



**DEPARTMENT OF BIOSCIENCES**  
SAURASHTRA UNIVERSITY  
RAJKOT - 360 005

## SYLLABUS

### 1. INTRODUCTION

The **Department** was established on June 21, 1969 by the eminent scholar and Ecologist, **Professor S.C. Pandeya** (1969-1988), to run a unique course of M.Sc., in Integrated Biology for the first time in Asia. Later, Professor R.M. Naik, the well known Ornithologist, took over the charge of the Department (1988-1991) and introduced M.Sc. Course in Microbiology. The main thrust area of the Department is **Environmental Sciences**; however, specialization in other areas of Biological Sciences are fully taken care of.

Owing to the current need, a change in the M.Sc. Integrated Biology Course has been made in the year 1994, in which courses are diversified into three streams, viz., **Animal Sciences, Plant Sciences** and **Microbiology**.

Besides the above post-graduate courses, facilities for M.Phil. and Ph.D. are available. The Department is recognised as **Department of Special Assistance (DSA)** by the University Grants Commission in the year 1986. Advanced research facilities are available in the Department. More than **100** students have obtained their **Ph.D. Degree** from this Department.

### 2. THE COURSE

The M.Sc. Courses in Biosciences (Animal Sciences/Plant Sciences/ Microbiology) is a full time curriculum, run for 2 years, spread over 4 semesters, with three theory Papers and three corresponding practicals in each semester. A semester will be of about 100 working days. At the starting of Semester-III, students will be offered a project work (Dissertation) which is partfulfilment for the degree and to be submitted at the end of the fourth semester.

#### 2.1 STUDY TOUR

Every student is required to go on study cum collection tours, and the **tours are compulsory**. The students shall make Tour Reports and submit them during the IV semester Examination for their evaluation.

## 2.2 SEMINARS

Regular seminars will be organised on every working Saturday and it is compulsory for all the students to attend and present their studies. For each seminar, a student will be given marks, the average of which will be added to their final examination marks.

## 2.3 ATTENDANCE

Students admitted to this Department will have to attend all the Lectures, Practicals and Seminars. A minimum of 80% attendance is required to sanction a term. Students whose terms are not granted will not be allowed to appear at the examination, and will have to join the same semester the following year.

## 2.4. EXAMINATIONS

At the theory examinations, there shall be one question from each of the units with an internal option and all the questions will be compulsory. Examinations will be held at the end of each semester. The semester wise distribution of the courses and papers are as follows:

### SEMESTER-I:

AS/PS/MICRO-1: Cell Biology

AS/PS/MICRO-2: Molecular Genetics and Evolution

AS/PS/MICRO-3: Biochemistry

### SEMESTER-II:

AS/PS/MICRO-4: Biotechnology and Radiation Biology

AS/PS/MICRO-5: Environmental Science

AS/PS/MICRO-6: Bio-statistics, Computer and Instrumentation

### SEMESTER-III: Animal Sciences

AS-7: General Zoology-I (Invertebrates & Chordates)

AS-8: General Zoology-II (Anatomy, Histology & Physiology)

AS-9: General Zoology-III (Embryology, Behaviour & Distribution of Chordates)

### SEMESTER-IV: Animal Sciences

AS-10: Basic Neurobiology

AS-11: Wildlife Biology

AS-12: Fisheries Biology

### SEMESTER-III: Plant Sciences

PS-7: Diversity of plant life-I (Cryptogams & Gymnosperms)

PS-8: Diversity of plant life-II (Plant Taxonomy and Geography)

PS-9: Plant Ecology

**SEMESTER-IV: Plant Sciences**

PS-10: Diversity of plant life-III (Plant Anatomy, Morphogenesis, and Embryology)

PS-11: Plant Physiology

PS-12: Applied Plant Sciences

**SEMESTER-III: Microbiology**

MICRO-7: Molecular Microbiology and Genetics

MICRO-8: Molecular Cytology and Taxonomy of Microorganisms

MICRO-9: Microbial Physiology and Metabolism

**SEMESTER-IV: Microbiology**

MICRO-10: Microbial Ecology and Biotechnology of waste treatment

MICRO-11: Biotechnology-2 (Fundamentals of Fermentation Technology)

MICRO-12: Biotechnology-3 (Microbial Fermentation and Application)

**2.4.1 SEMESTERWISE DISTRIBUTION OF MARKS:****SEMESTER-I:**

3 Papers (75 Marks each)	: 225	
3 Practicals (50 Mark each)	: 150	<b>375</b>

**SEMESTER-II:**

3 Papers (75 Marks each)	: 225	
3 Practicals (50 Mark each)	: 150	<b>375</b>

**SEMESTER-III:**

3 Papers (60 Marks each)	: 180	
3 Practicals (50 Mark each)	: 150	<b>330</b>

**SEMESTER-IV:**

3 Papers (60 Marks each)	: 180	
3 Practicals (50 Mark each)	: 150	<b>330</b>

Tour Reports	: 40	
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Class seminars	: 50	
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M.Sc. Dissertation	: 100	<b>190</b>
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<b>Grand Total</b>	<b>:</b>	<b>1600</b>
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Students are required to apply in the prescribed application form for appearing at the examination along with the necessary examination fees on the date to be notified by the University.

### 3.0 ADMISSION

Academic year of the University begins from June 23. The lectures and practicals of the third semester will start immediately. The same for the first semester will commence immediately following admissions.

#### 3.1 Eligibility:

Any student who has taken B.Sc. degree with at least a II class (48%) by first trial, will be eligible for admission to M.Sc. course according to their respective stream, viz., Animal Sciences (Zoology), Plant Sciences (Botany) and Microbiology. Students, who have cleared B.Sc. with the above subjects, as the second subject at S.Y. B.Sc. will also be considered for admission, provided the seats are vacant. A total of 10 seats are available in each of the streams; students will be admitted as per the reservation policy in effect from time to time.

Students applying for admission should attach certified true copies of their B.Sc. examination mark sheets and passing certificate. They have to submit Transfer Certificate from the college last attended by them, in case they are students of the Saurashtra University.

Candidates coming from Universities other than Saurashtra University have to submit Eligibility Certificate, immediately on obtaining admission, followed by submission of Transfer/ Migration Certificate.

**The M.Sc. courses run by this Department are full time studies and as such, a student admitted to the Department is not allowed to join any other courses or study or take up any service.**

Limited number of seats in the University Hostel will be available to the students admitted to the Department, and for this, desirous students will have to apply in prescribed form available from the Rector of the Hostels.

Some scholarships and freships are awarded to the students as per the University Rules.

Last date for receiving the application forms and the date and time of Admission Interview are shown in the application form. They should bring all the original mark sheets, certificates etc. at the time of the interview.

#### 3.2 Fee Schedules :

Semester-I : Total fee **Rs. 1180/- (for Girl Students Rs. 680/-)**

Subsequent semesters: Total fee **RS. 830/- (for Girl Students Rs. 330/-)**

- This does not include Examination Fees.
- The fees are to be paid in the Department Office on the day of admission.
- This is subject to change by the University from time to time

**3.3** Students admitted to the first semester in each of the streams will have to get registration as post-graduate students of this University. No transfer will be given to any student once registered for a particular stream.

#### **4. M.Sc. ORDINANCES AND RULES:**

##### **(a) Ordinances :**

**O. M.Sc. 1. :** Candidate for the Examination for the Degree of Master of Science must have :

- (i) Obtained the degree of Bachelor of Science of this University or a Degree recognised as equivalent there to, at least with second class.
- (ii) Passed in all papers including practicals, if any, prescribed by the relevant Board of Studies from time to time, for each of the two examinations held at the end of the second and fourth terms, i.e., M.Sc. Part-I and M.Sc. Part-II respectively for the degree of Master of Science, after keeping required minimum attendance as laid down in that behalf.

**O. M.Sc. 2. :** To pass the whole M.Sc. Examination, student should clear M.Sc. Part-I and Part-II examinations within a period of five years from the date of his registration. He shall be required to register himself as a fresh candidate and keep the attendance and appear and pass Part-I and Part-II Examinations afresh from first term onwards in order to obtain the degree of Master of Science.

**O. M.Sc. 3. :** No candidate for the M.Sc. Degree Examination can select a subject other than the one offered by him as a special subject at the M.Sc.(Sp.) Examination or as a principal subject at the B.Sc. Degree Examination.

**O. M.Sc. 3-A. :** A candidate can select a subject which he had offered as either Principal or Subsidiary, at B.Sc. level (Botany/ Zoology/ Microbiology) and shall be eligible for admission to M.Sc. in respective subject of Plant Sciences, Animal Sciences and Microbiology, in the Department of Biosciences of this University.

**O. M.Sc. 5. :** A candidate who has passed the M.Sc. Examination of this University in one specialization of the subject will be permitted, on submission of a new application and payment of a fresh fee, to appear in the other specialization of the same subject provided, he keeps two fresh terms in the specialization of the subject for the M.Sc. Examination.

Provided further, that the marks obtained by the candidate in the Previous Examination of M. Sc. Part-I/ Semesters I & II will be carried forward in the total marks in the new specialized subject and the class will be awarded accordingly but, he shall not be eligible for a prize, Scholarship or any other Award at the Examination.

**(Note :** In the Ordinance M. Sc. Part-I & M. Sc. Part-II are M. Sc. Semesters I, II & M. Sc. Semesters III, IV respectively).

**(b) Rules :**

**R. M. Sc. 4. :** A candidate shall be allowed to keep attendance for all the four terms irrespective of the fact that he/she has appeared or not at any of the Examinations of Part-I or Part-II. A candidate whose term is not granted, for whatsoever reason, shall be required to keep attendance for that term when the relevant papers are actually taught at the centres.

**R. M. Sc. 5. :**

1. To pass the M. Sc. degree examination a candidate shall be required to obtain, separately, not less than 40% of the total marks obtainable, separately in (a) each paper, and (b) practicals, if any and Viva-voce examination, if any.
2. Classes shall be awarded at the M. Sc. degree in the manner specified herein below, namely:
  - (a) Successful candidates who obtained not less than 70 per cent of the total marks obtainable in the aggregate at the Part-I and Part-II examinations shall be placed in the First Class with Distinction.
  - (b) A successful candidate who obtained less than 70 per cent but not less than 60 per cent of the total marks obtainable in the aggregate at the Part-I and Part-II examinations shall be placed in the First Class.
  - (c) A successful candidate who obtained less than 60 per cent but not less than 48 per cent in the aggregate at the Part-I and Part-II examinations shall be placed in the Second Class.

**R. M. Sc. 6. :** To pass M. Sc. Part-I and Part-II Examinations a candidate must obtain not less than 40 per cent of the total marks obtainable in (a) each paper and (b) Practical, if any and (c) Viva-voce examination, if any.

**O. 145-B :** " However, the candidate with M. Sc. Experimental Biology, Plant Botany or Plant Science, Bioscience, Animal Science be considered at par with M. Sc. Botany or Zoology according to either of the subjects which the candidate offered at B. Sc. level as Principal subject".

**Syndicate Resolution :** Ref: BF/2/AC/7/7/6/Syndicate/2/20/7/421/96 dated 10-10-1996.

**Modification of Ordinance 145-B :** " In view of the 3 main subjects under which M. Sc. Courses are currently run in the Bio-Sciences Department of this University, i.e. Plant Sciences, Animal Sciences and Microbiology, the Master Degree in these subjects should be treated as equivalent to M.Sc. Botany, M. Sc. Zoology and M. Sc. Microbiology, respectively, for the purpose of appointment of Teaching Staff in the University P.G. Departments or any other affiliated colleges".

## 5. Our Faculty :

Name	Designation	Research Fields
Dr. V. C. Soni	Professor	Wildlife & Behavioural Ecology, Ornithology, Animal Biodiversity
Dr. S. P. Singh	Professor & Head	Microbiology, Extremophiles, Protein Engineering
Dr. A. N. Pandey	Associate Professor	Desert Ecology & Plant Ecology
Dr. Vrinda S. Thaker	Associate Professor	Plant Physiology, Plant Biotechnology & Tissue Culture, Medicinal Plants
Dr. Sumitra V. Chanda	Associate Professor	Plant Physiology, Biochemistry & Pharmacology
Dr. Rahul Kundu	Associate Professor	Animal Physiology & Toxicology, Coastal Ecology, Fisheries Biology
Dr. S. J. Pathak	Assistant Professor	Environmental Microbiology, Environmental Science, Degradation of Xenobiotics
Dr. B. R. M. Vyas	Assistant Professor	Microbiology, Degradation of Xenobiotics
Ms. Varsha M. Trivedi	Assistant Professor	Arachnology & Insect Biology, Avian Biology
Dr. P. P. Sood ( Retired Professor)	ICMR Emeritus Scientist	Neurobiology & Toxicology, Hypertension and Therapy

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## M. Sc. Syllabus

### AS/PS/MICRO-1 : Cell Biology

#### Unit-1

- 1.1 Basic principle and working of electron microscope and its application in cell study
- 1.2 Cell concept, principle level of organization, basic differences in structural organization in Prokaryotes and Eukaryotes
- 1.3 Cellular chemistry : molecules and ions, chemical bonds, legands, chelates
- 1.4 Structural organization of plasma membrane
- 1.5 Membrane and cytoplasmic receptors and their mode of action, Secondary messenger (hormon-mediated message adenylate cyclase, protein kinase and G protein)

#### Unit-2

- 2.1 Intracellular junction, tight junction, intermediate junction, spot desmosome, gap junctions, plasmodesmata
- 2.2 Cell coat in animals and their functions
- 2.3 Plant cell wall: its ultra structure and function
- 2.4 Phenomenon of exocytosis and endocytosis
- 2.5 Endoplasmic reticulum: structure, chemical nature and function
- 2.6 Golgi apparatus: structure, chemical nature and function

#### Unit-3

- 3.1 Chloroplast: ultrastructure and function
- 3.2 Mitochondria: structure, morphogenesis, chemical nature and functions
- 3.3 Cell differentiation and cell-cell interactions
- 3.4 Lysosomes: structure, chemical nature, concept of suicide bag
- 3.5 Physiological and pathological functions of lysosomes
- 3.6 Peroxisomes and Glyoxisomes - structure, chemical nature & functions

#### Unit-4

- 4.1 Light and electron microscopic sturcture of chromosome and recent chromosomal model
- 4.2 Polytene chromosome, salivary gland and lampbrush chromosomes and their importance
- 4.3 Nucleus and nucleolus : Ultra structure, chemical nature, nucleolar chromosome, nucleolar and their fates
- 4.4 Nuclear envelop: ultrastructure, chemical nature, transport of material and pore complex
- 4.5 Nuclear-cytoplasmic relationship
- 4.6 GERL system and its role in intra-cellular secretion

#### Unit-5

- 5.1 Principle and application of phase contrast microscope
- 5.2 Principle and application of fluorescence microscope
- 5.3 Principle and application of scanning electron microscope
- 5.4 Cytometry and fluorimetry
- 5.5 Autoradiography and its application
- 5.6 Fixation and staining techniques in brief

**AS/PS/MICRO-2 : Molecular Genetics and Evolution****Unit-1. Gene structure and function**

- 1.1 Gene structure
- 1.2 Regulation of gene expression : gene amplification, sequencing and rearrangement
- 1.3 Genetic code, transcription : translation, DNA methylation
- 1.4 Post-translation modification and transport of protein
- 1.5 Signal hypothesis, protein targetting
- 1.6 Environmental control of gene expression

**Unit-2. DNA as a hereditary material**

- 2.1 Structural differences in prokaryotic and eukaryotic DNA
- 2.2 DNA constancy
- 2.3 DNA replication
- 2.4 Cell cycle : mitosis/meiosis
- 2.5 m-RNA; splicing, intron, exons, capping, polyadenylation, antisense RNA
- 2.6 DNA damage and repair

**Unit-3. Genome organization, mutation & cytoplasmic inheritance**

- 3.1 Genome organization: structure of chromatin, heterochromatinization
- 3.2 C-value paradox
- 3.3 Molecular basis of spontaneous and induced mutations
- 3.4 Chromosomal aberration
- 3.5 Linkage and genetic (chromosome) mapping
- 3.6 Extrachromosomal inheritance

**Unit-4. Population Genetics**

- 4.1 Principles of Mendelian genetics
- 4.2 Hardy-Weinberg genetic equilibrium
- 4.3 Factors affecting gene frequency - Natural selection
- 4.4 Genetic polymorphism
- 4.5 Intracellular flows of genetic instructions
- 4.6 Genetic drift

**Unit-5. Origin of life and organic evolution**

- 5.1 Origin of life : coacervates, Miller's experiment
- 5.2 Biodiversity and concepts of evolution
- 5.3 Modern taxonomy : chemosystematics, etc., Principles of classification; artificial, natural & classifications, cladogenesis, phenetic versus phylogenetic classification
- 5.4 Theories of organic evolution
- 5.5 Mechanism of speciation
- 5.6 Distinctiveness of species, naming of species, Darwin's view of species, biological species concept, allopatric, parapatric and sympatric species

**AS/PS/MICRO-3 : Biochemistry****Unit-1**

- 1.1 Biochemistry : Its scope and principles; atoms, molecules and chemical bonding, elements, and biospheres- occurrence and distributions of elements
- 1.2 Biomolecules: sugars and aminosugars
- 1.3 Polysaccharides
- 1.4 Nucleotides
- 1.5 Amino acids

**Unit-2**

- 2.1 Biopolymers: their conformation and configuration
- 2.2 Proteins: primary structure
- 2.3 Proteins: secondary, tertiary and quaternary structure
- 2.4 Vitamins
- 2.5 Lipids

**Unit-3**

- 3.1 Bioenergetics: Basic laws of thermodynamics
- 3.2 High energy compounds in living systems
- 3.3 Redox reactions
- 3.4 Phosphorylation in living systems
- 3.5 Electron transport chain

**Unit-4**

- 4.1 Biocatalyst: The enzymes, nature and their general properties
- 4.2 Nomenclature and classification
- 4.3 Principles and mechanism of enzyme catalysis
- 4.4 Enzyme kinetics
- 4.5 Enzyme inhibition

**Unit-5**

- 5.1 Metabolism and metabolic pathways
- 5.2 Pathways of carbohydrate metabolism
- 5.3 The Krebs cycle
- 5.4 Regulation of metabolic pathways
- 5.5 Allosteric proteins

**AS/PS/MICRO-4 : Biotechnology****Unit-1**

- 1.1 Basic understanding and historical development
- 1.2 Microbes and Biotechnology
- 1.3 General characteristics of microorganisms
- 1.4 Harvesting the metabolic potentials of microbes for industrial production
- 1.5 Biomass and single cell proteins, antibiotics and amino acids

## 1.6 Techniques of immunization of enzymes and cells, and their applications

### Unit-2

- 2.1 Basics of genetic engineering and parasexual reproduction in prokaryotes
- 2.2 Gene targeting
- 2.3 DNA isolation techniques
- 2.4 Restricted enzymes
- 2.5 Vectors : plasmids, cosmids and phages
- 2.6 Host-vector system

### Unit-3

- 3.1 Recombinant DNA technology
- 3.2 Applications : (a) crop improvement, (b) Antibiotics, (c) Degradation of Xenobiotics,
- 3.3 Applications : (a) Vaccines, (b) Human proteins, (c) Gene therapy, (d) Embryo transfer and Animal Husbandry
- 3.4 Principles and techniques of tissue culture
- 3.5 Cell and tissue cultures in plant and animals
- 3.6 Tissue culture and production of secondary metabolites

### Unit-4

- 4.1 Radiation Biology and types of Radiation
- 4.2 Units and measurements of radiation doses
- 4.3 Radiation effects on biological components of ecosystems
- 4.4 Fall out problem and disposal of radioactive wastes
- 4.5 Applications of Tracers in biology: Radioisotopes, their half-time and biological utility
- 4.6 Liquid scintillation spectrometry and its importance

### Unit-5

- 5.1 Antigen-Antibody: Structure of molecules of immunoglobulin, antigen- antibody Complex, of antigen-antibody binding
- 5.2 Immunological memories and adjuvants
- 5.3 Immunological regulators, Body immune system, Innate and adaptive immune system
- 5.4 T-cell receptors, delayed and immediate hypersensitive reactions, autoimmunity
- 5.5 Hybridoma technology, monoclonal antibodies, ELISA test and Epitopes
- 5.6 Immune response and malignant growth

## AS/PS/MICRO-5 : Environmental Science and Analytical Techniques

### Unit-1

- 1.1 Basic concepts of environmental science and ecology
- 1.2 Concepts of ecosystem: abiotic and biotic components and processes
- 1.3 Principles of limiting factors
- 1.4 Concepts of productivity
- 1.5 Food chain, food web, trophic levels, ecological efficiency and ecological pyramids

**Unit-2**

- 2.1 Development and evolution of ecosystem
- 2.2 Types of ecosystems and biomes of the world
- 2.3 Biogeochemical cycles (general concept)
- 2.4 Atmosphere: general introduction
- 2.5 Physico-chemical nature of atmosphere

**Unit-3**

- 3.1 The Hydrosphere: Basics and hydrobiological parameters
- 3.2 Aquatic ecosystem
- 3.3 Lithosphere : Composition of the Earth's crust and types of rocks
- 3.4 Soil formation and development
- 3.5 Soil components

**Unit-4**

- 4.1 Environmental management and planning
- 4.2 Environmental assesment (EA)-Enviromental Impact Assessment (EIA)
- 4.3 Air Pollution: Smog, Acid rain, Ozone depletion
- 4.4 Global warming effect (greenhouse effect)
- 4.5 Renewable and non-renewable resources and their conservation

**Unit-5**

- 5.1 Water, pH and concept of solubility
- 5.2 Basic undertanding of spectrophotometry
- 5.3 Extraction and isolation including centrifugation
- 5.4 Purification and seperation methods
- 5.5 Basic principle of chromatography, atomic absorption and NMR

**AS/PS/MICRO-6 : Biostatistics and Computer Science****Unit-1**

- 1.1 Biostatistics : Its applications; samples and populations, their properties, variables of different kinds. Probability and Conditional probability
- 1.2 Measure of central tendency : Arithmetic, Harmonic and Geometric means. Mode and Median, use and limitations; Frequency distribution
- 1.3 Normal, Binomial and Poisson distributions and their properties
- 1.4 Kurtosis and Skewness
- 1.5 Measures of dispersion : What is dispersion? Range, Interquartile range, Variance, standard and coefficient of variation, and their application
- 1.6 Sample and population means: Confidence limits and Confidence Interval for the population mean.

**Unit-2**

- 2.1 Significance tests: Student's t-test, the meaning of significance and significance levels; Null and Alternate Hypothesis; Types of errors

- 2.2 Paired and un-paired t-tests and their salient differences
- 2.3 Analysis of variance : General introduction and its application
- 2.4 Completely Randomized Design and Randomized Block Design
- 2.5 ANOVA table and F - ratio, Least Significant Difference and its application
- 2.6 Introduction to factorial analysis

### **Unit-3**

- 3.1 Regresssion and correlation; History, uses and assumption
- 3.2 Bivariate regression and correlation analysis
- 3.3 Geometric mode of representing regression 3.4 Interconversion of regression coefficient and coefficient, Application of these analyses
- 3.5 Introduction to Curvilinear regression analysis and its utility

### **Unit-4**

- 4.1 History of development of computers
- 4.2 General awareness of computer hardware
- 4.3 Basic knowledge of computer systems software
- 4.4 General introduction to Wordstar
- 4.5 General introduction to HPG
- 4.6 General introduction to Lotus

### **Unit-5**

- 5.1 Characters of non-parametric tests
- 5.2 Chi-square test, Sign and F-max tests
- 5.3 Goodness of fit, and test for homogeneity
- 5.4 Experimental design and its importance in Biology

## **M. Sc. Microbiology**

### **Semester III and IV**

#### **Micro : 7 : Molecular Microbiology and Genetics**

##### **Unit-1**

- 1.1 Basic understanding and organization of genome in prokaryotes and eukaryotes
- 1.2 Mutant methodology: Isolation of mutants; Phenotypic expression and detection
- 1.3 Means of genetic exchange in microorganisms: Transformation
- 1.4 Transduction
- 1.5 Conjugation

##### **Unit-2**

- 2.1 Molecular genetics of selected operons : Lactose
- 2.2 Arabinose
- 2.3 Histidine
- 2.4 Tryptophan
- 2.5 Gene control in eukaryotes;post-transcriptional and post translational modification

##### **Unit-3**

- 3.1 Genetic mapping in bacteriophages and bacteria Plasmid biology
- 3.2 Plasmid biology
- 3.3 Examples in microbial genetics: *Bacillus* and *Pseudomonas* genetics
- 3.4 Genetics of *Streptomyces* and *Yeast*
- 3.5 Nif genetics

##### **Unit-4**

- 4.1 Transposone, viroids and prions
- 4.2 Viral genetics : virulent phages T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub>
- 4.3 Temperate phages P<sub>22</sub>
- 4.4  $\lambda$ X-174, MB and other miniphages
- 4.5 Viral recombination and replication

#### **Micro : 8 : Molecular Cytology and Taxonomy of Microorganisms**

##### **Unit-1**

- 1.1 Composition, organization and structure of bacterial cell
- 1.2 Molecular structure of cell wall and its biosynthesis
- 1.3 Molecular organization of capsule, flagella and pili
- 1.4 Molecular nature of membrane
- 1.5 Motility, chemotaxis and genetic regulation

##### **Unit-2**

- 2.1 Development (morphogenesis) in microbes
- 2.2 Heterocyst

- 2.3 Microbial taxonomy
- 2.4 Principles and methods
- 2.5 Numerical taxonomy & chemotaxonomy

### **Unit-3**

- 3.1 Classification of prokaryotes
- 3.2 Bacterial phylogeny: Principles of Isolation of prokaryotes
- 3.4 Important bacterial genera:
  - 3.4.1 Pseudomonas
  - 3.4.2 Dinitrogen fixers
  - 3.4.3 Endospore formers

### **Unit-4**

- 4.1 Enterobacteriaceae
- 4.2 Actinomyces
  - 4.2.1 Streptomyces
  - 4.2.2 Nocardia & Arthrobacter
- 4.3 The Archaeobacteria

## **Micro-9 : Microbial Physiology and Metabolism**

### **Unit-1**

- 1.1 Nutritional diversity in microbes
- 1.2 Microbial growth
- 1.3 Growth kinetics
- 1.4 Methods of measurement of growth
- 1.5 The growth cycle, characteristics of growth phases

### **Unit-2**

- 2.1 The batch culture(closed) & continuous culture(open) systems
- 2.2. Efficiency of microbial growth: Growth Yields, Yield co-efficient and Methods of measurement of growth
- 2.3 Chemosynthesis:Carbohydrate metabolism; Interlinkages of pathways
- 2.4 Aerobic metabolic processes
  - 2.4.1 TCA cycle
  - 2.4.2 Glyoxylate cycles and gluconeogenesis

### **Unit-3**

- 3.1 Oxidation of methane, fats & fatty acids, hydrocarbons (hydrocarbons & aromatics)  
Incomplete oxidation
- 3.2 Anaerobic metabolic processes
- 3.3 Chemolithotrophy
- 3.4 Metabolism of amino acids

### **Unit-4**

- 4.1 Biochemistry of drug resistance

- 4.2 Biochemistry of antibiotic action
- 4.3 Nitrogen fixation
- 4.4 Denitrification

## **Micro - 10 : Microbial Ecology & Biotechnology of Waste Treatment**

### **Unit -1**

- 1.1 Microbes in their natural habitat
- 1.2 Habitats: soils, waters, specific habitats, extreme habitats
- 1.3 Methods in Microbial Ecology
- 1.4 Microbial interactions
- 1.5 Microbial succession

### **Unit -2**

- 2.1 The sulphur cycle
- 2.2 The phosphorus cycle
- 2.3 Transformation of Fe, Mn and other elements
- 2.4 Lignocellulose degradation
- 2.5 Microbial aspects & biochemistry of Lignin & Cellulose degradation

### **Unit -3**

- 3.1 Types of wastes and methods of sampling, Properties of waste waters and parameters
- 3.2 Microbial populations and waste treatments
- 3.3 Types of treatment systems
- 3.4 Biodegradation: Basic concept of biodegradation
- 3.5 Biodeterioration

### **Unit -4**

- 4.1 Biodegradation of biopolymers : Biodegradation of synthetic polymers & xenobiotic compounds
- 4.2. Methanogenic, Fermentative, Acetogenic microorganisms; technical processes and conditions
- 4.3 Disposal and effect of effluent on the environment
- 4.4 Environmental problems of pollutants : Special methods in microbial degradation
- 4.5 Pollution control & abatement

## **Micro-11 : Biotechnology - 2**

### **Unit-1**

- 1.1 Sources of industrial microbes; general methods for isolation and selection of microbes screening of useful microbes
- 1.2 Improvements of Strains mutation programmes
- 1.3 Fundamentals of Biochemical Eng.
- 1.4 Substrates for Microbial Fermentation
- 1.5 Bioreactors : Basic concept; bioreactor design
- 1.6 Sterilization of bioreactor, air and media

**Unit-2**

- 2.1 Aeration & Agitation
- 2.2 Inoculum preparation and inoculation
- 2.3 Mass transfer
- 2.4 Foam control, bioreactor probes, Measurement & control processes
- 2.5 Gas composition; solid and liquid handling
- 2.6 Scale-up in bioprocesses

**Unit-3. Downstream Processes**

- 3.1 Cell separation & Disintegration
- 3.2 Extraction & product purification
- 3.3 Utilization of By-products
- 3.4 Stoichiometry of bioprocesses
- 3.5 Biokinetics for optimum operation

**Unit-4**

- 4.1 Biomass production; from carbohydrates; molasses, spent sulphite liquor, Whey, from n-alkanes
- 4.2 Ethanol production: Sugar substrates; Starch; Cellulosic materials; Microbes: Yeast and bacteria
- 4.3 Ethanol from immobilized cell alcohol
- 4.5 By-product, economic & energetic aspects of ethanol fermentation

**Micro-12 : Microbial Fermentation Products and Applications****Unit-1**

- 1.1 Analytical methods for studying fermentation products, isolation, purification & characterization
- 1.2 Immobilization of enzymes & cells techniques, production of important metabolites
- 1.3 Organic acids: Citric, Acetic, Gluconic & Lactic acid
- 1.4 Amino acids: Lysine, Threonine and Glutamic acid

**Unit-2**

- 2.1 Extracellular polysaccharides
- 2.2 Vitamins
- 2.3 Antibiotics: penicillin, streptomycin, tetracycline, polyene & hybrid antibiotics
- 2.4 Ergot alkaloids
- 2.5 Plant growth hormones : GA, IAA & Cytokinin

**Unit-3: Microbial production of enzymes**

- 3.1 Basic concepts & production and sources of enzymes
- 3.2 Amylases and Cellulases
- 3.3 Proteases and Pectinases
- 3.4 Glucose isomerase, invertase and glucose oxidase

**Unit-4**

- 4.1 Industrial applications of free enzymes
- 4.2 Biosensors & Bioelectronics : Transducers; Biocatalytic compounds; field of application  
Biosensors, Biosensors in fermentation & environmental
- 4.3 Protein engineering & synthetic enzymes
- 4.4 Genetic engineering in relation to enzymes & other products
- 4.5 Biotransformation of Steroids & Antibiotics

## **M. Sc. Animal Science Semester III and IV**

### **AS -7 : GENERAL ZOOLOGY - I**

#### **Unit -1.**

- 1.1 Systematics of Invertebrates
- 1.2 Interrelationship of Invertebrate fauna
- 1.3 Larval structure and their significance in Invertebrates
- 1.4 Lower Chordates; systematics and evolution

#### **Unit -2. Comparative functional anatomy**

- 2.1 Locomotory organs and mode of locomotion in Invertebrates
- 2.2 Digestive organs in Invertebrates
- 2.3 Respiratory organs, pigments and mode of respiration in invertebrates
- 2.4 Excretion and reproduction in Invertebrates

#### **Unit -3.**

- 3.1 Arthropod as vector (mosquito, bee, flies, ticks) and mode of transmission of pathogen
- 3.2 Chemical, environmental and biological control of arthropod vectors
- 3.3 Biology and control of chief agricultural insect pests
- 3.4 Useful insects : Insect pest management

#### **Unit-4. Life cycle and biology of the followings**

- 4.1 Plasmodium
- 4.2 Trypanosoma and Leishmania
- 4.3 Ascaris and Wuchereria
- 4.4 Fasciola

### **AS - 8 : GENERAL ZOOLOGY - II**

#### **Unit -1. Mammalian anatomy, histology and physiology**

- 1.1 Digestive system and related organs
- 1.2 Kidney and excretory system
- 1.3 Integumentary system
- 1.4 Reproductive system

#### **Unit -2. Mammalian anatomy, histology and physiology**

- 2.1 Heart and circulatory system
- 2.2 Respiration and gaseous exchange
- 2.3 Skeletal muscle and thermoregulation
- 2.4 Sense receptors: Vision, hearing, smell and taste

**Unit-3.**

- 3.1 Local and endocrine hormones, pituitary hormones and their functions
- 3.2 Thyroid hormones
- 3.3 Natural sodium - potassium inhibitors, Na<sup>+</sup>, K<sup>+</sup> channels and blockers
- 3.4 Renin - angiotensin system and blood pressure regulation

**Unit-4.**

- 4.1 Osmoregulation: Aquatic, terrestrial and desert animals
- 4.2 Brain and atrium, natriuretic factors, endothelial factors, kidney hormones
- 4.3 Insulin and blood - glucose regulation, Lymphatic system
- 4.4 Calcium and Ca<sup>++</sup> channel blockers,  $\alpha$  and  $\beta$  blockers and their roles

**AS - 9 : GENERAL ZOOLOGY - III****Unit-1**

- 1.1 Systematics, diversity and evolutionary trend of chordates
- 1.2 Zoogeographical realms and types of distribution
- 1.3 Adaptive radiation and distribution of vertebrates
- 1.4 Migration of fish, birds and mammals

**Unit-2**

- 2.1 Circadian rhythm, Kin selection concept, its importance in hymenoptera and altruism
- 2.2 Sociobiology of birds and mammals
- 2.3 Animal behaviour; classification, instinct, imprinting, learning, foraging and feeding behaviour
- 2.4 Sexual behaviour, social behaviour and parental care

**Unit-3**

- 3.1 Gametogenesis and structure of sperm and ovum
- 3.2 Physiology of fertilization
- 3.3 Early embryonic development
- 3.4 Cleavage patterns and fate map

**Unit-4**

- 4.1 Blastulation of frog and chick
- 4.2 Gastrulation of frog and chick
- 4.3 Extra embryonic membranes and placenta
- 4.4 Cell differentiation and differential gene activity

**AS - 10 : NEUROBIOLOGY****Unit-1**

- 1.1 Origin of nervous system of Coelentrata; Platyhelminthes and Annelida
- 1.2 Origin of nervous system in Arthropoda; Mollusca and Protochordates
- 1.3 Basic plan of nervous system in vertebrates
- 1.4 Evolution of brain

**Unit-2**

- 2.1 Comparison of brain in vertebrates
- 2.2 Morphology of human brain
- 2.3 Neuronal components; structure of typical neuron; neuroglia, their classification, structure and function
- 2.4 Formation and function of myelin sheath

**Unit-3**

- 3.1 Histological details of medulla oblongata
- 3.2 Synapses and their classification; Ultrastructure of synapse
- 3.3 Molecular nature of synaptic transmission, Neurotransmitters : their classification and role
- 3.4 Glucose and energy metabolism in brain

**Unit-4**

- 4.1 Neuropeptides and their function
- 4.2 Endorphins; opiate peptides and pain killers
- 4.3 Epilepsy; depressions
- 4.4 Role of Central Nervous System in hypertension

**AS -11 : WILDLIFE BIOLOGY****Unit-1. Introduction and Outline of Ecological sub-divisions of Indian Wildlife**

- 1.1 Causes of wildlife depletion and Legislation
- 1.2 Himalayan Mountain Systems and Indian Deserts
- 1.3 Peninsular Indian sub-region and Tropical Evergreen Forests
- 1.4 Andaman - Nicobar islands and Mangrove Forests (Sundarvan)

**Unit-2. Conservation and Development**

- 2.1 Important National Parks of India
- 2.2 Important National Sancturaies of India
- 2.3 National Parks of Gujarat
- 2.4 Sanctuaries of Gujarat

**Unit-3. Wildlife Management**

- 3.1 Extensive and intensive management
- 3.2 Instruments used for Wildlife Management
- 3.3 Identification of Damage
- 3.4 Control methods

**Unit-4. Study of Case Histories and Protection**

- 4.1 Endangered species
- 4.2 Project Tiger
- 4.3 Gir Lion Sanctuary Project
- 4.4 Intranation Trade in Endangered species

**AS - 12 : FISHERY BIOLOGY****Unit-1**

- 1.1 Diversity of fishes and methods of identification
- 1.2 Aquaculture and its importance
- 1.3 Fishing vessels
- 1.4 Fishing gears

**Unit-2**

- 2.1 fish seed collection, transport and stocking
- 2.2 Methods of preservation and processing
- 2.3 Fish by-products
- 2.4 Fish marketing and fisheries management

**Unit-3**

- 3.1 Freshwater fisheries of Gujarat
- 3.2 Estuarine fisheries of Gujarat
- 3.3 Open sea fisheries of Gujarat
- 3.4 Crustacean, molluscan and other fisheries

**Unit-4**

- 4.1 Accessory respiratory organs
- 4.2 Colour changing and reproductive behaviour of fish
- 4.3 Artificial breeding and control
- 4.4 Fish diseases and control

**Semester III and IV****PS – 7: DIVERSITY OF PLANT LIFE – I****Unit – 1: Algae and Fungi**

- 1.1 A broad classification
- 1.2 Range of thallus structure and its evolutionary trends
- 1.3 Salient feature of reproduction
- 1.4 Patterns of life – cycles of algae
- 1.5 Patterns of life – cycles of fungi

**Unit – 2: Bryophytes**

- 2.1 Classification
- 2.2 Patterns and variation in morphology and anatomy
- 2.3 Reproduction
- 2.4 Life cycles
- 2.5 Evolutionary trends amongst the different groups and their affinities

**Unit – 3: Pteridophytes**

- 3.1 Classification
- 3.2 Classification
- 3.3 Salient feature of morphology and anatomy amongst different groups
- 3.4 Reproduction
- 3.5 Life histories in different groups and their evolutionary trends and affinities

**Unit – 4: Gymnosperms**

- 4.1 Classification
- 4.2 Morphological and anatomical features of different groups
- 4.3 Reproduction and life cycles in some typical forms
- 4.4 Evolutionary trends among the different groups
- 4.5 An outline of the principles of paleobotany

**PS – 8: DIVERSITY OF PLANT LIFE – II.**  
**PLANT TAXONOMY AND GEOGRAPHY**

**Unit – 1: Principles of Angiosperm Taxonomy**

- 1.1 Aims, phases and periods of classification
- 1.2 Organized, nomenclature, International codes of plant names; Generic and specific epithet
- 1.3 Concept of species: biological and taxonomic species
- 1.4 Taxonomic evidences and characters (outline)
- 1.5 Botanical Gardens, Botanical Survey of India: Organization and Role

### **Unit – 2: Systems of Classification**

- 2.1 Types: Artificial, Natural and Phylogenetic
- 2.2 Pre- and Post- Darwinian systems
- 2.3 Bentham and Hooker's systems, outlines of Englerian and Ralian Schools
- 2.4 Recent systems: Takhtajan and Cronquist (outlines)
- 2.5 Origin and phylogeny of Angiosperms: Monochlamydeae and Monocotyledons

### **Unit – 3: Systematics studies of Flora**

- 3.1 Selected families of Dicotyledons; general classification of polypetalae, gamopetalae and monochlamydeae
- 3.2 Detailed study of families of polypetalae
- 3.3 Detailed study of families of gamopetalae
- 3.4 Detailed study of families of monochlamydeae
- 3.5 Classification of families of monocotyledons
- 3.6 Detailed study of families of monocotyledons

### **Unit – 4: Plant Geography**

- 4.1 Climatic groupings and physical geographic regions including deserts, floristic regions of the world and India
- 4.2 Latitudinal zones and altitudinal zonation
- 4.3 Angiosperms: Centres of origin, number and size of families, genera and large families
- 4.4 Geographical classification of families: composition, tropical, temperate species
- 4.5 Endemic species and genera of India

## **PS – 9: PLANT ECOLOGY**

### **Unit – 1: Structure of Plant Communities**

- 1.1 Concept of plant community
- 1.2 Community attributes: Analytic and Synthetic characters
- 1.3 Physiogenomic characters and growth forms
- 1.4 Sampling methods
- 1.5 Community classification

### **Unit – 2: Dynamics and Function of Plant Communities**

- 2.1 Plant succession: Types, driving forces and trends
- 2.2 Primary production, productivity and methods of its measurement
- 2.3 Energy flow, System transfer function and Turnover

- 2.4 Litter production and decomposition
- 2.5 Environmental factors affecting productivity

**Unit – 3: Population and Autecology**

- 3.1 Population growth, natality, mortality and carrying capacity
- 3.2 Species interaction: Allelopathy, allelopathy and allelomeditation
- 3.3 Concept of Niche: Characteristic and differentiation
- 3.4 Concept of ecotypes and ecads
- 3.5 Mechanism of ecotype formation and classification

**Unit – 4: Soil and Dessert**

- 4.1 Soil: Biotic and abiotic components
- 4.2 Soil processes, soil biomass and soil plant relationships
- 4.3 Soil conservation and flood control
- 4.4 Desertification: causes and control
- 4.5 Fire: Effect on grasslands and forests
- 4.6 Plant indicators – an outline

**PS – 10: DIVERSITY OF PLANT LIFE – III  
ANATOMY, MORPHOGENESIS AND EMBRYOLOGY**

**Unit – 1: Anatomy**

- 1.1 Meristems
- 1.2 Theories of structural development and differentiation: Apical cell theory, Histogen theory and Tunica – Corpus theory
- 1.3 Development of plant tissues: simple and complex tissues
- 1.4 Secondary growth: Normal and anomalous

**Unit – 2: Morphogenesis**

- 2.1 & 2.2 Organogenesis of the root, stem, leaf, bud, flower and inflorescence
- 2.3 Morphogenesis: Factors affecting it
- 2.4& 2.5 Evolution of morphogenetic pattern

**Unit – 3: Embryology**

- 3.1 Micro and Meg sporangium
- 3.2 Female and Male gametophytes
- 3.3 Fertilization
- 3.4 Endosperm; types
- 3.5 Embryogenesis and types of embryo

**Unit – 4: Applies Embryology**

- 4.1 Apomix
- 4.2 Polyembryony
- 4.3 Embryology in relation to taxonomy
- 4.4 Experimental Embryology

## **PS – 11: PLANT PHYSIOLOGY**

### **Unit – 1: Mineral Nutrition**

- 1.1 Essential element and their role in plant growth and development
- 1.2 Passive and active transport
- 1.3 Assimilation of nitrate
- 1.4 Components of water potential
- 1.5 Transpiration and stomatal movement
- 1.6 Water stress and adaptation to water stress

### **Unit – 2: Photosynthesis and photorespiration**

- 2.1 Photosynthesis
- 2.2 Photorespiration
- 2.3 Distinguishing feature of C3 and C4 plants
- 2.4 Photorespiration in C4 plants
- 2.5 Source and sink relationship
- 2.6 CAM pathway

### **Unit –3: Growth and Development**

- 3.1 Growth: Plant growth processes, growth rate, growth indices
- 3.2 Physiology of flowering
- 3.3 Photomorphogenesis
- 3.4 Seed germination process
- 3.5 Dormancy, its causes, types and methods of breaking dormancy

### **Unit – 4: Plant Growth Hormones**

- 4.1 Auxin
- 4.2 Gibberllin
- 4.3 Kinetin
- 4.4 Abscisic acid
- 4.5 Ethylene
- 4.6 Plant growth regulators

**PS – 12: PLANT TECHNOLOGY: APPLICATION****Unit – 1: Plant Reproduction**

- 1.1 Seed and vegetative propagation
- 1.2 Tissue culture
- 1.3 Application of tissue culture in forestry and agriculture
- 1.4 Nursery plants and their management

**Unit – 2: Forest and Forestry**

- 2.1 Classification of Indian forests, National Forest Policy
- 2.2 Forms and growth of forest trees
- 2.3 Silviculture, Silvicultural Systems, Afforestation: Social, Community and Agroforestry
- 2.4 Forests Mensuration
- 2.5 Forest Protection
- 2.6 Major and minor forest products of India

**Unit – 3: Agricultural Products of India**

- 3.1 History, origin and distribution of crop plants (Vavilov's work)
- 3.2 Major staple crops: Rice, Wheat, Maize
- 3.3 Minor staple crops: Millets, Ragi, Rye, Oat, Barley and Sorghum
- 3.4 Major pulses, oil seeds and fibre crops
- 3.5 By – products of crops: Fodder, Fuel, White Coal, FYM

**Unit – 4: Grasslands and Fodder Resources**

- 4.1 Major grassland area of India and its classification
- 4.2 Important fodder grasses, Forbs and Legumes  
(including cultivate fodder species)
- 4.3 to 4.5 Grassland management