

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.

SCHEME OF EXAMINATIONS

Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
Part - I							
16UT L11T 15UHL11H 15UML11M 15UFL11F	Tamil-I/ Hindi-I/ Malayalam-I/ French - I	6	3	25	75	100	4
Part - II							
16UEG12E	English - I	6	3	25	75	100	4
Part - III							
16UBT13A	Core -I: Cell and Molecular Biology	5	3	25	75	100	4
16UBT13P	Core Practical- I: Cell and Molecular Biology	4	5	30	45	75	3
16UCY1AA	Allied - I: Chemistry	4	3	20	55	75	3
16UCY1AP	Allied Practical- I: Chemistry	3	3	20	30	50	2
Part - IV							
15UFC1FA	Environmental Studies	2	3	-	50	50	2
		30				550	22
Second Semester							
Part - I							
16UT L21T 15UHL21H 15UML21M 15UFL21F	Tamil-II/ Hindi-II/ Malayalam-II/ French - II	6	3	25	75	100	4
Part - II							
16UEG22E	English - II	6	3	25	75	100	4
Part - III							
16UBT23A	Core -II: Principles of Genetics	5	3	25	75	100	4

BoS Chairman/HoD
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B.Sc- Biotechnology (Students admitted from 2016-2017 onwards)

16UBT23P	Core Practical - II: Genetics	4	5	30	45	75	3
16UBT2AA	Allied -II: Biodiversity	4	3	20	55	75	3
16UBT2AP	Allied Practical - II: Biodiversity	3	5	30	45	75	3
Part - IV							
15UFC2FA	Value Education: Human Rights	2	3	-	50	50	2
		30				575	23
Third Semester							
Part - I							
15UTL31U 15UML31M 15UHL31H 15UFL31F	Tamil-III/ Hindi-III/ Malayalam-III/ French - III	5	3	25	75	100	4
Part - II							
16UEG32E	English - III	5	3	25	75	100	4
Part - III							
16UBT33A	Core -III: Microbiology	5	3	25	75	100	4
16UBT33P	Core Practical -III: Microbiology	4	5	30	45	75	3
16UBT3AA	Allied - III: Biochemistry	4	3	20	55	75	3
16UBT3AP	Allied Practical - III: Biochemistry	3	5	30	45	75	3
Part-IV							
15UFC3FA 15UFC3FB 15UFC3FC 15UFC3FD 15UFC3FE	Tamil/ Advanced Tamil (OR) Yoga for Human Excellence/Women's Rights/Constitution of India	2	3	-	50	50	2
	NMEC-I:	2	3	-	50	50	2
		30				625	25
Fourth Semester							
Part - I							
15UTL41U 15UHL41H 15UML41M 15UFL41F`	Tamil-IV/ Hindi-IV/ Malayalam-IV/ French - IV	5	3	25	75	100	4
Part - II							
16UEG42E	English - IV	5	3	25	75	100	4

B.Sc- Biotechnology (Students admitted from 2016-2017 onwards)

Part - III							
16UBT43A	Core -IV: Immunology	5	3	25	75	100	4
16UBT43P	Core Practical - IV: Immunology	4	5	30	45	75	3
16UMA4AB	Allied -IV: Mathematics and Statistics for Biology	4	3	20	55	75	3
Part - IV							
16UBT4SA	Skill Based Subject-I: Techniques for Biotechnology	3	3	25	75	100	4
15UFC4FA/ 15UFC4FB/ 15UFC4FC	Tamil/ Advanced Tamil (OR) General Awareness	2	3	-	50	50	2
	NMEC- II:	2	3	-	50	50	2
		30				650	26
Fifth Semester							
Part - III							
16UBT53A	Core - V: Recombinant DNA Technology	5	3	25	75	100	4
16UBT53B	Core -VI: Microbial Biotechnology	5	3	25	75	100	4
16UBT53C	Core -VII: Plant Biotechnology	5	3	25	75	100	4
16UBT53P	Core Practical - V: rDNA, Microbial and Plant Biotechnology	5	5	30	45	75	3
	Elective -I:	5	3	20	55	75	3
Part - IV							
16UBT5SA	Skill Based Subject- II: Entrepreneurial Biotechnology	5	3	20	55	75	3
16UBT53T	Internship	Grade A to C					
		30				525	21
Sixth Semester							
Part - III							
16UBT63A	Core -VIII: Animal Biotechnology	5	3	25	75	100	4
16UBT63B	Core - IX: Advanced Environmental Biotechnology	5	3	25	75	100	4
16UBT63C	Core -X: Nano	5	3	25	75	100	4

B.Sc- Biotechnology (Students admitted from 2016-2017 onwards)

	Biotechnology						
16UBT63P	Core Practical - VI: Animal, Environmental and Nano Biotechnology	5	5	30	45	75	3
	Elective- II	5	3	20	55	75	3
	Elective- III	5	3	20	55	75	3
Part -IV							
16UEX65A	Extension Activity	-	-	50	-	50	2
		30				575	23
Grand Total						3500	140

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.	16UBT5EA	Pharmaceutical Biotechnology
2.	16UBT5EB	Animal System Physiology

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.	16UBT6EA	Fundamentals of Bioinformatics
2.	16UBT6EB	Marine Biotechnology

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.	16UBT6EC	Basics of Clinical Trials
2.	16UBT6ED	Food 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	15UED34E	Mushroom Technology
2.	II	15UED44E	Apiculture

Total Credit Distribution

Subjects	Credits	Total		Credits	Cumulative Total
Part I: Tamil	4	4 x 100 =	400	16	32
Part II: English	4	4 x 100 =	400	16	
Part III:					
Core Theory	4	10 x 100	1000	40	87
Core Practicals	3	6 x 75 =	450	18	
Allied Theory	3	4 x 75 =	300	12	
Allied Practicals	2	1 x 50 =	50	02	
Allied Practicals	3	2 x 75 =	150	06	
Elective	3	3 x 75 =	225	09	
Part IV:					
Skill Based Subjects	3	1 x 75 =	75	03	07
Skill Based Subjects	4	1 x 100 =	100	04	
Languages & Others	2	4 x 50 =	200	08	12
NMEC	2	2 x 50 =	100	04	
Part V:					
Extension Activity	1	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. Two Skill Based Courses in IV and V semester.
6. Extension activity in VI semester
7. Elective papers in the Fifth and Sixth semesters.

Students have to complete the following –Industrial training: Subject code: **16UBT53T**.

Students must undergo Internship for 15 - 30 days during IV Semester Summer Vacation. Evaluation of the Report done by the Internal and External Examiners in the V Semester. Based on their performance Grade will be awarded as A To C.

A- 75 marks and above

B- 60-74 marks

C- 40-59 marks

Below 40 marks - Reappear (RA)

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

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

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	16UBTSS1	Environment, Health And Management
2.		16UBTSS2	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 **TamilNadu 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.

16UBT13A	CORE -I: CELL AND MOLECULAR BIOLOGY	SEMESTER - I
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Total Credits: 4
Hours Per Week: 5

OBJECTIVES:

1. To study the structural features of different types of cells.
2. To study the cellular organelles & their functions.

CONTENTS

UNIT - I

Discovery of the cells, development of cell theory, Prokaryotic cell structure (Bacteria) and Eukaryotic cell structure (Plant and Animal). Structure and Function of Nucleus, Ribosome, Mitochondria, Chloroplast, Golgi Apparatus, Endoplasmic Reticulum. Difference between Prokaryotic and Eukaryotic cell organization.

UNIT - II

Membrane architecture in Bacteria, Plant and Animal cells. Passive transport (diffusion and osmosis), Active transport (Primary and Secondary). Cell cycle, Cell division (mitosis and meiosis). Characteristics of cancer cells and apoptosis.

UNIT - III

Structural elucidation of DNA, Forms of DNA (A, B & Z). Replication - Experiment to prove semi conservative mode of replication (Meselson and Stahl experiment), Mechanism of DNA Replication, Enzymes involved in Replication (Helicase, Primase, DNA Polymerases (Type I, II & III), Topoisomers and Ligase), Difference between prokaryotic and eukaryotic replication.

UNIT - IV

Structure and Types of RNA, Transcription - Structure of RNA polymerase, Initiation, Elongation, Termination, Difference between prokaryotic and eukaryotic transcription. Post transcriptional processing of mRNA. Prokaryotic Transcription regulation -*lac* Operon.

UNIT - V

Elucidation of Genetic code, Wobble hypothesis, Translation - Initiation, elongation and Termination, Difference between prokaryotic and eukaryotic translation, post translational modification (Deformylation, Glycosylation, Acetylation, Amidation, lipid attachment and Disulfide bond formation).

REFERENCE BOOKS:

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

16UBT13P	CORE PRACTICAL - I: CELL AND MOLECULAR BIOLOGY	SEMESTER - I
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Total Credits: 3
Hours Per Week:4

1. Preparation of Buffer in different pH- Phosphate, Acetate, *Tris* Buffer
2. Preparation of Equilibrated Phenol
3. Sucrose Gradient Centrifugation
4. Preparation of permanent slide
5. Microscopic observation of Monocot and Dicot leaf section
6. Staining of plant cells - Onion epidermal cells
7. Simple staining of Bacteria
8. Staining of starch granules
9. Lignin staining
10. Cell(Yeast) counting
11. Blood smear preparation for blood cell identification
12. Mitotic preparation from onion root tip
13. Estimation of Chlorophyll
14. Extraction of DNA from Cheek Cells

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.** 2nd edition. Academic Press.
3. *Joseph Sambrook, Michael R. Green.* 2012. **Molecular Cloning: A Laboratory Manual.** 4th edition. Cold Spring Harbor.
4. *John Davey, Michael Lord.*2003. **Essential Cell Biology Volume 1: Practical Approach.** 1st edition. OUP Oxford.

16UCY1AA	ALLIED -I: CHEMISTRY	SEMESTER- I
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Total Credits: 3
Hours Per Week:4

OBJECTIVES:

1. On successful completion of this course the students shall gain knowledge in the basics of chemistry which helps bioscience students to understand chemical bonding in the biomolecules and the techniques involved in the biochemistry.

CONTENTS

UNIT - I

Chemical bonding

1. Molecular Orbital Theory - bonding, antibonding and nonbonding orbitals. MO configuration of H_2 , N_2 , O_2 , F_2 - bond order - diamagnetism and paramagnetism.
2. Ionic Bond: Nature of ionic bond, structure of NaCl and CsCl, factors influencing the formation of ionic bond.
3. Covalent Bond: Nature of covalent bond, structure of CH_4 , NH_3 , H_2O , shapes of $BeCl_2$, BF_3 , based on VSEPR theory and hybridization.

UNIT - II

Solutions

1. Normality, molarity, molality, mole fraction, mole concept.
2. Preparation of standard solutions - primary and secondary standards.
3. Principle of Volumetric analysis.
4. Strong and weak acids and bases - Ionic product of water- pH, pKa, pKb, Buffer solution, pH and pOH simple calculations.

UNIT-III

Basic Organic Chemistry

1. Electron displacement effect in organic compounds - Inductive effect - Electromeric effect - Resonance effect, Hyperconjugation and Steric effect.

2. Isomerism, Symmetry of elements (Plane, Centre and Axis of symmetry), Molecules with one chiral carbon and two adjacent chiral carbons -Optical isomerism of lactic acid and tartaric acid, Enantiomers, Diastereomers, Separation of racemic mixture (chemical, mechanical, biochemical and kinetic), Geometrical isomerism (maleic and fumaric acid).

UNIT - IV

1. Surface Chemistry

Adsorption – adsorbent and adsorbate, adsorption and absorption - chemisorption - physisorption - Difference between chemisorption and physisorption - applications of adsorption - Factors influencing adsorption, adsorption isobar, adsorption isostere.

2. Chromatography - Principles and applications of column, paper and thin layer Chromatography.

UNIT - V

Dyes

1. Terms used - chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic shift and hypochromic shift. Classification of dyes based on chemical structure and application-Preparation of azo (Methyl orange) and triphenyl methane (Malachite green) dyes.

TEXT BOOKS

1. *R. D. Madan. 2001. Modern Inorganic Chemistry.* S. Chand & Company, New Delhi.
2. *Puri, Sharma, Pathania. 2004. Principles of Physical Chemistry,* Vishal Publishing Company, Jalandhar.
3. *B.S.Bhal , Arun Bhal,1997. Advanced Organic Chemistry,* S. Chand & Co Limited, New Delhi.
4. *M. K. Jain, S. C. Sharma. 2001. Organic Chemistry,* Shoban Lal Nayin Chand, Jalandhar.
5. *Gopalan R. 1991.Elements of Analytical Chemistry,* Sultan Chand & Sons, New Delhi.

16UCY1AP	ALLIED PRACTICAL - I: CHEMISTRY	SEMESTER I
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Total Credits: 2
Hours Per Week:3

CONTENTS

I. Volumetric analysis

1. Estimation of Sodium Hydroxide using standard Sodium Carbonate.
2. Estimation of Hydrochloric acid using standard Oxalic acid.
3. Estimation of Oxalic acid using standard Sulphuric acid.
4. Estimation of Ferrous sulphate using standard Mohr salt solution.

II. Organic Analysis

1. To distinguish between aliphatic & aromatic.
2. To distinguish between saturated & unsaturated.
3. Detection of Elements (N, S, Halogens).
4. Functional group tests for phenols, acids (mono & di), aromatic primary amine, monoamide, diamide, carbohydrate. Functional group characterized by Confirmatory test.

TEXT BOOK

1. V. Venkateswaran, R. Veeraswamy & A. R. Kulandaivelu. 2004. **Basic Principles of practical chemistry**, Sultan Chand & Co.

16UBT23A	CORE - II: PRINCIPLES OF GENETICS	SEMESTER - II
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Total Credits : 4
Hours Per Week:5

OBJECTIVES:

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

CONTENT

UNIT- I

History of Genetics, Mendel's work: Monohybrid Experiment, Dihybrid Experiment, Back Cross and Test Cross. Chromosomal theory of Inheritance, Multiple Alleles, Pseudo alleles, Complementation Test.

UNIT- II

Concept of Chromosome and Gene, Structure of Prokaryote and Eukaryote chromosome. Gene Interactions: Allelic (Co-Dominance, Incomplete Dominance, Pseudo dominance), Non Allelic (Epistasis and Lethal genes).

UNIT- III

Extrachromosomal Inheritance - Mitochondrial genome, Chloroplast Genome and Maternal effect. Genetics of Haemoglobin, Crossing over: Theory, Mechanism and Benefits. Recombination- Holliday model.

UNIT- IV

Chromosomal Variations and its Abnormalities: Numerical - Euploidy and Aneuploidy; Structural - deletion, duplication, inversion and translocation. Transposable elements of Prokaryotes (IS Elements, Composite and Tn3 Family) and Eukaryotes (Maize transposable elements).

UNIT- V

Model organism for genetic analysis of development- *Drosophila* & *Arabidopsis*, Population Genetics: Gene frequency, Calculation of Gene frequency, Pedigree analysis, Genetic Counseling.

REFERENCE BOOKS:

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

16UBT23P	CORE PRACTICAL - II: GENETICS	SEMESTER - II
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Total Credits: 3
Hours Per Week:4

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

REFERENCE BOOKS:

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

16UBT2AA	ALLIED - II: BIODIVERSITY	SEMESTER - II
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Total Credits: 3
Hours Per Week:4

OBJECTIVES :

1. To study the diversity and conservation of organisms.
2. To know the importance of diversity.

CONTENTS

UNIT - I

Biodiversity – Definition and types. Biodiversity as a natural resource. Indian Biodiversity- vegetational zones and zones of faunal distribution. Major protected areas and their importance. Major biodiversity areas of the world and biodiversity hot spots.

UNIT - II

Important criteria used for classification in each taxon. Outline of classification - plants, animals and microorganisms. Evolutionary relationships among taxon.

UNIT - III

Threats to biodiversity (Terrestrial and Marine area). Factors affecting biodiversity - Climate change, Deforestation and Habitat loss, Over exploitation, Impact of exotic species and Pollution. Diversity-stability relationship.

UNIT - IV

Biodiversity Conservation - Wildlife parks, wildlife reserves, privately owned wildlife reserves & Biosphere reserves. Single species / single habitat based conservation programmes. *Ex-situ* & *in-situ* conservation. Conservation Breeding, Organisms of conservation concern: Rare, endangered species. Conservation strategies.

UNIT - V

International conventions and treaties on conservation, India's role & contribution. Institutions and their role in conservation; Zoos, Natural history museums & collections. Zoological survey of India, Botanical survey of India, Forest research Institute, Central Marine Fisheries research Institute.

REFERENCE BOOKS:

1. *Negi, S.S.* 1993. **Biodiversity and its Conservation in India.** 1st edition. Indus Publishing Co.
2. *Krishnamurthy K V.* 2003. **Textbook of Biodiversity.** 1st edition. Science Publisher.
3. *Mike J Jeffries.* 2006. **Biodiversity and Conservation.** 1st edition. Routledge.
4. *Michael I. Jeffery, Jeremy Firestone, Karen Bubna-Litic.* 2008. **Biodiversity Conservation, Law and Livelihoods.** 1st edition. Cambridge University Press.

16UBT2AP	ALLIED PRACTICAL - II: BIODIVERSITY	SEMESTER - II
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Total Credits: 3
Hours Per Week:3

1. Morphology and classification of 10 medicinally important plants.
2. Morphology and classification of 10 economically important insects.
3. Morphology and classification of 10 different 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)
9. Field visits to nearby Zoo, Forest, Nursery, and Culture collection center - Herbaria/Botanical Garden etc.

16UBT33A	CORE - III: MICROBIOLOGY	SEMESTER - III
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Total Credits: 4
Hours Per Week:5

OBJECTIVES:

1. To study the science of microbiology and describe some of the general methods used to investigate microorganisms.
2. To learn various activities of microorganisms.

UNIT - I

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

UNIT - II

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

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

UNIT - IV

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, 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).

REFERENCE BOOKS:

1. *Atlas M, Ronald. 1995. Principles of Microbiology.* Mcgraw - hill Inc.
2. *Michael Pelzar Jr. Microbiology.* 5th edition. McGraw Hill Education (India) Pvt Ltd.
3. *Prescott, L. M., John P. Harley, Donald A. Klein. 2004. Microbiology.* 6th edition. McGraw-Hill Science Publication.
4. *Gerard J. Tortora. 2012. Microbiology: An Introduction,* 11th edition. Benjamin Cummings Publishers.

16UBT33P	CORE PRACTICAL - III: MICROBIOLOGY	SEMESTER - III
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**Total Credits: 3
Hours Per Week:4**

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 BOOK:

1. *Cappuccino*. 2005. **Microbiology: A Laboratory Manual**, Pearson Education.

16UBT3AA	ALLIED - III: BIOCHEMISTRY	SEMESTER - III
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Total Credits: 3
Hours Per Week:4

OBJECTIVES:

1. To learn the structure, function & interrelationship of various biomolecules & consequences of deviation from normal.
2. To study the integration of the various aspects of metabolism & their regulatory pathways.

CONTENTS

UNIT-I

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

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

UNIT-III

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

UNIT- IV

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

Enzymes: Nomenclature and Classifications of enzyme. Coenzymes, Apozymes, 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.

REFERENCE BOOKS:

1. *Geoffery L Zubay*. 1995. **Principles of Biochemistry**. 1st edition. WCB publishers.
2. *Ambika Shanmugam*. 2012. **Fundamentals of Biochemistry**, 7th edition. Lippincott Williams & Wilkins.
3. *Lehninger Albert. L , Nelson David. L and Cox Michael M*,1993. **Principles of Biochemistry**. 2nd edition. CBS Publishers and Distributors, New Delhi.
4. *Voet, D. and Voet, J. G.* 1995. **Fundamentals of Biochemistry**. 2nd edition. John Wiley and sons inc.

16UBT3AP	ALLIED PRACTICAL - III: BIOCHEMISTRY	SEMESTER - III
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Total Credits: 3
Hours Per Week:3

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.

15UED34E	NMEC -I: MUSHROOM TECHNOLOGY	SEMESTER - III
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Total Credits: 2
Hours Per Week:2

OBJECTIVES:

1. To learn about the basics of Mushrooms.
2. To study about the production and applications of Mushrooms.

CONTENTS

UNIT-I

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

UNIT-II

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

UNIT-III

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.

REFERENCE BOOKS:

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

16UBT43A	CORE - IV: IMMUNOLOGY	SEMESTER - IV
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Total Credits: 4
Hours Per Week:5

OBJECTIVES:

1. To learn cells of immune system
2. To study techniques in immunology.

CONTENTS

UNIT-I

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

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

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

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

UNIT- V

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

REFERENCE BOOKS:

1. *Kuby, J.* 2003. **Immunology**. 5th edition. W.H. Freeman and Company.
2. *Rao, C.V.* 2002. **Textbook of Immunology**.1st edition. Narosa Publishing House.
3. *Ivan Riot.* 1988. **Essentials of Immunology**. 6th edition. Blackwell Scientific Publications.
4. *Tizard.* 1995. **Immunology**. 4th edition. Saunders college publishers.

16UBT43P	CORE PRACTICAL - IV: IMMUNOLOGY	SEMESTER - IV
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Total Credits: 3
Hours Per Week:4

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 BOOKS:

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

16UMA4AB	ALLIED-IV: BASIC MATHEMATICS AND STATISTICS	SEMESTER IV
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Total Credits: 3
Hours Per Week:4

OBJECTIVES :

1. On successful completion of this course the students shall enrich to solve various problems in bioscience
2. It helps the students to do research problems

CONTENT

UNIT-I

Nature and Scope of Statistical methods and their limitations - Data collection - Classification and Tabulation - Primary and Secondary data and their applications in life sciences .

UNIT- II

Diagrams- Line diagram, Bar diagram and Pie diagram - Graphical presentation - Histogram and Ogives - Measures of Location and Dispersion.

UNIT -III

Probability - Concept and Definition - Addition and Multiplication theorems of Probability (statement only) - simple problems - Binomial, Poisson and Normal distributions (without proof) - simple problems.

UNIT-IV

Correlation - Scatter diagram - Karl Pearson's co-efficient of Correlation - Co-efficient of determination - Spearman's Rank Correlation.

UNIT-V

Regression Analysis - Meaning and definition-Method of forming regression equations-Uses of regression equations- Simple Problems.

TEXT BOOK:

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

REFERENCE BOOK:

1. *Gupta.S.P.* **Statistical Methods.** 2004. Sultan Chand and Sons.

16UBT4SA	SKILL BASED SUBJECT-I: TECHNIQUES FOR BIOTECHNOLOGY	SEMESTER - IV
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Total Credits: 4
Hours Per Week:3

OBJECTIVES:

- To study the functions and applications of several common measurement systems used in Biotechnology
- To learn the technical vocabulary associated with instrumentation design and basic signal analysis

UNIT- I

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

UNIT- II

Chromatography Techniques: Principles and Applications of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC.

UNIT- III

Electrophoresis Techniques: Principles and Applications of PAGE, Agarose Gel Electrophoresis, 2D gel electrophoresis, Immuno diffusion, Immuno Electrophoresis.

UNIT- IV

Spectroscopic Techniques: Principles and Applications of UV and Visible Spectroscopy, Fluorescence Spectroscopy, Mass Spectroscopy, Atomic Absorption Spectroscopy, NMR, Electron Spin Resonance Spectroscopy (ESR) and FTIR.

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.

REFERENCE BOOKS:

1. *Sawhney, S. K. & Randhir Singh.* 2006. **Introductory Practical Biochemistry.** 3rd edition. Narosa publishing House.
2. *Boyer, Rodney F Benjamin and Cummins.* 2001. **Modern Experimental Biochemistry,** 2nd edition. Pearson Education.
3. *Freifelder, D.* 1982. **Physical Biochemistry: Application to Biochemistry and Molecular Biology.** 2nd edition. W.H.Freeman publishers.
4. *Walke, J. & Wilson,K.* 2000. **Principle & Technique - Practical Biochemistry.** 5th edition. Cambridge university press.

15UED44E	NMEC -II: APICULTURE	SEMESTER - III
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Total Credits: 2
Hours Per Week:2

OBJECTIVES:

1. To learn about the basics of honey bees and Honey
2. To study about the production and applications of Honey.

CONTENTS

UNIT-I

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

UNIT-II

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

UNIT-III

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.

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

16UBT53A	CORE - V: RECOMBINANT DNA TECHNOLOGY	SEMESTER - V
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Total Credits: 4
Hours Per Week:5

OBJECTIVES:

1. To learn the guidelines for Recombinant DNA Technology research which involves all the molecular Biology techniques
2. To study about different Cloning techniques

CONTENTS

UNIT-I

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

Plasmids - properties of plasmid, types of plasmids, plasmid compatibility and in compatibility, 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 Lambda Phage vectors, cosmid, phagemid, M13. Yeast vectors - YIP, YEP, YRP and YAC. Animal vectors- SV40 Vectors, Retero viral and Baculo viral vectors. Plant Vectors- Ti plasmid as a gene vector, expression vectors and shuttle vectors.

UNIT-IV

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

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.

REFERENCE BOOKS:

1. *Brown, T. A.* 1998. **Introduction to Gene Cloning.** 3rd edition. Stanley Thornes Publishing Ltd.
2. *Primrose, S. B.* 2003. **Principles of Gene Manipulation.** 6th edition. Blackwell Science Ltd.
3. *Ernst. L. Winnacker.* 2003. **From Genes to Clones.** 2nd edition. Panima Publishing Corporation.
4. *James. D. Watson.* 2001. **Recombinant DNA technology.** 2nd edition. WH Freeman and company.

16UBT53B	CORE - VI: MICROBIAL BIOTECHNOLOGY	SEMESTER - V
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Total Credits: 4
Hours Per Week:5

OBJECTIVES:

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

CONTENTS

UNIT-I

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 - 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

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 (β Lactam Antibiotics, Peptide antibiotics, Vitamin B12 and Riboflavin) and edible biomass.

UNIT-IV

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

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.

REFERENCE BOOKS:

1. Stanbury, A. H., Whittaker, A and Hall, S. J. 1995. **Principles of fermentation Technology**. 2nd 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**. 3rd edition. CRC Press.
3. GMP manual: Good manufacturing practices and implementation, http://www.gmppublishing.com/media/ebooks/flyer/files/gmpmanual_eu_4c_online.pdf.
4. Compendium of Good Practices in Biotechnology, BIOTOL series.

16UBT53C	CORE - VII: PLANT BIOTECHNOLOGY	SEMESTER - V
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Total Credits: 4
Hours Per Week:5

OBJECTIVES:

1. To understand various *in vitro* culture techniques of Plants
2. To learn gene transferring mechanisms in Plants

CONTENTS

UNIT-I

Plant Tissue Culture technique - History and Scope. Totipotency of plant cells- redifferentiation and dedifferentiation. Criteria for Plant Selection. Plant Tissue Culture lab - Architecture and Instruments. Plant tissue culture media and its types. Growth conditions and contamination management.

UNIT-II

Culture of plant materials- explants selection and technique of culturing the same. Micropropagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture and fusion, Somaclonal variation.

UNIT-III

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

UNIT-IV

Transgenic Plants -herbicide resistance, insect resistance, virus resistance, Drought resistance and transgenic plants as bioreactors. Application of antisense RNA technology, genetically modified foods and Golden Rice.

UNIT-V

Safety Assessment of GM crops, Biosafety regulations in India (Guidelines for research in transgenic plants, 1998). Issues related to transgenic plants- Transgene escape, Transgene loss, Terminator Seeds. Intellectual Property Rights and Regulatory Issues related to

biotechnology of tropical species in India. DBT and Ministry of Agriculture Guidelines for Plant tissue culture.

REFERENCE BOOKS:

1. *Chawla, H. S.* 2013. **Introduction to Plant Biotechnology.** 3rd edition. Oxford & IBH publishing company.
2. *Razdan, M. K.* 2002. **Introduction to Plant tissue culture.** 2nd edition. Oxford & IBH publishing company.
3. *Grierson, D. and Covey, S.V.* 1988. **Plant Molecular Biology.** 2nd edition. Blackie Publishers.
4. *Bhojwan, S. S.* 1996. **Plant tissue culture - Theory and Practice.** 1st edition. Elsevier Publishers.

16UBT53P	CORE PRACTICAL - V: rDNA, MICROBIAL AND PLANT BIOTECHNOLOGY	SEMESTER - V
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**Total Credits: 3
Hours Per Week:5**

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**.1st edition. Oxford University Press.
2. *Choudhary, S. S, Choudhary, P. and Choudhary, S.K.* 2005. **Laboratory guide in biosciences**. 2nd edition. Kalyani publishers.

16UBT5EA	ELECTIVE - I: PHARMACEUTICAL BIOTECHNOLOGY	SEMESTER - V
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Total Credits:3
Hours Per Week:5

OBJECTIVES:

1. To evaluate different pharmaceutical parameters of current biotechnology products.
2. To determine parameters related to stability and formulation of biotechnology products

CONTENTS

UNIT -I

History of Pharmaceutical industry, Drug Discovery, Development phase and drug Manufacturing process. Generics and biogenerics. Protein based biopharmaceuticals.

UNIT-II

Transgenic plants as functional foods or nutraceuticals, Drugs derived from plants. Antitumor agent - etoposide, colchicine, taxol. Cardiotonic-Convallatoxin and Digitalin. Anti Inflammatory -Aescin and bromilin. Antihypertensive - Reserpine. Muscle Relaxant - Tubocurarine.

UNIT -III

Drugs derived from Animal - Gelatin, Glycerin, Heparin, Lanolin, Premarin, Animal vaccines. Pharmaceutics from Marine source - Cytarabine, Zicomotide, Omega - 3 - acid ethyl ester, Trabectodin, Brentuximab vadotin.

UNIT -IV

DNA Vaccine construction and immunology, DNA vaccine expression, plasmid delivery of DNA vaccines. Peptide vaccine, Gene Pharming, Cytokines as biopharmaceuticals.

UNIT -V

Estimation of toxicity LD₅₀ and ED₅₀. Immunogenicity of biopharmaceuticals: Immunogenicity; Factors contributing to immunogenicity (product-related factors, host-related factors), Consequence of immunogenicity to biopharmaceuticals; Measurement of immunogenicity.

REFERENCE BOOKS:

1. *Oliver Kayser and Rainer H. Müller.* 2005. **Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications.** 1st edition. Wiley Publishers.
2. *Jay P. Rho. and Stan G. Louie.* 2003. **Hand book of Pharmaceutical Biotechnology.** 1st edition. CRC Press.
3. *Goodman and Gilman.* 2006. **The Pharmacological Basis of Therapeutics.** 11th edition. Mc Graw Hill Medical Publishing Division.
4. *Heinrich Klefenz.* 2002. **Industrial Pharmaceutical Biotechnology.** 1st edition. WILEY-VCH Publication.

16UBT5EB	ELECTIVE - I: ANIMAL SYSTEM PHYSIOLOGY	SEMESTER - V
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Total Credits: 3
Hours Per Week:5

OBJECTIVES:

1. To learn the structure of various organelles of our body
2. To study the regulatory mechanism in our body

CONTENTS

UNIT I

Blood and circulation: Blood corpuscles, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure.

UNIT II

Respiratory system: anatomy and structure transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

UNIT III

Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs: Vision, hearing and tactile response.

UNIT IV

Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

UNIT V

Digestive system: Digestion, absorption, energy balance, BMR. Endocrinology: Endocrine glands, basic mechanism of hormone action, hormones and diseases; neuroendocrine regulation.

REFERENCE BOOKS:

1. *Ganong, H.* 1989. **Review of Medical Physiology.** 14th edition, Appleton & Lange publisher, New York
2. *Shier, D., Butler, J. and Lewis, R., Holes.* 2003. **Human Anatomy and Physiology.** 10th edition. WCB/McGraw Hill, Boston.
3. *EcKert, R.* 2002. **Animal Physiology.** 5th edition. W.H.Freeman.
4. *Williams S. Hoar.* 1991. **General and Comparative Physiology.** 3rd edition. Prentice Hall of India- New Delhi.

16UBT5SA	SKILL BASED SUBJECT - II: ENTREPRENEURIAL BIOTECHNOLOGY	SEMESTER - V
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Total Credits: 3
Hours Per Week:5

OBJECTIVES:

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

CONTENTS

UNIT - I

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

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

UNIT - III

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

UNIT - IV

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

Commercialization of Biopharmaceutical products - 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.

REFERENCE BOOKS:

1. *Kolehinsky P.* 2004. **The Entrepreneur's guide to Biotechnology startup**, 4th 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**. 1st edition, Academia Press.

16UBT63A	CORE - VIII: ANIMAL BIOTECHNOLOGY	SEMESTER - VI
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Total Credits: 4
Hours Per Week:5

OBJECTIVES:

1. To study about various *in vitro* culture techniques
2. To learn about preservation of animal cells

CONTENTS

UNIT-I

Animal cell culture - History and scope, ATC Lab organization, Basic requirement for animal tissue culture lab, Sterilization and contamination management. Safety aspects of cell culture, Preparation of culture media-Types of animal cell culture media. Role of pH, Carbon dioxide, Oxygen, Temperature, serum and growth factors in cell culture.

UNIT-II

Process of initiation of cell culture, Growth of cells in culture- methods of culture, Types of animal cell culture: primary cell culture, Continuous culture. Maintenance and storage of culture, Cell line banking, Cell quantitation methods and Cytotoxicity assays.

UNIT-III

Applications of animal cell culture - Hybridoma technology and its applications. Production of native and recombinant proteins in animal cell. Scaling up of cultures - Suspension and Monolayer cultures.

UNIT-IV

Conventional methods of improvement of animal live stock: artificial insemination, *in vitro* fertilization, embryo culture, embryo sexing, splitting and cloning. Somatic cell nuclear transfer. Production of transgenic animals and its applications. Gene targeting, silencing and knock-out.

UNIT-V

Trends in Aquaculture Biotechnology, Silk worm Biotechnology. Stem cells – Properties, types, potential uses of human stem cells and stem cell controversy. Ethical issues in animal transgenics.

REFERENCE BOOKS:

1. *Wilson Aruni. , A. and Ramadass. , P.* 2011. **Animal Tissue culture.** 1st edition. MJP Publishers, India.
2. *John R. Masters.* 2000. **Animal cell culture.** 3rd edition. Oxford University Press.
3. *Freshney, R.I.* 1996. **Animal cell culture: A practical approach.** 2nd edition. Oxford University Press
4. *Rastogi, V.* 2001. **Developmental Biology.** 1st edition. Kedarnath Ramnath Publishers.

16UBT63B	CORE - IX: ADVANCED ENVIRONMENTAL BIOTECHNOLOGY	SEMESTER - VI
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Total Credits: 4
Hours Per Week:5

OBJECTIVES:

- To understand the basic vocabularies of environmental biology
- To study about the hazards of industrial pollutants on environment

UNIT- I

Biodegradation – Definition, Acclimation, detoxification, activation, bio-availability, effect of chemical structure on biodegradation, recalcitrance, predicting products of biodegradation, co-metabolism and biotransformation. Factors affecting biodegradation.

UNIT- II

Biodegradation of Hydrocarbons - Microbial degradation of hydrocarbons: Methane, ethane, propane, butane and other long chain alkanes, alkenes, alkynes. Aerobic and anaerobic biodegradation of aromatic compounds. Microbial degradation of halogenated and sulfonated compounds. Biodegradation of pesticides. Microbial degradation of biopolymers - Cellulose, starch, pectin and lignin. Polyhydroxy alkanates (Bioplastics).

UNIT- III

Bioremediation- Definition, Constraints, advantages and applications, Types of bioremediation - Natural and engineered, *ex-situ* and *in-situ*, Bioaugmentation and biostimulation, solid phase and slurry phase bioremediation, Oxygen delivery for Bioremediation, Criteria to be met for considering bioremediation - factors affecting bioremediation, treatability studies for bioremediation- purpose, experimental design and example protocol.

UNIT- IV

Specific bioremediation technologies - Application, advantages and disadvantages. Phytoremediation, Hazardous wastes, biotechnology for

hazardous waste management, cyanide detoxification, detoxification of oxalate and urea.

UNIT- V

Bio-magnification and Bio-amplification. Bioleaching and Biomining. Restoration of degraded lands - Reforestation through micropropagation of *Casurina* for tropical reforestation on adverse sites, development of stress tolerant plants; use of mycorrhizae in reforestation, reforestation of soils contaminated with heavy metals.

REFERENCE BOOKS:

1. *Katherine H. Baker*. 1994. **Bioremediation**. 1st edition. Mc Graw-Hill.
2. *Levin M.A.* 1993. **Biotreatment of industrial and hazardous waste**. 1st edition. McGraw-Hill, Inc.
3. *Martin Alexander*. 1999. **Biodegradation and Bioremediation**. 2nd edition. Academic Press.
4. *Alan Scragg*. 2007. **Environmental Biotechnology**. 2nd edition. Oxford university press.

16UBT63C	CORE - X: NANOBIOTECHNOLOGY	SEMESTER - VI
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**Total Credits: 4
Hours Per Week:5**

OBJECTIVES:

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

CONTENTS

UNIT - I

Journey of Biotechnology to Bionanotechnology. Historical perspectives. 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 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 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 of Bionanotechnology. 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

Bionanotechnology- A remedy for all diseases. *in vitro* diagnosis. 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.

REFERENCE BOOKS:

1. *Richard Brooker and Earl Boysen*. 2006. **Nanotechnology**. Wiley Publishing Inc., India.
2. *David S. Goodsell*,.2004. **Bionanotechnology: Lessons from Nature**. John Wiley & Sons, Inc., Publication.
3. *Committee on Nanophotonics Accessibility and Applicability*. 2008. **Nanophotonics: Accessibility and Applicability**. The National Academies Press.
4. *K. Eric Drexler*. 1987. **Engines of Creation: The Coming Era of Nanotechnology**. Anchor Publishers.

16UBT63P	CORE PRACTICAL-VI: ANIMAL, ENVIRONMENTAL AND NANO BIOTECHNOLOGY	SEMESTER - VI
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Total Credits: 3
Hours Per Week:5

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.** 6th edition. Wiley Blackwell.
2. *Choudhary, S. S, Choudhary, P. and Choudhary, S.K.* 2005. **Laboratory Guide in Biosciences.** 2nd edition. Kalyani publishers.

16UBT6EA	ELECTIVE- II: FUNDAMENTALS OF BIOINFORMATICS	SEMESTER - VI
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Total Credits: 3
Hours Per Week:5

OBJECTIVES:

1. To understand the uses of Bioinformatics in Biological sciences.
2. To study the tools of Bioinformatics.

CONTENTS

UNIT-I

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

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.

REFERENCE 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.* 3rd edition, PHI Learning Pvt. Ltd., India.
3. *Mount D. 2004. Bioinformatics: Sequence and Genome Analysis.* 2nd edition, University of Tuscan Press.
4. *Ouellette B F F. and Baxevanais A D. 2004. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins.* 3rd edition, Wiley, John & sons.

16UBT6EB	ELECTIVE - II: MARINE BIOTECHNOLOGY	SEMESTER - VI
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Total Credits: 3
Hours Per Week:5

OBJECTIVES:

- To learn the diversity of marine organisms
- To understand the metabolites produced by marine organisms.

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

REFERENCE BOOKS:

1. *Shyam Kishor Agarwal*. 1996. **Biodiversity and Environment**. APH Publishing.
2. *Jeffery S. Levinton*. 2001. **Marine Biology: Function, Biodiversity, Ecology**. 2nd edition. Oxford University Press.
3. *Robert R. Stickney*. 2000. **Encyclopedia of Aquaculture**. 1st edition. John Wiley & Sons, Inc.
4. *Sverdrup H.U.* 1942. **The Oceans Their Physics, Chemistry and General Biology**. 1st edition. Prentice-Hall, Inc.

16UBT6EC	ELECTIVE - III: BASICS OF CLINICAL TRIALS	SEMESTER - VI
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Total Credits: 3
Hours Per Week:5

OBJECTIVES:

1. To learn about the regulations in Clinical trials.
2. To study about the various guidelines

CONTENTS

UNIT-I

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

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

REFERENCE BOOKS:

1. *Allan Hackshaw*. 2009. **A Concise Guide to Clinical Trials**. 1st edition. Wiley Publishers.
2. *Richard Chin* and *Bruce Y. Lee*. 2008. **Principles and Practice of Clinical Trial Medicine**. 1st edition. Academic Press.
3. *Sandy Weinberg*. 2009. **Guide Book for Drug Regulatory Submissions**. 1st edition. John Wiley & sons.
4. *Haynes, R.B., Sackett, D.L., Guyatt, G.H.,and Tugwell, P.* 2005. **Clinical Epidemiology: How to Do Clinical Practice Research**. 3rd edition. Lippincott- Williams and Wilkins.

16UBT6ED	ELECTIVE- III: FOOD BIOTECHNOLOGY	SEMESTER - VI
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Total Credits: 3
Hours Per Week:5

OBJECTIVES:

1. To study about various alternate foods.
2. To study the various preservation methods.

CONTENTS

UNIT-I

Food Biotechnology – Introduction and Scope; Production of Single cell protein and Baker’s yeast; Mushroom cultivation. Food and dairy products: Cheese, bread and yogurt. Fermented vegetables – Saurkraut; Fermented Meat – Sausages.

UNIT-II

Novel microorganisms eg. LAB (Probiotics), Cyanobacteria, methylotrophs enzyme biotransformations. Role of Plant tissue culture for improvement of food additives; color and flavor. Genetic modifications of microorganisms; detection and rapid diagnosis. Genetically modified foods and crop.

UNIT-III

Food borne infections and intoxications; with examples of infective and toxic types – *Clostridium*, *Salmonella*, *Staphylococcus*. Mycotoxins in food with reference to *Aspergillus* species. Food preservation: canning, dehydration, ultrafiltration, sterilization, irradiation. Chemical and naturally occurring antimicrobials; Biosensors in food industry.

UNIT-IV

Types of beverages and their importance: Synthetic beverages-carbonated, low-calorie and dry beverages; isotonic and sports drinks; soft drinks. Production of pectin, vitamins from apple pomace; Production of citrus oil from peels of citrus fruits. Processing of tea waste - as a feed for livestock and poultry; Fermented foods: alcoholic

beverages - beer, wine and distilled spirits non alcoholic beverages - yoghurt and vinegar.

UNIT-V

Quality assurance: Microbiological quality standards of food Intellectual property rights and animal welfare. Government regulatory practices and policies. FDA, EPA, HACCP, ISI. Risk analysis; consumer and industry perceptions.

REFERENCE BOOKS :

1. *Lee Byong, H.V.* 1996. **Fundamentals of Food Biotechnology**. 1st edition. C H Publishers.
2. *Roger, A.* 1989. **Food Biotechnology**, 1st edition. Elsevier Applied Sci. Pub.
3. *Goldberg Israel.* 1994. **Functional Foods**. 1st edition. Chapman & Hall Publishers.
4. *Pometto,A., Shetty,k.,Paliyath,G., Levin, R.E.* 2005. **Food Biotechnology**. 2nd edition. CRC Publication.

16UBTSS1	SELF STUDY PAPER - I : ENVIRONMENT, HEALTH AND MANAGEMENT	SEMESTER: I To V
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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.

16UBTSS2	SELF STUDY PAPER - II : BIOFERTILIZER TECHNOLOGY	SEMESTER: I To V
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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

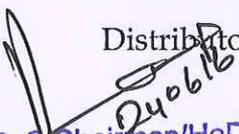
Preparation of microbial inoculants - large-scale production of microbes - their application as biofertilizers - crop responses to biofertilizers.

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**. 2nd 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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