



## Andhra Pradesh State Council of Higher Education

### B.Sc., Honours in BOTANY:MAJOR

w.e.f AY2023-24onwards

#### COURSE STRUCTURE

Year	Semester	Course	Title	No. Hrs./ Week	No. of Credits	
I	I	1	Introduction to Classical Biology	5	4	
		2	Introduction to Applied Biology	5	4	
	II	3	Non-vascular Plants –(T) Non-vascular Plants –(P)	3 2	3 1	
		4	Origin of Life and Diversity of Microbes –(T) Origin of Life and Diversity of Microbes –(P)	3 2	3 1	
II	III	5	Vascular Plants –(T) Vascular Plants –(P)	3 2	3 1	
		6	Plant Pathology and Plant Diseases –(T) Plant Pathology and Plant Diseases –(P)	3 2	3 1	
		7	Plant Breeding –(T) Plant Breeding –(P)	3 2	3 1	
		8	Plant Biotechnology –(T) Plant Biotechnology –(P)	2 3	1 3	
		9	Anatomy and Embryology of Angiosperms –(T) Anatomy and Embryology of Angiosperms –(P)	2 3	1 3	
	IV	10	Plant Ecology, Biodiversity and Phytogeography –(T) Plant Ecology, Biodiversity and Phytogeography –(P)	2 3 2	1 3 1	
		11	Plant Resources and Utilization –(T) Plant Resources and Utilization –(P)	3 2	3 1	
			Cell Biology and Genetics –(T) Cell Biology and Genetics –(P)	2 3	1 3	
	III	V	12	Plant Physiology and Metabolism –(T)	3	3
			13	Plant Physiology and Metabolism –(P)	2	1
			14 A	Organic Farming –(T) Organic Farming –(P)	3 2	3 1
				3	3	
			<b>OR</b>	2	1	
				3	3	
14 B			Seed Technology –(T)      Seed Technology –(P)	2	1	
15 A			Mushroom Culture Technology –(T) Mushroom Culture Technology –(P)	3 2	3 1	
			<b>OR</b>	3	3	
15 B			Plant Propagation Techniques –(T)			

		Plant Propagation Techniques–(P)	2	1
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VII & VIII semesters detailed Syllabus will be available in due course of time.

Semester	Course No. & Title of the course	Hours/ week (Th.)	No. credits (Th.)	Hours/ week (Pr.)	No. credits (Pr.)
VII Core Courses	16 (A) Plant Systematics (OR) 16 (B) Plant Developmental Biology 17 (A) Plant Molecular Biology	3	3	2	1
	(OR) 17 (B) Plant Genetic Engineering 18 (A) Crop Physiology	3	3	2	1
	(OR) 18 (B) Plant Biochemistry 19 (A) Phyto-medicines and Ethnobotany	3	3	2	1
VII Skill Enhanced Courses (SEC)	(OR) 19 (B) Herbal Technology 20 (A) Soil fertility and Conservation 20 (B) Agroforestry	3	3	2	1
	21 (A) Phyto-biodiversity and Conservation (OR) 21 (B) Phytochemistry and Pharmacognosy	3	3	2	1
VIII Core Courses	22 (A) Bioinformatics and Computational Biology (OR) 22 (B) Omics in Plant Science	3	3	2	1
	23 (A) Plant Cytogenetics (OR) 23 (B) Biostatistics and Intellectual Property Rights	3	3	2	1
	24 (A) Biofertilizers and Biopesticides (OR) 24 (B) Industrial and Environmental Biotechnology (OR) 25 (A) Gardening and Landscaping (OR) 25 (B) Floriculture	3	3	2	1
		3	3	2	1
VIII Skill Enhanced Courses (SEC)		3	3	2	1
		3	3	2	1

**Course: 1**                      **INTRODUCTION TO CLASSICAL BIOLOGY**

**Hours/Week: 5**

**Credits: 4**

### **Learning objectives**

The student will be able to learn the diversity and classification of living organisms and understand their chemical, cytological, evolutionary and genetic principles.

### **Learning Outcomes**

1. Learn the principles of classification and preservation of biodiversity
2. Understand the plant anatomical, physiological and reproductive processes.
3. Knowledge on animal classification, physiology, embryonic development and their economic importance.
4. Outline the cell components, cell processes like cell division, heredity and molecular processes.
5. Comprehend the chemical principles in shaping and driving the macromolecules and life processes.

### **Unit 1: 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

#### **Unit 4: 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, noncovalent – Vander Waals, hydrophobic, hydrogen bonds.

5.4. Green chemistry

#### **References**

1. Sharma O.P., 1993. Plant taxonomy. 2<sup>nd</sup> Edition. McGraw Hill publishers.
2. Pandey B.P., 2001. The textbook of botany Angiosperms. 4<sup>th</sup> edition. S. Chand publishers, New Delhi, India.
3. Jordan E.L., Verma P.S., 2018. Chordate Zoology. S. Chand publishers, New Delhi, India.
4. Rastogi, S.C., 2019. Essentials of animal physiology. 4<sup>th</sup> Edition. New Age International Publishers.
5. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.
6. Satyanarayana U., Chakrapani, U., 2013. Biochemistry. 4<sup>th</sup> Edition. Elsevier publishers.
7. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.
8. Karen Timberlake, William Timberlake, 2019. Basic chemistry. 5<sup>th</sup> Edition. Pearson publishers.
9. Subrata Sen Gupta, 2014. Organic chemistry. 1<sup>st</sup> Edition. Oxford publishers.

#### **ACTIVITIES:**

1. Make a display chart of life cycle of nonflowering plants.
2. Make a display chart of life cycle of flowering plants.
3. Study of stomata

4. Activity to prove that chlorophyll is essential for photosynthesis
5. Study of pollen grains.
6. Observation of pollen germination.
7. Ikebana.
8. Differentiate between edible and poisonous mushrooms.
9. Visit a nearby mushroom cultivation unit and know the economics of mushroom cultivation.
10. Draw the Ultrastructure of Prokaryotic and Eukaryotic Cell
11. Visit to Zoology Lab and observe different types of preservation of specimens
12. Hands-on experience of various equipment – Microscopes, Centrifuge, pH Meter, Electronic Weighing Balance, Laminar Air Flow
13. Visit to Zoo / Sericulture / Apiculture / Aquaculture unit
14. List out different hormonal, genetic and physiological disorders from the society

## I -Semester

**Course: 2**                      **INTRODUCTION TO APPLIED BIOLOGY**

**Hours/Week: 5**

**Credits: 4**

### **Learning objectives**

The student will be able to learn the foundations and principles of microbiology, immunology, biochemistry, biotechnology, analytical tools, quantitative methods, and bioinformatics.

### **Learning Outcomes**

1. Learn the history, ultrastructure, diversity and importance of microorganisms.
2. Understand the structure and functions of macromolecules.
3. Knowledge on biotechnology principles and its applications in food and medicine.
4. Outline the techniques, tools and their uses in diagnosis and therapy.
5. Demonstrate the bioinformatics and statistical tools in comprehending the complex biological data.

### **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
- 3.4. vectors; Physical, chemical, and biological methods of gene transfer.
- 3.5. Transgenic plants – Stress tolerant plants (biotic stress – BT cotton, 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 – Immunoblotting 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. 11<sup>th</sup> Edition. Pearson publications, London, England.
2. Micale, J. Pelczar Jr., E.C.S. Chan., Noel R. Kraig., 2002. Pelczar Microbiology. 5<sup>th</sup> Edition. McGraw Education, New York, USA.
3. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4<sup>th</sup> 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. 3<sup>rd</sup> Edition. Cambridge Publishers.

7. U. Sathyanarayana, 2005. Biotechnology. 1<sup>st</sup> 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. 5<sup>th</sup> Edition. Oxford publishers.
10. AP Kulkarni, 2020. Basics of Biostatistics. 2<sup>nd</sup> Edition. CBS publishers.

## **ACTIVITIES**

1. Identification of given organism as harmful or beneficial.
2. Observation of microorganisms from house dust under microscope.
3. Finding microorganism from pond water.
4. Visit to a microbiology industry or biotech company.
5. Visit to a waste water treatment plant.
6. Retrieving a DNA or protein sequence of a gene'
7. Performing a BLAST analysis for DNA and protein.
8. Problems on biostatistics.
9. Field trip and awareness programs on environmental pollution by different types of wastes and hazardous materials.
10. Demonstration on basic biotechnology lab equipment.
11. Preparation of 3D models of genetic engineering techniques.
12. Preparation of 3D models of transgenic plants and animals.

[**NOTE:** In the colleges where there is availability of faculty for microbiology and biotechnology, those chapters need to be handled by microbiology and biotechnology faculty. In other colleges, the above topics shall be dealt by Botany and Zoology faculty]

## II Semester

### Course 3: Non-Vascular Plants (Algae, Fungi, Lichens and Bryophytes)

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Credits -3

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**I. Learning Objectives:** By the end of this course the learner has:

1. To realize the characteristics and diversity of non-vascular plants.
2. To recognize the ecological and economic value of algae, fungi, lichens and bryophytes.
3. To inquire the habit, habitat, morphological features and life cycles of selected genera of non-vascular plants.

**II. Learning Outcomes:** On completion of this course students will be able to:

1. Compile the general characteristics of algae and their significance in nature.
2. Compare and contrast the characteristics of different groups of algae.
3. Summarise the important features of fungi and their economic value.
4. Distinguish the characteristics of different groups of fungi.
5. Elaborate the features and significance of amphibians of plant kingdom
6. Explain the diversity among non-vascular plants.

**III. Syllabus of Theory:**

**Unit-1: Introduction to Algae**

**8Hrs.**

1. General Characteristics of algae: Occurrence and distribution, cell structure, pigments, flagella and reserve food material.
2. Classification of algae: F.E.Fritsch (1935) and Lee (2008)
3. Thallus organization and life cycles in algae.
4. Ecological and economic importance of algae.

**Unit-2: Biology of selected Algae**

**10Hrs.**

1. Occurrence, structure, reproduction and life cycle of:
  - (a) Chlorophyceae: *Spirogyra* (b) Phaeophyceae: *Ectocarpus*
  - (c) Xanthophyceae: *Vaucheria* (d) Rhodophyceae: *Polysiphonia*
2. A brief account of Bacillariophyceae
3. Culture and cultivation of *Chlorella*

**Unit-3: Introduction to Fungi**

**8Hrs.**

1. General characteristics of fungi and Ainsworth (1973) classification.
2. Thallus organization and nutrition in fungi.

3. 4Reproduction in fungi (asexual and sexual); Heterothallism and parasexuality.

**Unit-4: Biology of selected Fungi**  
Ecological and economic importance of fungi.

1. Occurrence, structure, reproduction and life cycle of: **10Hrs.**

(a) Mastigomycotina: *Phytophthora* (b) Zygomycotina: *Rhizopus*

(c) Ascomycotina: *Penicillium* (d) Basidiomycotina: *Puccinia*

2. Occurrence, structure and reproduction of lichens; ecological and economic importance of lichens.

**Unit-5: Biology of Bryophytes** **9Hrs.**

1. General characteristics of Bryophytes; Rothmaler (1951) classification.

2. Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life cycle of

(a) Hepaticopsida: *Marchantia* (b) Anthocerotopsida: *Anthoceros*

(c) Bryopsida: *Funaria*

3. General account on evolution of sporophytes in Bryophyta.

**IV. Text Books:**

1. Pandey, B.P. (2013) College Botany, Volume-I, S. Chand Publishing, New Delhi

2. Hait,G., K.Bhattacharya & A.K.Ghosh (2011) A Text Book of Botany, Volume-I, New Central Book Agency Pvt. Ltd., Kolkata

**V. Reference Books:**

1. Fritsch, F.E. (1945) The Structure & Reproduction of Algae (Vol. I & Vol. II)  
Cambridge University Press Cambridge, U.K.

2. Bold, H.C.& M. J. Wynne (1984) Introduction to the Algae, Prentice-Hall Inc., New Jersey

3. Robert Edward Lee (2008) Phycology. Cambridge University Press, New York

4. Van Den Hoek, C., D.G.Mann & H.M.Jahns (1996)Algae : An Introduction to Phycology. Cambridge University Press, New York.

5. Alexopoulos, C.J., C.W.Mims & M.Blackwell (2007) Introductory Mycology, Wiley& Sons, Inc., New York

6. Mehrotra, R.S.& K. R. Aneja (1990) An Introduction to Mycology. New Age International Publishers, New Delhi.
7. Kevin Kavanagh (2005) Fungi; Biology and Applications John Wiley& Sons, Ltd., West Sussex, England.
8. John Webster & R. W. S. Weber (2007) Introduction to Fungi, Cambridge University Press, New York.
9. Shaw, A.J.& B.Goffinet (2000) Bryophyte Biology .Cambridge University Press, New York.

## VI. Suggested activities and evaluation methods:

**Unit-1: Activity:** collection from any water bodies in their locality, recording the characteristics, identification and classifying them according to Fritsch system.

**Evaluation method:** Evaluating the presentation or report summarizing findings.

**Unit-2: Activity:** Microscopic observations and recording distinguishing characters of any six algal forms excluding the genera in the syllabus.

**Evaluation method:** Conducting a Quiz or an exam/ evaluating the chart or drawings or summarized data on similarities and differences.

**Unit-3: Activity:** Collection or laboratory culture of fungi and reporting the important features.

**Evaluation method:** Evaluating the report/conducting JAM/Quiz/Group discussion.

**Unit-4: Activity:** Microscopic observations and summarizing the salient features of the fungal genera and lichen forms in the syllabus.

**Evaluation method:** Conducting a Quiz or an exam/ evaluating the chart or drawings or concise data on similarities and differences.

**Unit-5:** Collection, characterization, identification and classification of any four bryophytes from their native locality or college campus.

**Evaluation method:** Assessment of observations and documentation accuracy/presentation or report summarizing findings based on a rubric.

## II Semester

### Course 3: Non-vascular Plants (Algae, Fungi, Lichens, and Bryophytes)

Credits -1

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**I. Course Outcomes:** On successful completion of this practical course, student shall be able to:

1. Identify some algal and fungal species based on the structure of thalli and reproductive organs.
2. Decipher the lichens and Bryophytes based on morphological, anatomical and reproductive features.

### II. Laboratory/field exercises:

Study/ microscopic observation of vegetative, sectional/anatomical and reproductive structures of the following using temporary or permanent slides/ specimens/ mounts:

1. **Algae:** *Spirogyra*, *Ectocarpus*, *Vaucheria* and *Polysiphonia*; a centric and a pennate diatom.
2. Demonstration of culture and cultivation of *Chlorella*
3. Identification of some algal products available in local market.
4. **Fungi:** *Phytophthora*, *Rhizopus*, *Penicillium* and *Puccinia*
5. Identification of some fungal products available in the local market.
6. **Lichens:** Crustose, foliose and fruticose
7. **Bryophyta:** *Marchantia*, *Anthoceros* and *Funaria*.

**II Semester**  
**Course 4: Origin of Life and Diversity of Microbes**  
Credits -3

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**I. Learning Objectives:** By the end of this course the learner has:

1. To get awareness on origin and evolution of life.
2. To understand the diversity of microbial organisms.
3. To get awareness on importance of microbes in nature and agriculture.

**II. Learning Outcomes:** On completion of this course students will be able to:

1. Illustrate diversity of viruses, multiplication and economic value.
2. Discuss the general characteristics, classification and economic importance of special groups of bacteria.
3. Explain the structure, nutrition, reproduction and significance of eubacteria.
4. Evaluate the interactions among soil microbes.
5. Compile the value and applications of microbes in agriculture.

**III. Syllabus of Theory:**

**Unit-1: Origin of life and Viruses**

**10 Hrs.**

1. Origin of life, concept of primary Abiogenesis; Miller and Urey experiment.; discovery of microorganisms, Pasteur experiments, germ theory of diseases.
2. Five kingdom classification of R.H. Whittaker
3. Shape and symmetry of viruses; structure of TMV and Gemini virus.
4. Multiplication of TMV; A brief account of prions, viroids and virusoids; Transmission of plant viruses and their control.
5. Significance of viruses in vaccine production, bio-pesticides and as cloning vectors.

**Unit-2: Special groups of Bacteria**

**7 Hrs.**

1. General characteristics, outline classification and economic importance of following special groups of bacteria:
  - a) Archaeobacteria
  - b) Chlamydiae
  - c) Actinomycetes
  - d) Mycoplasma
  - e) Phytoplasma
  - f) Cyanobacteria
2. Culture and cultivation of *Spirulina*

**Unit-3: Eubacteria**

**8 Hrs.**

1. Occurrence, distribution and cell structure of eubacteria.
2. Classification of Eubacteria based on nutrition.
3. Reproduction- Asexual (Binary fission and endospores) and bacterial recombination (Conjugation, Transformation, Transduction).
4. Economic importance of Eu-bacteria with reference to their role in Agriculture and industry (fermentation and medicine).

**Unit-4: Soil microbes – interactions**

**10Hrs.**

1. Distribution of soil microorganisms in soil.
2. Factors influencing the soil microflora - Role of microorganisms in soil fertility.
3. Interactions among microorganisms, mutualism, comensalism, competition, amensalism, parasitism, predation.
4. Microorganisms of rhizosphere, phyllosphere and spermophere; microbial interactions and their effect on plant growth.

**Unit-5: Microbes in agriculture**

**10 Hrs.**

1. Mass production, mode of applications, advantages and limitations of bacterial inoculants (*Rhizobium*, *Azotobacter*, *Azospirillum*, Cyanobacteria).
2. Role of Frankia and VAM in soil fertility.
3. Microbial biopesticides: mode of action, factors influencing, target pests; microbial herbicides.

**IV. Text Books:**

1. Bhattacharjee, R.N., (2017) Introduction to Microbiology and Microbial Diversity, Kalyani Publishers, New Delhi.
2. Dubey, R.C. & D. K. Maheswari (2013) A Text Book of Microbiology, S.Chand & Company Ltd., New Delhi
3. Toshniwal, R.L. (2007) Agricultural Microbiology, Agrobios (India), Jodhpur

**V. Reference Books:**

1. Pelczar Jr., M.J., E.C.N. Chan & N. R. Krieg (2001) Microbiology, Tata McGraw- Hill Co, New Delhi
2. Presscott, L. Harley, J. and Klein, D. (2005) Microbiology, Tata McGraw –Hill Co. New Delhi.

3. Gyaneshwar, A.D., G.J. Parekh, and V.S. Reddy (2004) Agricultural Microbiology: Plant-Soil Interactions, Research Signpost, Kerala, India
4. Zaki A. Shuler and Zainul Abid (2014) Agricultural Microbiology: Principles and Applications, CRC Press, Boca Raton, Florida, USA

#### **VI. Suggested activities and evaluation methods:**

**Unit-1: Activity:** Collecting scientific literature on historical developments in microbiology.

**Evaluation method:** Evaluating the report based on a rubric. **Unit-2: Activity:** Group discussion on various groups of special bacteria. **Evaluation method:** Assessment of active participation, soft skills, communication skills, collaborative skills, time management etc., of a group or a student based on a rubric. **Unit-3: Activity:** Presentation or poster summarizing the classification of Eu-bacteria based on nutrition. **Evaluation method:** Assessment based on accuracy and understanding. **Unit-4: Activity:** Microscopic observation of bacterial samples from soil/ phylloplane in their native place/ college campus. **Evaluation method:** Evaluating the report on characteristics and classification of

eubacteria.

**Unit-5: Activity:** Culture and mass production of bioinoculants.

**Evaluation method:** Skills performed in establishing the culture and mass production.

## II Semester

### Course 4: Origin of Life and Diversity of Microbes

Credits -1

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**I. Course Outcomes:** On successful completion of this practical course, student shall be able to:

1. Take all necessary precautions in the microbiology laboratory.
2. Handle the instruments and prepare media for laboratory work.
3. Identify various microbes through microscopic observations

**II. Laboratory/Field exercises:**

1. Microbiology good laboratory practices and biosafety.
2. Study the principle and applications of important instruments (autoclave, hot air oven, incubator, Inoculation loop, Inoculation needle, membrane filter, laminar air flow system, colony counter, biological safety cabinets, BOD incubator, pH meter) used in the microbiology laboratory.
3. Study of Viruses (Gemini and TMV) using electron micrographs/ models.
4. Gram staining technique of Bacteria.
5. Microscopic study of Cyanobacteria using temporary/permanent slides.
6. Microscopic study of Eubacteria using temporary/permanent slides.
7. Study of Archaeobacteria and Actinomycetes using permanent slides/ electron micrographs/diagrams.