commercially important product for all the above)

## UNIT - V

### **Biopharmaceutical products, IPR and product safety**

Insulin, Vaccines, Therapeutic products, Monoclonal antibodies, Hormones, Interferon (Example with one commercially important product for all the above). Importance of IPR, Patents, Trade Marks, Trade secret, Copyright, Product safety and liability, Insurance and contracts.

### **TEXT BOOKS:**

1. D. Kumari Manimuthu Veeral. 2015. **Textbook of organic farming**. Agrotech Publishing Academy.
2. S. S. Kanka. 1997. **Entrepreneurship Development**, S.Chand and Co, New Delhi

### **REFERENCE BOOKS:**

1. Kolehinsky P. 2004. **The Entrepreneur's guide to Biotechnology startup**, 4<sup>th</sup> edition. (www.elelexa.com)
2. Casson M, Yeung B, Basu A and Wadespm N. 2006, **The Oxford Handbook of Entrepreneurship**, Oxford University Press.
3. Shimasaki C. 2014. **Biotechnology Entrepreneurship**. 1<sup>st</sup> edition, Academia Press.

<b>17UBT5SB</b>	<b>SKILL BASED SUBJECT- IV: PHARMACEUTICAL BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week:4**

**PREAMBLE:**

To study the mechanism of drug action and to learn the production and application of new drugs.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Learn basic of Biopharmaceutical	K1
CO2	Understand the sources of Biopharmaceutical and therapeutic enzymes	K1, K2
CO3	Know the drug development process	K1, K2
CO4	Learn about Dosage forms, Manufacturing Principles and packing techniques	K1, K2, K3
CO5	Know the regulatory aspects with respect to clinical trails	K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	M
CO3	M	M	S	S	S
CO4	S	S	M	S	S
CO5	M	S	S	S	S

S-Strong; M-Medium; L-Low

17UBT5SB	<b>SKILL BASED SUBJECT- IV: PHARMACEUTICAL BIOTECHNOLOGY</b>	<b>SEMESTER - V</b>
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**Total Credits: 4**  
**Hours Per Week:4**

## **CONTENTS**

### **UNIT - I**

#### **Introduction to Pharmaceuticals**

Introduction- Biopharmaceuticals and pharmaceutical biotechnology; Sources of drug - plant, animals, microbes; Physico-chemical properties of the drugs; Drug isolation and evaluation; Delivery of biopharmaceuticals- Oral, Pulmonary, Nasal, Transmucosal and Transdermal delivery system; Drug metabolism-Pharmacokinetics: Absorption, Distribution, Metabolism and Excretion (ADME) and Pharmacodynamics.

### **UNIT - II**

#### **Sources of Biopharmaceuticals**

Sources of Biopharmaceuticals- *E.coli*; Animal cell culture system; Yeast (*Saccharomyces cerevisiae*); Fungus; Transgenic animals; Transgenic plants and Insect-based systems. Nucleic acids of therapeutic interest; Biosimilar drugs- Growth Hormones, Blood products; Therapeutic enzymes.

### **UNIT - III**

#### **Drug Development Processes**

Discovery of biopharmaceuticals-Impact of genomics and related technologies upon drug discovery; Gene chips; proteomics; structural genomics; pharmacogenetics; Initial product characterization; Pre-clinical studies.

## UNIT - IV

### **Dosage forms and Manufacturing Principles**

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oral liquids – vegetable drugs – topical applications; preservation of drugs. Packing techniques, quality management.

## UNIT - V

### **Regulatory Aspects**

Regulatory authorities - Food and drug administration (USA) - Investigational new drug application, Regulations in clinical trials - Central Drugs Standard Control Organization- Drug Controller General of India- Roles and Responsibilities.

### **TEXTBOOKS:**

1. *Gary Walsh* (Ed) 2005. **Pharmaceutical Biotechnology – Concepts and Application.**
2. *Andrew Sinclair* 2006. **A Practical Guide to Biopharmaceutical Manufacturing.**
3. *Goodman & Gilman*’s. 2006. **The Pharmacological Basis of Therapeutics**, Permagon Press, New York
4. *Lachman L Lieberman, HA, Kanig, J.*, 1986, “**Theory and Practice of Industry pharmacy**”, 3rd Edition, Varghese Publishing & Co, New Delhi.

**REFERENCE BOOKS:**

1. *Muruges, N.* 2014. **A Concise text book of Pharmacology.** 7th edition. Sathya Publications.
2. *Katzung, B.G.* 1995. **Basic and Clinical Pharmacology.** 12th edition. Prentice Hall of Intl.
3. *Goodman and Gilman.* 2006. **The Pharmacological Basis of Therapeutics.** 11th edition. Mc Graw Hill Medical Publishing Division

<b>17UBT63A</b>	<b>CORE-IX: ANIMAL BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To provide a basic understanding of animal biotechnology and its applications.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	To develop an understanding on basic pattern of animal cell culture and controlling characters.	K1
CO2	Acquire knowledge on handling animal cell culture and their applications	K1, K2
CO3	Understand the gene transfer technology , transgenic animal and stem cell technology	K3
CO4	Emphasize techniques on fertilization in animals and its development	K2, K3
CO5	Highlight the applications of animal biotechnology in various fields	K2, K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	M	S	S
CO4	S	M	M	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT63A</b>	<b>CORE-IX: ANIMAL BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Animal cell culture media and reagents**

Animal cell culture basics- Preparation of culture media- Role of carbon dioxide, serum and growth factors in cell culture, Types of cell culture media, Ingredients, Physiochemical properties, Antibiotics, growth supplements, Fetal bovine serum; Serum free media. Conditioned media, other cell culture reagents, Preparation and sterilization of cell culture media and other reagents.

### **UNIT-II**

#### **Animal cell culture**

Principles of sterile techniques and cell propagation; Primary cell culture, secondary cell culture, continuous cell lines, suspension cultures - Chemically defined and serum free media for cell culture Contamination and eradication, cryopreservation of animal cells - Tissue engineering and organotypic culture, Cytotoxicity and viability assays.

### **UNIT-III**

#### **Gene transfer technology**

Gene transfer in cells; physical, chemical and biological methods. Production of native and recombinant proteins in animal cell. Hybridoma technology and its applications- gene targeting, silencing and knock-out. Gene transfer technology in animals. Production of transgenic animals.



## UNIT-IV

### Fertilization in animals

Fertilization in animals: Blastulation, gastrulation, early embryonic development - fate map. Conventional methods of improvement of animal live stock: artificial insemination, *in vitro* fertilization, embryo culture, embryo sexing, splitting and cloning. Stem cell technology.

## UNIT-V

### Biotechnological application

Biotechnology of silk worm - commercial production of silk, Baculovirus in Biocontrol, Integrated pest management. Manipulation of Growth hormone -somatotrophic hormone-Thyroid hormone; Manipulation of lactation -Lactogenesis- galactopoiesis - Manipulation of wool growth.

### TEXT BOOKS:

1. Freshney.R.I, "**Culture of Animal cells: A manual of basic technique**", Fifth edition, Wiley Publishers, 2010.
2. Ramadass.P, "**Animal Biotechnology: Recent concepts and Developments**", MJP Publications, India, 2008.
3. Ranga,M.M. 2007. **Animal biotechnology**. 3<sup>rd</sup> Edition. Agrobios India.
4. John R. Masters. 2000. **Animal cell culture**. 3<sup>rd</sup> edition. Oxford University Press.

### REFERENCE BOOKS:

1. Rastogi,V. 2001. **Developmental Biology**. 1<sup>st</sup> edition. Kedarnath Ramnath Publishers.
2. Leach.C.K, **In vitro cultivation of Animal cell**, Butterworth and Heinemann Ltd., 1994.
3. Renaville.R and Burny.A, **Biotechnology in Animal husbandry**, Kluwer Academic Publishers, 2001.

<b>17UBT63B</b>	<b>CORE - X: ENVIRONMENTAL BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits : 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To understand the basic vocabularies of environmental biology and to study about the hazards of industrial pollutants on environment.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	To understand the basics of Ecosystem structure and organization	K1
CO2	To Acquire knowledge on handling Pollution and waste management	K1, K2
CO3	Understand the concept and application of Biodegradation	K1, K2
CO4	Emphasize techniques on Bioremediation	K2, K3
CO5	Highlight the applications, Policies and Regulations relating to Environmental biotechnology.	K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	M	S	S	M
CO3	S	S	M	S	M
CO4	S	S	M	M	S
CO5	M	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT63B</b>	<b>CORE - X: ENVIRONMENTAL BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT- I**

#### **Ecosystem- structure and organization**

Ecosystem- Definition, structure- primary production, secondary production- food chain - food web- trophic levels- energy flow- pyramid of biomass- pyramid of energy. Biogeochemical cycle: Nitrogen and Phosphorous.

### **UNIT- II**

#### **Pollution and Waste Management**

Pollution- types- sources- effects and its control measures- air- water- land- noise- thermal- pesticide- radioactive- green house effect, ozone and its importance - global warming - Acid rain. Sewage Treatment System- Characteristics, Primary, secondary and tertiary treatment. Solid waste disposal and solid waste Management.

### **UNIT- III**

#### **Biodegradation**

Biodegradation - Definition, Acclimation, bio-availability, effect of chemical structure on biodegradation, recalcitrants, Factors affecting biodegradation. Microbial degradation of hydrocarbons: Methane, ethane. Aerobic and anaerobic biodegradation of aromatic compounds. Microbial degradation of pesticides. Microbial degradation of biopolymers - Cellulose, starch, pectin and lignin. Polyhydroxy alkanoates (Bioplastics).

## **UNIT- IV**

### **Bioremediation**

Bioremediation- advantages and applications, Types of bioremediation - Natural and engineered, *ex-situ* and *in-situ*, solid phase and slurry phase bioremediation, Oxygen delivery for Bioremediation, Criteria to be met for considering bioremediation - factors affecting bioremediation, Bioaugmentation and biostimulation. Phytoremediation. Bioleaching.

## **UNIT- V**

### **Social issues and the environment**

Sustainable development, role of individual in the protection of environment, environmental ethics-issues and possible solutions, resettlement and rehabilitation of people and its problems, Environmental Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act, issues involved in enforcement of environmental legislation.

### **TEXT BOOKS:**

1. Y.K.Singh, 2006. **Environmental Science**. 1<sup>st</sup> Edition. New Age International (P) Limited, Publishers.
2. Agarwal, S.K. 2007. **Environmental Biotechnology**. 1<sup>st</sup> Edition. APH Publishing.
3. Chatterji, A.K. 2011. **Introduction to Environmental Biotechnology**. 3<sup>rd</sup> edition. Prentice-Hall of India.
4. Dash, M.C. 1998. **Fundamentals of Ecology**. 2<sup>nd</sup> edition. Tata McGraw Hill.

**REFERENCE BOOKS:**

1. *Martin Alexander*. 1999. **Biodegradation and Bioremediation**. 2<sup>nd</sup> edition. Academic Press.
2. *Alan Scragg*. 2007. **Environmental Biotechnology**. 2<sup>nd</sup> edition. Oxford university press.
3. *G. Tyler Miller, JR. Scott E. Spoolman*. 2010. **Environmental Science**. Thirteenth edition. Yolanda cossio publisher

<b>17UBT63C</b>	<b>CORE - XI: NANOBIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

### **PREAMBLE:**

To learn the basics of Bionanotechnology and study the latest trends in nano level application of bionanoparticles in the medical field.

### **COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Learn basic of Bio nanotechnology	K1
CO2	Understand the basic of Bionanomachinery and protein folding structure	K1, K2
CO3	Know the functional concept of biomaterials	K1, K2
CO4	Learn about microarray technology, Nanobiosensors, Biochips, Biorobotics and its application	K1, K2, K3
CO5	Know the drug delivery system and cancer biology based on bionanotechnology	K3

### **Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	M	S	S	M
CO3	S	M	S	S	S
CO4	S	S	S	S	S
CO5	M	S	S	S	S

S-Strong; M-Medium; L-Low

17UBT63C	<b>CORE - XI: NANOBIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**

**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Introduction**

Introduction to Bionanotechnology: Opportunities & challenges of Bionanotechnology. Key features of Nano-size, Comparison of particle behavior at nanosize to macrosize. Strategies for Nanoarchitecture (top down & bottom up approaches). Biomolecular design and Bionanomachines in action.

### **UNIT - II**

#### **Structural Bionanotechnology**

Structural principles of Bionanotechnology: Natural Bionanomachinery. Overview of Nanodevices. Strategies for construction of Nanomachines. Carbon as a raw material. Protein folding Aspects: Stable structure, Globular proteins, Role of chaperones in folding, lipid bilayer, DNA based nanostructures. Flexibility of biomolecules.

### **UNIT - III**

#### **Functional of Bionanotechnology**

Functional principles of Bionanotechnology. Information driven nanoassembly: Energetics; Biomaterials- Filaments and fibrils, Minerals combined with biomaterials for specific applications. Biomolecular sensing taste and light sensors. Bacterial sensors, Self-replication, Machine phase Bionanotechnology- Muscle sarcomeres and nerves.

## **UNIT - IV**

### **Applications**

Microarray technology- Principle, types and Applications of Bionanoimaging. Magnetic Nano particles, Nanobiosensors, Biochips, Biorobotics, Synthesis of gold, Titania, Nanopore technology, Nanoarrays, DNA computers.

## **UNIT - V**

### **Clinical based Bionanotechnology**

Medical Applications of Nanoparticles & Nanosystems. Nano drug delivery. Conventional drug delivery & targeted drug delivery and advantages. Delivery profile, Role of Nanotechnology in drug delivery & Cancer biology. Nanoparticle synthesis in plants, bacteria and yeast.

### **TEXT BOOKS:**

1. *Niemeyer, C.M. and Mirkin, C.A.* 2004. **Nanobiotechnology: Concepts, Applications and Perspectives.** Wiley-VCH.
2. *Goodsell, D.S.* 2004. **Bionanotechnology.** John Wiley and Sons, Inc.,
3. *Shoseyov, O. & Levy, I.,* 2007. **Nanobiotechnology: Bioinspired Devices and Materials of the Future.** Humana Press.
4. *David S. Goodsell.* 2004. **Bionanotechnology: Lessons from Nature.** John Wiley & Sons, Inc., Publication.

### **REFERENCE BOOKS:**

1. *Bhushan, B.* 2004. **Springer Handbook of Nanotechnology.** Springer-Verlag Berlin Heidelberg,
2. *Freitas Jr R.A.* 2004. **Nanomedicine.** Vol. II, 1st Edition, Landes Biosciences,.
3. *Kohler, M. & Fritzsche, W.* 2004. **Nanotechnology – An Introduction to Nanostructuring Techniques.** Wiley-VCH.
4. *Richard Brooker & Earl Boysen.* 2006. **Nanotechnology.** Wiley Publishing Inc., India.



<b>17UBT63D</b>	<b>CORE XII: BIOETHICS, BIOSAFETY AND IPR</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To equip students with issues related to ethical and legal issues concerning biotechnology products.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Impart basic knowledge about lab safety and committees involved.	K1,K2
CO2	Understand the role of bioethics in the field of biotechnology and its products	K3
CO3	Gain insight on types of IPR and its licensing.	K3, K4
CO4	Imbibe skills on patenting and strategies involved.	K4, K5
CO5	Highlight the global scenario on IPR	K4, K5

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

17UBT63D	CORE XII: BIOETHICS, BIOSAFETY AND IPR	SEMESTER - VI
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**Total Credits: 4**  
**Hours Per Week: 4**

#### **UNIT- I**

##### **Biosafety**

Good Lab Practices, Introduction to Biological Safety Cabinets, Primary Containment for Biohazards, Biosafety Levels, GMOs and LMOs and their environmental impact, Roles of Institutional Biosafety Committee, RCGM, GEAC.

#### **UNIT- II**

##### **Bioethics**

Bioethical issues related to Healthcare & medicine Food & agriculture. Genetic engineering, Human Genome Project. Genetic Testing, types, pros and cons, informed consent. Socioeconomic problems and environmental problems relating to bioethics.

#### **UNIT - III**

##### **Introduction to IPR**

Definition, Concept of Intellectual Property, Kinds of Intellectual Property Patents, Copyrights, Designs, Trademarks, Geographical Indication, Infringement of IPR, protection and Remedies, Licensing and its types.

#### **UNIT - IV**

##### **Patenting Strategies**

Requirement of patentable novelty, Inventive step, Prior art Classifying products as patentable and non-patentable, Procedure for applying for patent, Patent Infringement and related case studies Biological

Patentability. Biopiracy and Bioprospecting. Farmers Rights and Plant breeders rights Biodiversity.

## UNIT -V

### Issues in Patenting

Traditional knowledge and patent issues with relevance to Indian context. Basmati rice patent case, turmeric patent case, Neem leaves patent, superbug patenting.

### TEXT BOOKS:

1. *Deepa Goel*. 2013. **IPR Biosafety and Bioethics**, 1<sup>st</sup> edition. Pearson Education.
2. *Sateesh, M.K.* 2008. **Bioethics and Biosafety**. 1<sup>st</sup> Edition. I.K. International Publishing House.
3. *Catherine J. Holland*. 2007. **Intellectual Property: patents, trademarks, copyrights, trade secrets**. 1<sup>st</sup> edition. Entrepreneur Press.

### REFERENCE BOOKS:

1. *Srinivasan, K. and Awsthi, H.K.* 1997. **Laws of Patents**. 1<sup>st</sup> edition. Jain Book Agency.
2. *Thomas H. Murray and Maxwell J. Mehlman*. 2005. **Encyclopedia of Ethical, Legal and Policy issues in Biotechnology**. 1<sup>st</sup> edition. Wiley Interscience.

<b>17UBT63P</b>	<b>CORE PRACTICAL-VI: ANIMAL, ENVIRONMENTAL AND NANO BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 3**  
**Hours Per Week: 6**

### **CONTENTS**

1. Preparation of ATC medium and membrane filtration
2. Preparation of primary culture from chick embryo.
3. Cell counting and cell viability.
4. MPN Test
5. Determination of Chemical oxygen demand
6. Estimation of Chloride
7. Qualitative Analysis of
  - i) Starch Degradation
  - ii) Cellulose degradation
  - iii) Gelatin hydrolysis
  - iv) Lipid degradation
  - v) Casein hydrolysis
8. Biodegradation of Starch- Quantitative Estimation of starch by Iodine Method.
9. Synthesis of Silver Nano particles by microorganisms
10. Spectral analysis of Silver Nano particles.
11. Antibacterial screening of Silver Nano particles.

### **REFERENCE BOOKS:**

1. *Freshney, R. I.* 2010. **Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.** 6<sup>th</sup> edition. Wiley Blackwell.
2. *Choudhary, S. S, Choudhary, P. and Choudhary, S.K.* 2005. **Laboratory Guide in Biosciences.** 2<sup>nd</sup> edition. Kalyani publishers.

<b>17UBT6EA</b>	<b>ELECTIVE - II: MARINE BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To study the marine diversity and its relationship with biotechnology and ecology.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Acquaintance to various flora and fauna kingdoms and their biology.	K1
CO2	Insight to marine products and their use in biotechnology	K1,K2
CO3	Impart knowledge on relationship between marine lives and pathogens and toxins.	K1, K2, K3
CO4	Highlight ecological impact on marine pollution	K2, K3
CO5	Knowledge on applications of marine biotechnology	K2,K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	M	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	M
CO5	S	M	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT6EA</b>	<b>ELECTIVE - II: MARINE BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Marine flora**

Phytoplankton, seaweeds, sea grasses and mangroves. Marine fauna- Zooplankton; marine invertebrates (crustaceans & molluscs); Vertebrates and marine mammals (dolphins and whales). Biology of marine organisms- feeding and reproduction.

### **UNIT - II**

#### **Marine natural products**

Carrageenan, Agar- Agar, Seaweed fertilizer (SLF), bioactive compounds and commercial products from marine organisms- marine copepods as living capsules in aquaculture.

### **UNIT - III**

#### **Sea food spoilage**

Fish and human pathogens. Marine Pharmacology- marine toxins, antiviral and antimicrobial agents.

### **UNIT-IV**

#### **Marine pollution**

Pollutants (oil, thermal and radioactive). Biological indicators (microbes, Phyto and Zooplankton). Marine fouling-Macrofoulers, Biofilms, Antifouling methods.

## UNIT-V

### Aqua farms

Design and construction. Selection of cultivable species. Culture systems- extensive, semi intensive, intensive and raceway cultures. Induced spawning and mass production of seeds

### TEXT BOOKS:

1. *Shyam Kishor Agarwal*. 1996. **Biodiversity and Environment**. APH Publishing.
2. *Jeffery S. Levinton*. 2001. **Marine Biology: Function, Biodiversity, Ecology**. 2<sup>nd</sup> edition. Oxford University Press.

### REFERENCE BOOKS:

1. *Robert R. Stickney*. 2000. **Encyclopedia of Aquaculture**. 1<sup>st</sup> edition. John Wiley & Sons, Inc.
2. *Sverdrup H.U.* 1942. **The Oceans Their Physics, Chemistry and General Biology**. 1<sup>st</sup> edition. Prentice-Hall, Inc.

<b>17UBT6EB</b>	<b>ELECTIVE - III: FOOD AND DAIRY TECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

To study the cattle development, dairy farming, dairy products and food production from the dairy products

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of Food technology and its methods	K1
CO2	Know the role of various microorganisms in food production	K1, K2
CO3	Understand the various food preservation methods and its importance	K1, K2
CO4	Know the dairy food products and its different types and varieties	K2, K3
CO5	Understand the Quality and Safety monitoring of food products	K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	M
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	M	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low



<b>17UBT6EB</b>	<b>ELECTIVE - III : FOOD AND DAIRY TECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Introduction to food technology**

Introduction to Food technology, Scope and application. Role of biotechnology in food production. Difference between conventional and non-conventional technology for food production.

### **UNIT - II**

#### **Role of Microbes in food production**

Microbes of importance in food fermentations - Homo & hetero-fermentative bacteria, yeasts & fungi; Lactic acid bacteria fermentation and starter cultures, Alcoholic fermentations -Yeast fermentations - characteristics and strain selection, fungal fermentations. Microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idly and soy products

### **UNIT - III**

#### **Objectives and techniques of food preservation:**

Canning: classification of cans, canning of food items, Thermal process time calculations for canned foods, spoilage in canned foods. Water activity of food and its significance in food preservation. Low temperature preservation: cold storage and freezing including cryogenic freezing. Preservation by fermentation: curing and pickling; Use of preservative in foods: chemical preservative, biopreservative including antibiotics.

## UNIT - IV

### **Dairy based products:**

Composition of milk; Varieties of milk; Checks for purity of milk; Handling of fresh milk. Pasteurization of milk; HTST and UHT techniques; Packaging of milk; Manufacture of milk products like evaporated milk, powder milk, condensed milk, cream butter, cheese, yogurt, ice cream, ghee, baby food and sweet meat. Quality control of milk and milk products; Milk plant hygiene and sanitation.

## UNIT - V

### **Food safety and quality control**

Impact of food safety on global trade; Food safety in retail food businesses; international food service operators, institutional food service operators; application of the principals of modern hygiene . HACCP, GMP; Surveillance networks, Consumer and food service operator education, function and roles of USFDA, USDA and EPA; Food Safety and Standards Act India 2006; Prevention of Food Adulteration Act, India, 1954.

### **TEXT BOOKS:**

1. *Geoffrey Campbell-Platt*. 2017. **Food Science and Technology**. 2<sup>nd</sup> edition. Wiley Blackwell Publishers.
2. *W.C. Frazier, D.C. Westhoff*. 1977. **Food Microbiology**. 4<sup>th</sup> edition. Tata McGraw-Hill Education.
3. *M. Shafiur Rahman*. 1999. **Handbook of Food Preservation**. 1<sup>st</sup> edition. CRC Press.
4. *N. S. Rathore, S.S. Chasta , G.k. Mathur*. 2008. **Fundamentals of Dairy Technology**. 1<sup>st</sup> edition. Himanshu Publications.

**REFERENCE BOOKS:**

1. *Gustavo F. Gutierrez-Lopez, Gustavo V. Barbosa Canosa.* 2003. **Food Science and Food Biotechnology.** CRC Press.
2. *Shivashraya Singh.* 2014. **Dairy Technology: Set of 2 Volumes.** New India Publishing Agency.
3. *D. McSwane, N. Rue, R. Linton.* 1997. **Essentials of Food Safety and Sanitation.** Prentice Hall.
4. *Y. Motarjemi, H. Lelieveld.* 2013. **Food Safety Management.** 1<sup>st</sup> edition. Academic Press.

<b>17UBT6EC</b>	<b>ELECTIVE- III: BIOPROSPECTING</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

1. To Learn various methods of Bioprospecting.
2. To study about potentials of Bioprospecting

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Focus on Major areas of Bio-prospecting	K1,
CO2	Comprehend knowledge on Natural products from plants	K1, K2
CO3	Elucidate Screening for bioactive Compounds	K3
CO4	Highlight Drug discovery and product development	K2
CO5	To understand Regulatory legislation and convention in Bioprospecting	K2, K3

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	S	M	M	M
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT6EC</b>	<b>ELECTIVE- III: BIOPROSPECTING</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Major areas of Bio-prospecting**

Major area of Bioprospecting : Chemical prospecting, Bionic prospecting and Gene prospecting. Bioresources mapping, inventorisation and monitoring of biological diversity. Historical context of present bioprospecting, biodiversity prospecting - the InBio experiences, contracts for Bioprospecting.

### **UNIT - II**

#### **Natural products from plants**

Drugs derived from plants, Antitumor agent - Etoposide, Colchicine, Taxol, Vinblastine, Vincristine. Cardiotonic - Convallatoxin, Acetyldigoxin, Adoniside, Antiinflammatory - Aescin, Bromelain, Choleric - Curcumin. QuinineCinchona-Antimalarial Morphine-Opium plant- analgesic.

### **UNIT - III**

#### **Screening for bioactive Compounds**

Screening for bioactivity, antimicrobials, pharmacologically active agents of microbial origin, bioprospecting for industrial enzymes, plant growth promoting agents, biotreatment, bioprospecting novel antifoulants and anti-biofilm agents from microbes.

## **UNIT - IV**

### **Drug discovery and product development**

Drug discovery and product development: Discovery from traditional medicine. Modern tools in drug discovery. Role of chromatography in drug analysis. Product development procedures and policies.

## **UNIT - V**

### **Regulatory legislation and convention in Bioprospecting**

Regulatory legislation and convention in Bioprospecting: rules and regulations in patenting of products and process development and various conventions pertaining to Bioprospecting of products from microorganism, plant and animal products.

### **TEXTBOOKS:**

1. *Joseph Priest.* 2008. **Energy: Principles, Problems, Alternatives.** 6<sup>th</sup> edition. Kendall and Hunt Pub Co.,.
2. *Alan T. Bull.* 2004. **Microbial Diversity and Bioprospecting.** 1<sup>st</sup> edition. ASM Press.

### **REFERENCE BOOKS:**

1. *Srinivasan, K. and Awasthi, H.K.* 1997. **Law of Patents.** 1<sup>st</sup> edition. Jain Book Agency.
2. *Cori Hayden.* 2003. **When Nature Goes Public: The Making and Unmaking of Bioprospecting in Mexico.** 1<sup>st</sup> edition. Princeton University Press.

<b>17UBT6ED</b>	<b>ELECTIVE III: FORENSIC BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

**PREAMBLE:**

- To study the basic of criminology, forensic science technology and Biotechnologist role in collecting the evidences.

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept and development of forensic methods.	K1
CO2	Know the role of various methods to identify biological evidences.	K1, K2
CO3	To gain knowledge on the concepts of toxicology in forensic sciences.	K1, K2
CO4	Impart the concepts of drug analysis in forensic	K2, K3
CO5	Understand the techniques of DNA finger printing	K3,

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	M	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low

<b>17UBT6ED</b>	<b>ELECTIVE III : FORENSIC BIOTECHNOLOGY</b>	<b>SEMESTER - VI</b>
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**Total Credits: 4**  
**Hours Per Week: 4**

## **CONTENTS**

### **UNIT - I**

#### **Introduction to Forensic Sciences**

History and Development of Forensic Science, Deductive Reasoning, Organization of a Crime Laboratory, Services of the Crime Laboratory, Functions of the Forensic Scientist, Other Forensic Science Services, Detection Murder Trial Criminal Justice -Aspects of the Justice System, Aspects of Trials

### **UNIT - II**

#### **Identifying Biological evidences**

Identifying the Body: Human or Nonhuman, Skin Coloration, Defensive Wounds and Other Visible Marks, Processes of Decay, Hair, Fiber and Botanical Remains - Identification and Comparison of Hair, Collection and Preservation of Hair Evidence, Types of Fibers, Identification and Comparison of Manufactured Fibers, Botanical Remains: Pollen, Seeds, and Other Remain

### **UNIT - III**

#### **Forensic Toxicology and Forensic Serology**

Toxicology of Alcohol, Role of the Toxicologist, Techniques Used in Toxicology, Significance of Toxicological Findings, Drug Recognition Expert, Nature of Blood, Immunoassay Techniques, Forensic Characterization of Bloodstains, Stain Patterns of Blood, Principles of Heredity, Forensic Characterization of Semen, Collection of Rape Evidence



## UNIT - IV

### Drug Analysis

Narcotic Drugs, Hallucinogens, Depressants, Stimulants, Club Drugs, Anabolic Steroids, Drug-Control Laws, Drug Identification, Collection and Preservation of Drug Evidence

## UNIT - V

### DNA: The Indispensable Forensic Science Tool and finger prints

Recombinant DNA: Cutting and Splicing DNA, DNA Typing, The Combined DNA Index System (CODIS) Fingerprints: Fundamental Principles of Fingerprints, Classification of Fingerprints, Automated Fingerprint Identification Systems, Preservation of Developed Prints, Digital Imaging for Fingerprint Enhancement.

### TEXT BOOKS:

1. *Stuart H. James, Jon J. Nord. Suzanne Bell.* 2015. **Forensic Science: An Introduction to Scientific and Investigative Techniques.** 4<sup>th</sup> Edition Hardcover. CRC pub.
2. *Max M. Houck, Jay A. Siegel .* 2015 .**Fundamentals of Forensic Science.** 3<sup>rd</sup> edition. Academic Press

### REFERENCE BOOKS:

1. *William J. Tilstone, Kathleen A. Savage, Leigh A. Clark.* 2006. **Forensic Science: An Encyclopedia of History, Methods, and Techniques.** 1<sup>st</sup> edition ABC-CLIO pub.
2. *Fred Smith.* 2004. **Handbook of Forensic Drug Analysis.** 1<sup>st</sup> edition. Academic Press

17UED34E	NMEC -I: MUSHROOM TECHNOLOGY	SEMESTER - III
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**Total Credits: 2**  
**Hours Per Week: 2**

**PREAMBLE:**

- To learn about the basics of Mushrooms, production and its applications

**CONTENTS**

**UNIT - I**

**Basic concepts of Mushroom Technology**

Mushroom Technology - Introduction, History and Scope. Edible and Poisonous Mushrooms. Importance and nutritive value of edible mushrooms. Mushroom research centers in India.

**UNIT - II**

**Types of mushroom and its cultivation**

Cultivation of button mushroom (*Agaricus bisporus*), milky mushroom (*Calocybe indica*), oyster mushroom (*Pleurotus sajorajju*) and paddy straw mushroom (*Volvariella volvcea*).

**UNIT-III**

**Production, Harvest and Storage methods**

Isolation and culture of spores, culture media preparation. Production of mother spawn, multiplication of spawn - Inoculation Technique - Cultivation technology - Substrates, composting technology, bed, polythene bag preparation, spawning - Cropping - Mushroom production - Harvest - Storage methods and marketing.

**TEXT BOOKS:**

1. *Krishnamoorthy, A.S at al.*, 1991. **Oyster Mushrooms**. Department of Plant Pathology, Tamil Nadu.
2. *Suman B C, Sharma V P.* 2007. **Mushroom Cultivation in India**. Daya Publishing House.

**REFERENCE BOOKS:**

1. *NIIR Board of Consultants and Engineers.* 2011. **Handbook on Mushroom Cultivation and Processing (with Dehydration, Preservation and Canning)**. Asia Pacific Business Press Inc.
2. *Biswas S.* 2012. **Mushrooms: A Manual for Cultivation**. PHI Learning Private Limited-New Delhi.

<b>17UED44E</b>	<b>NMEC -II: APICULTURE</b>	<b>SEMESTER - III</b>
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**Total Credits: 2**  
**Hours Per Week: 2**

**PREAMBLE:**

- To learn about the lifecycle of honey bees, production and applications of honey

**CONTENTS**

**UNIT - I**

**History**

History of Bee keeping – Present status of Apiculture in India – species of honey bees.

**UNIT - II**

**Lifecycle and Cultivation**

Bee colony, Castes. Natural colonies and their yield. Types of beehives – structure – location, care and management. Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc.

**UNIT - III**

**Social status of Apiculture**

Bee foraging: Pollen and nectar yielding plants. Honey Extraction, seasonal maintenance. Economics of Apiculture and Management. Honey yield in national and international market. Prospects of apiculture as self employment venture.

**TEXT BOOKS:**

1. *Ghosh G. K.* 1998. **Beekeeping in India.** Ashish Publishers.
2. *Abrol D. P.* 2010. **A Compressive Guide to Bees and Beekeeping.** Scientific Publishers.

**REFERENCE BOOKS:**

1. *Singh Dharm Singh Devender Pratap.*2006. **A Handbook of Beekeeping.** Agrobios (India).
2. *NPCS Board of Consultants & Engineers.* 2015. **The Complete Book on Beekeeping and Honey Processing.** 2<sup>nd</sup> edition. NIIR Project Consultancy Services.

<b>17UBTSS1</b>	<b>SELF STUDY PAPER - I : ENVIRONMENT, HEALTH AND MANAGEMENT</b>	<b>SEMESTER: III</b>
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**Total Credits: 1**

**OBJECTIVES:**

1. To study about Environmental Characters.
2. To study the various types of Pollution and its management.

**CONTENTS**

**UNIT - I**

Ecology - ecosystem and their types - definitions - environmental components and interrelationships - physical, chemical and biological characteristics of environment energy flow and materials cycling.

**UNIT - II**

Definition - source of pollution - types of pollution - air, water, soil, noise and radioactive pollution - environmental sanitation - environmental issues - global - national - regional and local.

**UNIT - III**

Prescribed environmental standards - WHO - Pollution Control Board - risk probability and hazards to humans - toxicology - chemical hazards - biological hazards: disease development and developing countries.

**UNIT - IV**

Pollution control methods - physical, chemical and biological - waste water treatment - activated sludge process, oxidation ponds and trickling filter - anaerobic process.

## UNIT-V

Tool for environment management - Environmental Impact Assessment - waste minimization techniques - environmental planning in urban development - natural resources and sustainable development - environmental ethics.

### REFERENCE BOOKS:

1. *Kurian Joseph and R.Nagendra.* 2004. **Essentials of Environmental Studies.** Pearson Education, New Delhi.
2. *Tyler Miller.J.R.* 2004. **Environmental Science.** Thomson Brooks/Cole, Singapore.
3. *Suresh K.Dhameja.* 2005. **Environmental Science and Engineering.** Kataria sons, Delhi.
4. *Dubey.R.C.* 2006. **Environmental Health Ecological Perspectives.** Jones and Bartlett Publishers, Singapore.

<b>17UBTSS2</b>	<b>SELF STUDY PAPER – II : BIOFERTILIZER TECHNOLOGY</b>	<b>SEMESTER: III</b>
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**Total Credits: 1**

**OBJECTIVES:**

1. To study about Biofertilizers.
2. To study the various microbial species.

**CONTENTS**

**UNIT - I**

An introduction to fertilizers, synthetic fertilizers, natural fertilizers, inorganic fertilizers, organic fertilizers, bio-fertilizers - importance, advantages and constraints.

**UNIT - II**

Isolation, culturing methods, enumeration and identification of microbial species - Rhizobium, Azospirillum Azotobacters, blue green algae and phosphate solubilisers.

**UNIT - III**

Morphology of Rhizobium, Azospirillum, Azotobacters, blue green algae and phosphate solubilisers and maintenance - inoculant preparation.

**UNIT - IV**

Preparation of microbial inoculants - large-scale production of microbes - their application as biofertilizers - crop responses to biofertilizers.

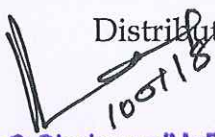


## UNIT - V

Azolla - distribution, morphological and biochemical characteristics - cyanobacterial symbionts - azolla biofertilizer technology - organic matter and composting - method of processes, applications and limitations.

### REFERENCE BOOKS:

1. *N.S.Subba Rao*. 2000. **Biofertilizers in Agriculture**. Oxford & IBH publishing Co., New Delhi.
2. *Daniel Sundararaj, D. and G. Thulasidas*. 1993. **Botany of Field Crops**. 2<sup>nd</sup> Edition. McMillan India Ltd.
3. *Jeswani, L.M. and Baldev, B.* 1990. **Advances in Pulse Production Technology**. ICAR, New Delhi.
4. *Malsen, L.J.G.V. and S. Somaatmadja*. 1993. **PROSEA - Plant Resources of South East Asia. No.1. Pulses**. International Book Distributors, Dehradun.

  
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