

S.V.K.P & Dr K.S.RAJU ARTS & SCIENCE COLLEGE (A), PENUGONDA
Recognized by UGC as “College with Potential for Excellence”
Accredited by NAAC with “A” Grade
(Affiliated to ADIKAVI NANNAYA UNIVERSITY)



**B.Sc., BIOTECHNOLOGY
SYLLABUS,
SEMESTER I TO V
2023-2024**



I Semester Syllabus

BIOTECHNOLOGY

(w.e.f. 2023-24 Admitted Batch)

23BSC11 INTRODUCTION TO CLASSICAL BIOLOGY

Hours/Week: 5

Credits : 4

Unit1: Introduction to systematics, taxonomy and ecology.

- 1.1 Systematics– Definition and concept, Taxonomy –Definition and hierarchy.
- 1.2 Nomenclature– ICBN and ICZN, Binomial and trinomial nomenclature.
- 1.3 Ecology– Concept of ecosystem, Biodiversity and conservation.
- 1.4 Pollution and climate change.

Unit 2: Essentials of Botany.

- 2.1 The classification of plant kingdom.
- 2.2 Plant physiological processes (Photosynthesis, Respiration, Transpiration, phytohormones).
- 2.3 Structure of flower–Micro and macro sporogenesis, pollination, fertilization and structure of mono and dicot embryos.
- 2.4 Mushroom cultivation, floriculture and landscaping.

Unit 3: Essentials of Zoology

- 3.1 The classification of Kingdom Animalia and Chordata.
- 3.2 Animal Physiology –Basics of Organ Systems & their functions, Hormones and Disorders
- 3.3 Developmental Biology –Basic process of development (Gametogenesis, Fertilization, Cleavage and Organogenesis)
- 3.4 Economic Zoology –Sericulture, Apiculture, Aquaculture

Unit4: Cell biology, Genetics and Evolution

- 4.1 Cell theory, Ultrastructure of prokaryotic and eukaryotic cell, cell cycle.
- 4.2 Chromosomes and heredity–Structure of chromosomes, concept of gene.
- 4.3 Central Dogma of Molecular Biology.
- 4.4 Origin of life

Unit 5: Essentials of chemistry

- 5.1 Definition and scope of chemistry, applications of chemistry in daily life.
- 5.2 Branches of chemistry
- 5.3 Chemical bonds–ionic, covalent, non-covalent– Vander Waals, hydrophobic, hydrogen bonds.
- 5.4 Green chemistry

References

1. Sharma O.P., 1993. Plant taxonomy. 2nd Edition. McGrawHill publishers. India.
2. Jordan E.L., Verma P.S., 2018. Chordate Zoology. S. Chand publishers, New Delhi, India.
3. Rastogi, S.C., 2019. Essentials of animal physiology. 4th Edition. New Age International Publishers.
4. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.
5. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.
6. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.
7. Karen Timberlake, William Timberlake, 2019. Basic chemistry. 5th Edition. Pearson publishers.
8. Subrata Sen Gupta, 2014. Organic chemistry. 1st Edition. Oxford publishers.



I Semester Syllabus

BIOTECHNOLOGY

(w.e.f. 2023-24 Admitted Batch)

23BSC12 INTRODUCTION TO APPLIED BIOLOGY

Hours/Week: 5

Credits: 4

Unit 1: Essentials of Microbiology and Immunology

- 1.1 History and Major Milestones of Microbiology; Contributions of Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.
- 1.2 Groups of Microorganisms– Structure and characteristics of Bacteria, Fungi, Archaea and Virus.
- 1.3 Applications of Microorganisms in– Food, Agriculture, Environment and Industry.
- 1.4 Immune system–Immunity, types of immunity, cells and organs of immune system.

Unit 2: Essentials of Biochemistry

- 2.1 Biomolecules I– Carbohydrates, Lipids.
- 2.2 Biomolecules II– Amino acids & Proteins.
- 2.3 Biomolecules III– Nucleic acids -DNA and RNA.
- 2.4 Basics of Metabolism– Anabolism and catabolism.

Unit 3: Essentials of Biotechnology

- 3.1 History, scope and significance of biotechnology. Applications of biotechnology in Plant, Animal, Industrial and Pharmaceutical sciences.
- 3.2 Environmental Biotechnology– Bioremediation and Biofuels, Biofertilizers and Biopesticides.
- 3.3 Genetic engineering– Gene manipulation using restriction enzymes and cloning vectors; Physical, chemical and biological methods of gene transfer.
- 3.4 Transgenic plants–Stress tolerant plants (bioticstress–BTcotton, abiotic stress–salt tolerance). Transgenic animals – Animal and disease models.

Unit 4: Analytical Tools and techniques in biology– Applications

- 4.1 Applications in forensics–PCR and DNA fingerprinting
- 4.2 Immunological techniques– Immuno blotting and ELISA.
- 4.3 Monoclonal antibodies–Applications in diagnosis and therapy.
- 4.4 Eugenics and Gene therapy.

Unit 5: Biostatistics and Bioinformatics

- 5.1 Data collection and sampling. Measures of central tendency –Mean, Median, Mode.
- 5.2 Measures of dispersion– range, standard deviation and variance. Probability and tests of significance.
- 5.3 Introduction, Genomics, Proteomics, types of Biological data, biological databases- NCBI, EBI, Gen Bank; Protein 3D structures, Sequence alignment
- 5.4 Accessing Nucleic Acid and Protein databases, NCBI Genome Workbench

REFERENCES

1. Gerard J., Tortora, Berdell R. Funke, Christine L. Case., 2016. Microbiology: An Introduction. 11th Edition. Pearson publications, London, England.
2. Micale, J. Pelczar Jr., E. C. S. Chan., Noel R. Kraig., 2002. Pelczar Microbiology. 5th Edition. McGraw Education, New York, USA.
3. Sathyanarayana. U, Chakrapani. U., 2013. Biochemistry. 4th Edition. Elsevier publishers.
4. Jain J. L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.
5. R. C. Dubey, 2014. Advanced Biotechnology. S. Chand Publishers, New Delhi, India.
6. Colin Ratledge, Bjorn, Kristiansen, 2008. Basic Biotechnology. 3rd Edition. Cambridge Publishers.
7. U. Sathyanarayana, 2005. Biotechnology. 1st Edition. Books and Allied Publishers pvt. ltd., Kolkata.
8. Upadhyay, Upadhyay and Nath. 2016. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.
9. Arthur M. Lesk. Introduction to Bioinformatics. 5th Edition. Oxford publishers.
10. A. P. Kulkarni, 2020. Basics of Biostatistics. 2nd Edition. CBS publishers.



II Semester Syllabus BIOTECHNOLOGY HONOURS (23BT21 MAJOR/MINOR)

(W.e.f. 2023-24 Admitted Batch)

BIOMOLECULES AND ANALYTICAL TECHNIQUES

Hours/week-3

Credits-3

Unit-I-Carbohydrates, Protein and Lipids

1. Classification, structure, properties of carbohydrates, amino acids, peptide bond and peptides.
2. Classification, Structure (primary, secondary, tertiary, quaternary) and functions of proteins. Denaturation and Renaturation of proteins.
3. Classification structure and properties of saturated and unsaturated fatty acids.

Unit-II- Nucleic acid, Vitamins, and Bioenergetics

1. Structure and functions of DNA and RNA.
2. Source, structure, biological role, and deficiency manifestation of vitamin A, B, C, D, E, and K. Free energy, entropy, enthalpy, and redox potential.
3. High energy compounds, Electron-Transport System and Oxidative Phosphorylation.

Unit-III-Centrifugation, Chromatography, and Electrophoresis

1. Basic principles of sedimentation and types of centrifugations.
2. Principle, instrumentation, and application of partition, absorption, paper, TLC, ion exchange, gel permeation, and affinity chromatography.
3. Basic principles and types of electrophoresis, factors affecting electrophoretic migration. PAGE (Native, SDS-PAGE). Introduction to 2D & Isoelectric Focusing.

Unit - IV-Spectroscopy, Microscopy and Laser Techniques

1. Beer-Lambert law, light absorption and transmission. Extinction coefficient, Design and application of photoelectric colorimeter and UV-visible spectrophotometer. Introduction to crystallography and application.
2. Types and design of Microscopes - compound, phase contrast, fluorescent electron microscopy (TEM, SEM).
3. Introduction to radioisotopes, measurement of radioactivity (scintillation counter and autoradiography)

Unit -V- Biostatistics

1. Mean, median, mode, standard deviation,
2. One-way ANOVA, Two-way Anova
3. t-test, F-test and chi-square.

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II Semester Syllabus (w.e.f. 20203-24 Admitted Batch)
23BT21P BIOTECHNOLOGY
PRACTICAL SYLLABUS

Hours/week-2

Credits-1

1. Introduction to basic instruments (Principle standard operation procedure) demonstration and record
2. Calculation of molarity, normality, and molecular weight of compounds.
3. Qualitative analysis of carbohydrates (sugars)
4. Quantitative analysis of carbohydrates
5. Quantitative estimation of protein - Lowery method
6. Estimation of DNA by Diphenylamine reagent
7. Estimation of RNA by Orcinol reagent
8. Assay of protease activity
9. Preparation of starch from potato and its hydrolyze by salivary amylase
10. Preparation of standard buffer and pH determination
11. Separation of amino acids by paper chromatography
12. Separation of lipids of TLC
13. Agarose gel electrophoresis
14. Calculation of mean, median and mode

REFERENCES

1. Outlines of Biochemistry, 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
2. Principles of Biochemistry, 4th edition, (1997), Jeffery Zubey; McGraw-Hill College, USA
3. Principles of Biochemistry, 5th Edition (2008), Lehninger, David Nelson & Michael Cox; W.H.Freeman and Company, NY
4. Fundamentals of Biochemistry, 3rd Edition (2008), Donald Voet & Judith Voet; John Wiley and Sons, Inc. USA
5. Biochemistry, 7th Edition, (2012), Jeremy Berg & Lubert Stryer; W.H.Freeman and Company, NY
6. An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGrawHill Edu. Pvt.Ltd. New Delhi, India
7. Biochemical Methods, 1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India
8. Textbook of Biochemistry with Clinical Correlations, 7th Edition, (2010), Thomas M. Devlin; John Wiley and Sons, USA
9. Proteins: biotechnology and biochemistry, 1st edition, (2001), Gary Walsch; Wiley, USA
10. Biochemical Calculations, 2nd Ed., (1997), Segel Irvin H; John Wiley and Sons, NY
11. Biophysical Chemistry Principles & Techniques Handbook, (2003), A. Upadhyay, K. Upadhyay, and N. Nath
12. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001), Palmer Trevor, Publisher: Horwood Pub. Co., England.
13. Analytical Biochemistry, 3rd edition, (1998), David Holmes, H. Peck, Prentice-Hall, UK
14. Introductory Biostatistics, 1st edition, (2003), Chap T. Le; John Wiley, USA.
15. Methods in Biostatistics, (2002), B. K. Mahajan –Jaypee Brothers.
16. Statistical methods in biology, (1995), Bailey, N. T.; Cambridge university press



II Semester Syllabus

BIOTECHNOLOGY

(w.e.f. 2023-24 Admitted Batch)

23BT22 MICROBIOLOGY, CELL BIOLOGY

Hours/week-3

Credits-3

Unit-I- Scope and Techniques of Microbiology

1. History and contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming.
2. Ultra structure of Bacteria and growth curve. Pure culture techniques.
3. Sterilization techniques, principles and application of physical methods (autoclave, hot air oven, incineration), chemical methods and radiation methods. Simple, gram and acid- fast staining.

Unit-II-Microbial Taxonomy and Metabolism

1. Concepts of microbial species and strains. Classification of bacteria based on morphology, nutrition and environment. General characteristics, transmission and cultivation of viruses.
2. Structure and properties of plant (Tobacco mosaic virus, TMV), animal (Newcastle disease virus, NDV), human (Human immunodeficiency virus, HIV) and bacterial viruses (T4 phage). Emerging and reemerging viruses (Dengue) and Zoonotic viruses (Rabies, SARS-CoV-2).
3. Microbial production of penicillin. Bacterial toxins, tuberculosis, typhoid. Introduction to fungi, algae and mycoplasma.

Unit-III- Cell Structure and Functions

1. Structure, properties and functions of cellular organelles (E.R, Golgi bodies, Mitochondria, Ribosomes, lysosomes, Nucleus) of eukaryotic cells.
2. Cell cycle and its regulation
3. Cell division (Mitosis and Meiosis).

Unit-IV- CELL SIGNALLING

1. Chemical composition and dynamic nature of the membrane,
2. Cell Surface Receptors
3. cell signaling and communication (GPCR . cAMP, cGMP, IP3-DAG)

Unit – V - Central Dogma of Molecular Biology

1. Genome organization of prokaryotic and eukaryotic organisms
2. Enzymes involved in Replication, Transcription, and Translation
3. DNA repair Mechanism

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II Semester Syllabus (w.e.f. 20203-24 Admitted Batch)
23BT22P BIOTECHNOLOGY
PRACTICAL SYLLABUS

Hours/week-2

Credits-1

1. Cleaning and preparation of glassware
2. Preparation of nutrient agar medium for bacteria
3. Preparation of PDA medium for fungi
4. Sterilization techniques (Autoclave, Hot air oven, Filter)
5. Isolation of bacteria from soil
6. Simple staining technique
7. Differential staining technique
8. Microbial counting by Haemocytometer
9. Identification of different bacteria
10. Motility test by hanging drop
11. Biochemical identification of bacteria
12. Preparation of pure culture by slab, slant, streak culture
13. Study of stages of cell division
14. Extraction and isolation of DNA from bacteria

REFERENCES

1. Microbiology–6th Edition, (2006), Pelczar M.J., Chan E.C.S., Krieg N.R.; The McGrawHill Companies Inc. NY
2. Prescott's Microbiology, 8th edition, (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton; McGrawHill Science Engineering, USA
3. Textbook of Microbiology, Anantnarayan and Paniker (2017)
4. Brock biology of microorganisms, 2003, Brock, T. D., Madigan, M. T., Martinko, J. M., & Parker, J.; Upper Saddle River (NJ): Prentice-Hall, 2003
5. Genes XI, 11th edition, (2012), Benjamin Lewin; Publisher - Jones and Barlett Inc. USA
6. Molecular Biology of the Gene, 6th Edition, (2008), James D. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R.; Cold Spring Harbour Lab. Press, Pearson Pub.
8. Molecular Biology, 5th Edition, (2011), Weaver R.; McGraw Hill Science. USA
9. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi; Oxford University Press.
10. Molecular Biology: Genes to Proteins, 4th edition (2011), Burton E Tropp Jones & Bartlett Learning, USA.
11. Cell and Molecular Biology: Concepts and Experiments, 6th Edition, Karp, G. 2010.; John Wiley & Sons. Inc.



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PENUGONDA-534 320, West Godavari District., (A.P.)

III Semester Syllabus

BIOTECHNOLOGY

Paper-III IMMUNOLOGY AND rDNA TECHNOLOGY (20BT3)

(W.e.f.2020-2021admittedBatch)

UNIT I:

Concepts, Cells and Organs of the Immune System: Terminology, antigen, hapten, antibody (types), antigenicity, immunogenicity and types of immunity. Innate and adaptive immunity. Hematopoiesis, organs, tissues, cells and mediators of the immune system (primary and secondary lymphoid organs, lymphocytes and cytokines). Introduction to complement components, MHC. Basic concepts of humoral and cell-mediated immuneresponse.

UNIT II:

Vaccinology and Clinical Immunology: Live, killed, attenuated, subunit and recombinant vaccines. Role and properties of adjuvants. Hybridoma technology, monoclonal antibodies and their application in immunodiagnosis. Antigen and antibody interactions - precipitation, agglutination, immune diffusion and ELISA. Introduction to hypersensitivity and autoimmunity.

UNIT III:

Introduction, Tools and Techniques of rDNA Technology: Introduction to rDNA technology, steps involved in cloning, tools of genetic engineering (Genes, Cloning vectors - plasmids and cosmids, Enzymes – restriction endonucleases and DNA Ligase, Hosts – bacteria and yeast). Principles and application of PCR. Southern, Northern and Western Blotting. Introduction to DNA sequencing (Sanger Sequencing) and Site-directed Mutagenesis.

UNIT IV:

Cloning Strategies and Application of rDNA Technology: rDNA library, construction, methods of transformation, recombinant selection and screening methods. Applications of rDNA technology in agriculture (transgenic plants, edible vaccines and antibodies) and medicine (disease diagnosis and DNA fingerprinting).

UNIT V:

Bioinformatics: Databases (PubMed, NCBI, EMBL and ExPASy), nucleotide and protein BLAST analysis, CLustal W and phylogenetic tree construction. Introduction to omics (proteomics, genomics and transcriptomics). Introduction to nanotechnology.



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III Semester Syllabus

BIOTECHNOLOGY

IMMUNOLOGY AND rDNA TECHNOLOGY LAB-(20BT3P)

List of Practical: -

1. Determination of Blood Groups
2. Pregnancytest
3. Widal test
4. Ochterloney immunodiffusion
5. Radial immunediffusion
6. ELISA
7. Production of antibodies (theory exercise)
8. Bleeding, separation of serum and storage
9. Lymphoid organs (theoryexercise)
10. Isolation of plasmid DNA (alkaline lysis method)
11. Analysis of plasmid DNA by Agarose gelelectrophoresis
12. Southern blotting (theory exercise)
13. PCR Amplification (theory exercise)

Recommended books:

1. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
2. Bioinformatics: 2004, A Practical Guide to the Analysis of Genes and Proteins, Andreas D. Baxevanis, B. F. Francis Ouellette, Wiley-Interscience

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IV Semester Syllabus**BIOTECHNOLOGY****PAPER IV PLANT AND ANIMAL BIOTECHNOLOGY (20BT4A)**

(w.e.f. 2020-21 Admitted Batch)

UNIT I:

Plant tissue culture techniques & secondary metabolites production: Plant tissue culture: totipotency, media preparation – nutrients and plant hormones; sterilization techniques; establishment of cultures – callus culture, cell suspension culture, applications of tissue culture-micro propagation; Somatic embryogenesis; synthetic seed production; protoplast culture and somatic hybridization - applications. Cryopreservation, Plant secondary metabolites- concept and their importance

UNIT II:

Transgenesis and Molecular markers: Plant transformation technology-- Agrobacterium mediated Gene transfer (Ti plasmid), hairy root features of Ri plasmid, Transgenic plants as bioreactors. Herbicide resistance –glyphosate, Insect resistance- Bt cotton, Molecular markers- RAPD, RFLP and DNA fingerprinting-principles and applications.

UNIT III:

Animal tissue culture techniques: Animal cell culture: cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, cell lines, stem cell cultures; Tests: cell viability and cytotoxicity, Cryopreservation. Transfection methods (calcium phosphate precipitation, electroporation, Microinjection) and applications.

UNIT IV:

Transgenic animals & Gene Therapy: Production of vaccines, diagnostics, hormones and other recombinant DNA products in medicine (insulin, somatostatin, vaccines), IVF, Concept of Gene therapy, Concept of transgenic animals – Merits and demerits -Ethical issues in animal biotechnology.

UNIT V:

Bioethics, Biosafety and IPR: Bioethics in cloning and stem cell research, Human and animal experimentation, animal rights/welfare. Bio safety-introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GLP, GMP, Introduction to IP-Types of IP: patents, trademarks & copyright.

RECOMMENDED BOOKS:

1. Introduction to Plant Tissue Culture.. M.K.Razdan, 2003, Science Publishers
2. Plant Tissue Culture, kalyan Kumar De, 1997, New Central Book Agency
3. Biotechnology – By U. Satyanarayana; 1997
4. Plant Cell, Tissue and Organ Culture, Applied and Fundamental Aspects By Y.P.S. Bajaj and A. Reinhard, 2001
5. Introduction to Plant Tissue Culture, M.K.Razdan, 2003, Science Publishers
6. A Textbook of Biotechnology, R C Dubey, S. 2014, Chand Publishing
7. Elements of Biotechnology, P.K.Gupta, 1994, Rastogi Publications
8. Daniel R. Marshak, Richard L. Gardner, David Gottlieb “Stem cell Biology” edited by Daniel 2001, Cold Spring Harbour Laboratory press, New York
9. M.M. Ranga, Animal Biotechnology; Agrobios (India), 2006.



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IV Semester Syllabus

BIOTECHNOLOGY

PAPER-IVB ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY (20BT4B)

(w.e.f. 2020-21 Admitted Batch)

UNIT I:

Pollution Types and Control: Environmental Biotechnology-Environmental Pollution: Types of pollution, air pollution & its control through Biotechnology, Biofilters, Bioscrubbers, Biotrickling filter. Water pollution and its management: Measurement of water, pollution, sources of water pollution. Microbiology of waste water treatment, aerobic processes, activated sludge, oxidation ponds, trickling filters, and rotating biological contactors. Anaerobic processes: Anaerobic digesters, upward flow anaerobic sludge blanket reactors.

UNIT II:

Bioremediation: Biodegradation and Bioremediation – Concepts & principles of Bioremediation, Bioremediation of Hydrocarbons and its applications Degradation of pesticides and other toxic chemicals by microorganism. Role of genetically Engineered microbes, Concept of Phytoremediation, , environmental safety guidelines.

UNIT III:

Biofuels: Biofuels-biogas, microbial groups involved in biogas production & interactions, factors affecting biogas production, Biofertilizers, Vermiculture.

UNIT IV:

Basic principles of Microbial technology: Industrially important microbes, its screening, selection and identification. Maintenance and preservation of industrially important microbial cultures. Strain Improvement, Basic concepts of fermentation; Design of fermenter and applications.

UNIT V:

Commercial Production of Microbial products: Microbial technology products and applications; Microbial production of Organic acids (Lactic acid, citric acid), Amino acids (Glutamic acid, Aspartic acid and Lysine). Fermentation by microbes for food additives: dairy products (Cheese, Yogurt), beverages (Beer,Wine) and antibiotics (Streptomycin, Penicillin)

RECOMMENDED BOOKS :

1. K. Vijaya Ramesh, Environmental Microbiology, 2004, MJP Publishers, Chennai.
2. A.G. Murugesan, C. Raja Kumari, Environmental Science & Biotechnology - Theory & Techniques, 2005, MJ Publishers
3. Environmental microbiology
By Raina M. Maier Ian L. Pepper & Charles
P. Gerba, 2000, Academic Press.
4. Environmental Chemistry, A.K. De. Wiley Eastern Ltd., 2001, New Delhi
5. Introduction of Biodeterioration, D. Allsopp and K.J. Seal,
ELBS/Edward Arnold, 2008
6. Power un seen: How microbes rule the world. By Dixon, B.
Freeman/Spectrum, 1994, Oxford.
7. Environmental Microbiology. By. Mitchell. R. Wiley, 1992, New York
8. Introduction to Environmental Sciences, Y. Anjaneyulu, 2004, BS Publications
9. Industrial Microbiology by A.H. Patel, 2009
10. Prescott & Dum (2002) Industrial Microbiology, Agrabios (India), 2005, Publishers
11. Creueger W. & Crueger A. A Text of Industrial Microbiology, 2000, 2nd
Edition, Panima Publishers Corp.



V Semester Syllabus

BIOTECHNOLOGY

(w.e.f. 2020-21 Admitted Batch)

TECHNIQUES IN NURSERY DEVELOPMENT (20BT5A1)

UNIT I: Introduction to Nursery

(10h)

Definition, objectives and importance. Basic requirements for a nursery layout and components of a good nursery. Types of nurseries. Bureau of Indian standards (BIS - 2008) related to nursery.

UNIT II: Nursery inputs

(10h)

Tools, implements and containers. Nursery media. Electricity, equipment and machinery management. Types of nursery beds and their preparations. Precautions and maintenance of nursery beds.

UNIT III: Seeds and Propagules

(10h)

Selection of seed and different sowing methods. Use of different plant parts for vegetative propagation to raise nursery. Different techniques of vegetative propagation.

UNIT IV: Management Practices

(10h)

Routine seasonal operations in a nursery. Supply of water, nutrients and removal of weeds. Identification of pests and diseases, control and prevention methods.

UNIT V: Grafting techniques

(10h)

Introduction to grafting, definition, types and tools for grafting. Steps involved in simple, splice graft, tongue graft, Whip graft, cleft graft and wedge graft. Grafting of horticultural & floricultural crops and applications.

REFERENCES:

1. Ratha Krishnan, M., *et al.* (2014) Plant Nursery
2. Management: Principles and Practices, Central Arid Zone Research Institute – ICMR, Jodhpur, Rajasthan.
3. Vikas Kumar, Anjali Tiwari, Practical manual of Nursery management, Agri – biotech Press, New Delhi.
4. Tarai Ranjan Kumar, (2020) Plant propagation and nursery management, New India Publishers.
5. P.K.Ray, (2020) Essentials of plant nursery management.
6. P.K.Ray, (2012) How to start and operate a Plant Nursery.

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V Semester Syllabus (w.e.f. 2020-21 Admitted Batch)
BIOTECHNOLOGY

BSc	Semester:V(SkillEnhancementCourse-Elective)	Credits:1
Course: 20BT5A1	Techniques in nursery development Lab	Hrs/Wk:2

1. Demonstration of different types of nurseries
2. Handling of nursery tools, equipment and types of containers
3. Laying of nursery bed with soil and compost
4. Seed collection, treatment and rising of seedlings on nursery bed
5. Handling of grafting and layering techniques in the nursery
6. Watering, weeding and management of nursery
7. Maintaining of the seedlings / cuttings in the nursery



V Semester Syllabus

BIOTECHNOLOGY

(w.e.f. 2020-21 Admitted Batch)

HYDROPONICS CULTIVATION 20BT5A2

UNIT I: Introduction to Soilless culture (10h)

Definition, History and origin of soilless culture, Present status of hydroponics-contrasts with soil based culture, Applications & future developments.

UNIT II: Macronutrients, micronutrients (10h)

Functions and effect on plants, deficiency symptoms of the following essential minerals N, P, Mg, Ca, K, S, Fe, Mn, Cu, Zn, B, Mo, Physical factors, light (Quantity, energy, photoperiodism *etc*), Temperature (Heating and cooling), Humidity, CO₂, ppm, pH and TDS.

UNIT III: Cultural conditions (10h)

Plant nutrition. Inorganic salts (fertilizers) major and minor nutrients formulating, monitoring and analysing. Selection of fertilizers, media used for hydroponics-expanded clay, rock wool, coir, perlite, pumice, vermiculite, sand gravel *etc*. Weed management, diseases and pest control.

UNIT IV: Techniques in hydroponics (10h)

Static solution culture, continuous-flow solution culture and aeroponics.

UNIT V: Cultivation of crop plants by hydroponics (10h)

Passive sub-irrigation, Ebb and flow or flood and drain irrigation. Deep water culture protocols for –Tomato cultivation through Dutch bucket method, chilly cultivation through NFT system, Spinach through raft System and measurements of yield.

REFERENCES:

1. Keith Roberto, *How to Hydroponics*. The future Garden Press New York.4th Edition
2. Howard M. Resh. *Hobby Hydroponics*. CRC Press, USA.
3. Prasad S and Kumar U. *Green House management for Horticultural crops*. Agro-Bios India.
4. Dahama A.K. *Organic Farming for Sustainable Agriculture*. Agrobios, India
5. Subba Rao N.S. (1995). *Biofertilizers in Agriculture and Forestry*. Oxford and IBH Publishing Company. Pvt. Ltd New Delhi.

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BSc	Semester:V(SkillEnhancementCourse-Elective)	Credits:1
Course: 20BT5A2	Hydroponics cultivation Lab	Hrs/Wk:2

1. Handling of tools required for hydroponic set up
2. Preparation of macronutrients and micronutrients solutions/stock cultures
3. Preparation of different media for hydroponic system.
4. Evaluating the effect of bio fertilizers on hydroponic cultivation
5. Weeding management techniques - demonstration
6. Demonstration of pests and diseases control and prevention methods
7. Cultivation of tomato by hydroponic system
8. Cultivation of chilli through hydroponic cultivation



V Semester Syllabus
BIOTECHNOLOGY
(w.e.f. 2020-21 Admitted Batch)
20BT5B1 ORGANIC FARMING

UNIT I: Soil: (10h)

Definition, soil formation, composition and characteristics. Types of soils. Distribution of soil groups in India. Acidic, Alkaline and heavy metal contaminated soil. Methods of reclamation. Effects of chemical dependent farming on yield and soil health.

UNIT II: Plant Nutrition (10h)

Macro and micro nutrients, functions of nutrients in plant growth and development. Nutrient uptake and utilization by plant. Types of fertilizers. Organic, inorganic and bio fertilizers. Chemical fertilizer. Advantages & disadvantages of their use. Importance of organic and bio fertilizers.

UNIT III: Organic Farming (10h)

Definition, concept, benefits. Integrated farming system (combination of organic and inorganic). Mixed farming system. Concept of different cropping systems in relation to organic farming, Inter cropping, crop rotation. Organic farming process. Organic fertilizers, crop nutrients and effective microorganisms in Organic farming.

UNIT IV: Organic compost (10h)

Definition, types of compost, farm yard compost, green leaf compost, animal husbandry, animal housing, animal feeding, animal health, breeding goals.

Vermi compost: Introduction, vermi composting material, species of earthworms, small scale, large scale composting process. Vermi castings, harvesting, processing and drying. Nutrient content of vermi compost. Field application methods.

UNIT V: Biofertilizers (10h)

Introduction, status and scope. Structure and characteristic features of bacterial bio fertilizers- *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*. Cynobacterial biofertilizers- *Anabaena*, *Nostoc*, *Hapalosiphon* and fungal biofertilizers- AM mycorrhiza and ectomycorrhiza. Mechanism of nitrogen fixation and phosphorus solubilization.

REFERENCES:

1. Principles of Organic Farming:: by E Somasundaram,DUdhayaNandhini,MMeyyappan;2021
2. Organic farming in India:: by Arpita Mukherjee; 2017
3. Biofertilizer and biocontrol agents for agriculture;; by AM Pirttilä · 2021
4. Trends in Organic Farming in India;; by S. S. Purohit, 2006
5. Biofertilizers for Sustainable Agriculture and Environment;; by BhoopanderGiri Ram Prasad, Qiang-Sheng Wu, Ajit Varma; 2019

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V Semester Syllabus (w.e.f. 2020-21 Admitted Batch)
BIOTECHNOLOGY

BSc	Semester:V(SkillEnhancementCourse-Elective)	Credits:1
Course:20BT5B1P	Organic Farming Lab	Hrs/Wk:2

1. Collection of different soil samples
2. Qualitative estimation of nitrogen, phosphorus and potassium in soil samples
3. Collection of fruit, vegetable and other domestic waste
4. Preparation of compost beds and introducing earthworms
5. Collection of vermi castings
6. Sieving, drying and packing of vermi compost
7. Visit to animal shed and observing farm yard manure production
8. Preparation of media and isolation of bio fertilizers



V Semester Syllabus
BIOTECHNOLOGY
(w.e.f. 2020-21 Admitted Batch)
20BT5B2- BIOFERTILIZERS AND BIOPESTICIDES PRODUCTION

UNIT I: Bio fertilizers (10h)

Introduction, history, concept, scope of bio fertilizers in India. Classification, microorganisms used as bio fertilizers. Bacterial, fungal and algal bio fertilizers. Symbiotic and a symbiotic microorganisms. Mechanism of nodulation and nitrogen fixation.

UNIT II: Mycorrhizal bio fertilizers (10h)

Importance, types, characteristic features of ecto and endo mycorrhiza. Mechanism of phosphorus solubilization. Uptake of phosphates by the roots. Consortium based inoculums and significance.

UNIT III: Bio pesticides (10h)

Definition, concept, history, scope and importance of biopesticides. Classification - botanicals, bacterial, fungal and viral based biopesticides. Mechanism of action of *Bacillus thuringiensis* and *Trichoderma viridaeas* bio control agents.

UNIT IV: Mass production techniques (10h)

Media, types, preparation. Methods of isolation, streak plate, spread plate and pour plate techniques, purification and identification of microorganisms used as bio fertilizers and bio pesticides. Mass production and packing techniques.

UNIT V: Field application methods (10h)

Preparation of carrier based inoculum. Sphagnum, peat, vermiculite as inoculums carriers. Dosage standardisation. Seed treatment, foliar application, root dressing and soil application techniques. Storage and maintenance of inoculum.

REFERENCES:

1. Biofertilizers: Commercial Production Technology and Quality Control, 2017 by Dr. P.Hyma
2. Biofertilizers Technology, 2010, by S.Kaniyan, K.Kumar and K. Govindarajan
3. Biofertilizers for Sustainable Agriculture, 2017; by Arun K Sharma
4. Advances In Plant Biopesticides 2021, by Dwijendra Singh, Springer India
5. A Textbook of Integrated Pest Management, 2013by Ram Singh & Vikas Jindal G.S. Dhaliwal

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V Semester Syllabus (w.e.f. 2020-21 Admitted Batch)
BIOTECHNOLOGY

BSc	Semester:V(SkillEnhancementCourse-Elective)	Credits:1
Course:20BT5BP	Biofertilizers and Biopesticides production Lab	Hrs/Wk:2

1. Preparation of Nutrient agar, YEMA, and PDA media
2. Isolation of *Rhizobium* from root nodules
3. Isolation of *Azotobacter* from soil samples
4. Isolation of *Trichoderma*
5. Gram staining of bacteria
6. VAM root staining
7. Raising of legume seedlings with *Rhizobium* treatment
8. Visit to commercial bio control units and Krishi seva Kendra



V Semester Syllabus
BIOTECHNOLOGY
(w.e.f. 2020-21 Admitted Batch)
APICULTURE -20BT5C1

UNIT I: Biology of Bees 10 hrs

History, Classification and Life Cycle of Honey Bees. Social Organization of Bee Colony.

UNIT II: Rearing of Bees 10 hrs

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth. Methods of Extraction of Honey (Indigenous and Modern).

UNIT III: Diseases and Enemies 10 hrs

Bee Diseases and Enemies. Control and Preventive measures.

UNIT IV: Economy and Entrepreneurship 10 hrs

Products of Apiculture Industry and its Uses (Honey, Bee Wax, Propolis) and Pollen.

UNIT V: Entrepreneurship in Apiculture 10 hrs

Bee Keeping Industry: Present and future, Role of Bees in cross pollination in horticulture and agriculture. Prospects of apiculture as self-employment venture.

REFERENCES:

1. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
2. Graham, J M (1992) The hive and the honey bee. Dadant and Sons, Hamilton, Illinois.
3. Mishra R.C. (1995) Honey bees and their management in India. ICAR Publication New Delhi.
4. Singh, S. (1971) Beekeeping in India, ICAR publication..
5. Bisht, D.S. (2004). Agricultural Development in India, Anmol Pub. Pvt. Ltd.
6. Singh S.(1964). Beekeeping in India, Indian council of Agricultural Research, NewDelhi
7. Mehrotra, K.N. Bisht, D.S. (1981). Twenty-five years of apiculture research at IARI. Apiculture in relation to agriculture.



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V Semester Syllabus (w.e.f. 2020-21 Admitted Batch)

BIOTECHNOLOGY

BSc	Semester:V(SkillEnhancementCourse-Elective)	Credits:4
Course: 20BT5C1	Apiculture Lab	Hrs/Wk:4

1. Handling of tools and techniques for Apiculture
2. To study the morphological and anatomical characteristics of queen and worker bees
3. Identification of different species of honey bees
4. Preparation of honey bee trays for beekeeping, maintenance and colony inspection
5. Extraction of honey and bee wax
6. Processing of honey, packing and storing
7. Identification of honey adulteration



V Semester Syllabus
BIOTECHNOLOGY
(w.e.f. 2020-21 Admitted Batch)
PEARL CULTURE 20BTC2

UNIT I: Overview of Pearl oyster (10h)

Biology of Pearl oyster: Pearl producing molluscs. Morphology and anatomy of Pearl oyster, Life cycle of pearl oyster.

UNIT II: Process of Pearl formation (10h)

Structure and Histology of mantle. Natural Process of Pearl formation. Chemical composition of Pearls. Economic importance of pearls.

UNIT III: Pearl oyster culture (10h)

Pearl oyster culture Techniques of pearl oyster culture (Fresh water and Marine water) for artificial production of pearls. Pearl culture techniques -Rafts, long lines, Pearls oyster baskets, under water platforms, mother oyster culture/Collection of oysters, rearing of oysters, Environmental parameters.

UNIT IV: Pearl Oyster surgery (10h)

Selection of Oyster, Graft tissue preparation, Nucleus insertion, Conditioning for surgery, Post-operative culture, harvesting of pearl, clearing of pearl.

UNIT V: Pearl culture Economy (10h)

Diseases and Predators of Pearl oysters' Present status, prospects and problems of pearl industry in India.

REFERENCES:

1. Haws Maria (2002). The basics of pearl farming: a Layman's manual: (U.S.A). CTSA publications.
2. Alexander E .Farn (1986) pearls :(U.S.A.).Butterworth Heinemann publications.
3. Le Jia Li (2014) new technologies to promote freshwater pearl culture (China) Ocean Press publications.
4. Bardach, J.E.W (1972) Aquaculture farming and husbandry of freshwater and Sorting of Pearl. Marketing and economics concerned with Pearl Culture. Generation marine organisms
5. David Dobilet (1995) Pearl farming (Australia) Nat Geographic Mag publication
6. Yuan Cha Da (2014) Environmental effects Pearl farming (China) Jiangxi People publishing house.

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V Semester Syllabus (w.e.f. 2020-21 Admitted Batch)
BIOTECHNOLOGY

BSc	Semester:V(SkillEnhancementCourse-Elective)	Credits:1
Course:20BTC2	Pearl Culture Lab	Hrs/Wk:2

1. Technique for measurement of soil and water
2. Culture technique of microorganism for pond maintenance. Surgical techniques
3. Graft tissue preparation, implantation techniques, post operation care
4. Designed pearl culture techniques, bleaching, collection of pearls, cleaning of pearls
5. Sorting of pearls, marketing of pearls.