Proposed Syllabus

M. Sc. Bioscience Semester I & II

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. June 2019

Department of Biosciences
Veer Narmad South Gujarat University, Surat

THE COURSE

The M.Sc. Bioscience (Botany), M.Sc. Bioscience (Microbiology), M.Sc. Bioscience (Zoology), is a full time curriculum, run for 2 years, spread over 4 semesters, with four theory Papers (three core and one elective / interdisciplinary / multidisciplinary) and one combined practical in first two semesters.

ADMISSION

Academic year of the University begins from June. The lectures and practical's of the third semesterstarts immediately. The same for the first semester usually commences immediately after admissions. The admission process is as per the criteria laid down by the university

ELIGIBILITY

A candidate shall be admitted to M.Sc. Bioscience (Botany) / M.Sc. Bioscience (Zoology) / M.Sc. Bioscience (Microbiology) based on subject which he/she has taken as the Core –I (Principal) subject at the B.Sc. Degree examination. If seats are vacant than admission can be given to students who have taken the Core –II (Subsidiary subject/ Second subject / subject taken up to S.Y. B.Sc. at least).

ATTENDANCE

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 paid service.

Admitted students have to attend all the Lectures, Practical and Seminars. A minimum prescribed attendance as per University rules is required to sanction a term grant. Students whose term is not granted will not be allowed to appear in the examination, and will have to join the same semester in the following year.

EVALUATION AND EXAMINATION

- There shall be University examination for every core and elective/interdisciplinary/ multidisciplinary course at the end of each semester.
- There shall be continuous evaluation of every student for 30% of internal weightage during the semester as shown below:

Theory Examination

Internal Assessment

Continuous Internal assessment will based upon

1. Attendance/regularity/punctuality
2. Written Assignments
3. Internal test
4. Any one option selected by students from: Seminars, Poster presentations, Viva-voce, field work, academic tour, MCQ's tests, quiz competitions, group discussion etc.

External Theory Question Paper format

1. Question paper shall consist of 2 sections.
2. Section-I covers first 2 units of the course.
3. Section-II covers remaining 2 units of the course.
4. Both sections of question paper comprise two questions with internal option of 14 marks each from each unit.
5. Third question shall be short answer type of (07) marks which will cover respective both units.

Practical examination

External practical examination paper format

Exercise 1:	Based on paper I	[25 Marks]
Exercise 2:	Based on paper II	[25 Marks]
Exercise 3:	Based on paper III	[25 Marks]
Exercise 4:	Based on paper IV	[25 Marks]
Exercise 5:	Spotting	[20 Marks]
Exercise 6:	Viva	[15 Marks]
Exercise 7:	Journal/Lab record	[05 Marks]

TEACHING AND LEARNING STRATEGIES

Along with Classroom teaching and laboratory practical on need based modern pedagogical techniques from following can be adapted

Hands on Learning, Story Telling, Role Play, Visual clues, Instructional Conversations, Science Text Cards, Word Games, Graphic Organizers, Word Parts, Social media, Virtual science labs, Thinking Maps, Crossover Learning, Argue with Science, Brain storming, Context-Based Learning, Computational thinking, Multimedia Approach, Projects, Science museums, ICT Enabled Learning, Video clips, Power Points, Documented Problem Solving, Peer-to-Peer Teaching, Science movies, Science games, Mobile apps for Science, Field trips, Science clubs, Flipped Classroom, Guided Discovery Problems, Science Quiz, Learning By Doing Science etc.

M. Sc. Bioscience Sem. I							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios-101	Biochemistry	4	-	70	30	100	4
Bios-102	Cell Biology and Immunology	4	-	70	30	100	4
Bios-103	Instrumentations and Biostatistics	4	-	70	30	100	4
Bios-104	Fundamentals of Developmental Biology and Physiology	4	-	70	30	100	4
Bios- 105	Practical Based on Bios-101 to 104	-	16	140	60	200	8
Total		**16**	**16**	**420**	**180**	**600**	**24**

M. Sc. Bioscience Sem. II							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios-201	Evolution and Genetics	4	-	70	30	100	4
Bios-202	Molecular Biology and Recombinant DNA methods	4	-	70	30	100	4
Bios-203	Diversity and ecology	4	-	70	30	100	4
Bios-204	Bioinformatics, IPR, Biosafety & Bioethics	4	-	70	30	100	4
Bios- 205	Practical Based on Bios-201 to 204	-	16	140	60	200	8
Total		**16**	**16**	**420**	**180**	**600**	**24**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-101**	**Semester**	**I**
Biochemistry			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-101: BIOCHEMISTRY

Learning Objective and Outcomes:

This Course will focuses on the synthesis, structure and functions of biomolecules in the living organisms. After learning this unit the students will be able to

- **CO 1**Student will be able to understand the process of synthesis of proteins, lipids, nucleic acids, and carbohydrates and their role in metabolic pathways along with their regulation at the epigenetic, transcriptional, translational, and post-translational levels including RNA and protein folding, modification, and degradation.
- **CO 2** Students will be able to explain reaction kinetics, thermodynamics of the molecules. They will be able to understand principles of catalysis and enzyme kinetics.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

Unit I

1.1 **Chemical fundamentals:**Structure of atoms, molecules and chemical bonds.

1.2 **Stabilizing interactions:** Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.

1.3 **Water:**weak interactions in aqueous systems, ionization of water, weak acids, and weak bases, buffering against pH changes in biological systems, water as a reactant, the fitness of the aqueous environment for living organisms;Acid, Base pH and buffer

1.4 **Kinetics:**Reaction kinetics, thermodynamics, colligative properties

Reference Books

1. *Foundation of General, Organic and Biochemistry, Katherine and Joseph, McGraw Hill*
2. *Biochemistry Demystified, Sharon Walker and David McMohan, McGraw Hill,*
3. *Lehninger Principles of Biochemistry, Nelson, WH free Man*
4. *Fundamentals of Biochemistry: Life at the Molecular Level, Donald Voet, Judith G. Voet, Charlotte W. Pratt, Wiley*
5. *Fundamentals of biochemistry, Jain, S. Chand publication*

Unit II

2.1 **Composition, structure and function of biomolecules:** Carbohydrates, lipids, proteins, nucleic acids and vitamins.

2.2 **Conformation of proteins**: Ramachandran plot, secondary structure, domains, motif and folds.

2.3 **Conformation of nucleic acids:** Helix (A, B, Z), t-RNA, micro-RNA.

2.4 **Stability:**Stability of proteins and nucleic acids

Reference Books

1. *Foundation of General, Organic and Biochemistry, Katherine and Joseph, McGraw Hill*
2. *Lehninger Principles of Biochemistry, Nelson, WH free Man*
3. *Biochemistry: Concepts and Connections, Dean R. Appling, Spencer J. Anthony-Cahill,Christopher K. Mathew, Pearson*
4. *Fundamentals of Biochemistry: Life at the Molecular Level, Donald Voet, Judith G. Voet, Charlotte W. Pratt, Wiley*
5. *Biochemistry for life sciences by Uma Bhardwaj, Pearson Education*
6. *Fundamentals of biochemistry, Jain, S. Chand publication*
7. *Biochemistry Dr. C. B. Powar Dr. G.R. Chatwal, Himlaya Publishing House*

Unit III

3.1 **Introduction to enzymes:** Principles of catalysis, Enzyme Specificity, Types of enzyme

3.2 **Enzyme kinetics:**factor affecting enzyme activity, Michaelis-Menten Equation and its Transformations

3.3 **Enzyme inhibition:** Reversible and irreversible inhibition

3.4 **Enzyme regulation:** Allosteric enzyme regulation, Covenant modification, enzyme synthesis

Reference Books

1. *Understanding Enzyme, Trevor Palmer, Ellis Horwood Ltd.*
2. *Enzymology T. Devasena, Oxford University Press*
3. *Fundamentals of Enzymology,by Nicholas C. Price,Oxford University Press*
4. *Fundamentals of Biochemistry: Life at the Molecular Level, Donald Voet, Judith G. Voet, Charlotte W. Pratt, Wiley*
5. *Lehninger Principles of Biochemistry, Nelson, WH free Man*
6. *Fundamentals of biochemistry, Jain, S. Chand publication*

Unit IV

4.1 **Bioenergetics:**Principles of Bioenergetics, Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway, The Metabolism of Glycogen in Animals, The Citric Acid Cycle, Oxidative Phosphorylation and Photophosphorylation, Carbohydrate Biosynthesis in Plants and Bacteria

4.2 **Lipid Biosynthesis:** Biosynthesis of Fatty Acids and Eicosanoids, Biosynthesis of Triacylglycerols, Biosynthesis of Membrane Phospholipids, Biosynthesis of Cholesterol, Steroids, and Isoprenoids, Fatty Acid Catabolism: Digestion, Mobilization, and Transport of Fats, Oxidation of Fatty Acids, Ketone Bodies

4.3 **Nitrogen Metabolism:**Overview of Nitrogen Metabolism, Biosynthesis of Amino Acids, Molecules Derived from Amino Acids, Biosynthesis and Degradation of Nucleotides, Amino Acid Oxidation and the Production of Urea : Metabolic Fates of Amino Groups,

Nitrogen Excretion and the Urea Cycle, Pathways of Amino Acid Degradation, symbiotic and non-symbiotic nitrogen fixation by microorganisms

4.4 **Integration and Hormonal Regulation of Mammalian Metabolism:** Tissue-Specific Metabolism: The Division of Labor, Hormonal Regulation of Fuel Metabolism, Long Term Regulation of Body Mass, Hormones: Diverse Structures for Diverse Functions

Reference Books

1. *Lehninger Principles of Biochemistry, Nelson, WH free Man*
2. *Fundamentals of Biochemistry: Life at the Molecular Level, Donald Voet, Judith G. Voet, Charlotte W. Pratt, Wiley*
3. *Lippincott Illustrated Reviews Biochemistry, Denise R.Ferrier, Wolters Kluwer India Pvt. Ltd*
4. *Biochemistry: Concepts and Connections, Dean R. Appling, Spencer J. Anthony-Cahill,Christopher K. Mathew, Pearson*
5. *The Physiology and Biochemistry of Prokaryotes by David White,OUP USA*
6. *Introduction to Plant physiology, William G. Hopkins and Norman P.A. Huner, Wiley India Pvt Ltd*
7. *Introduction to biochemistry and Metabolism by D Anandhi Pearson Education*
8. *Plant Biochemistry, Hans-Walter Heldt, Elsevier*
9. *Plant physiology by by Lincoln Taiz and Eduardo Zeiger, Sinauer Associates Inc.,U.S*
10. *Fundamentals of biochemistry, Jain, S. Chand publication*
11. *Bios Instant Notes In Biochemistry, by David & Hooper, Nigel Hames,Taylor& Francis*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-102**	**Semester**	**I**
Cell Biology and Immunology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-102:CELL BIOLOGY AND IMMUNOLOGY

Learning Objective and Outcomes*:*

The course mainly emphasize on study of ultra-structure of various cell types, cell division and its regulation. The course also deals with molecules involve in immune system and their role in immune system. After learning this course students will be able to understand…

- **CO 1**Basic structure and chemical properties of plant, animal and bacterial cells
- **CO 2** Phases, mechanism and regulation of cell cycle, cell signaling pathways and cancer biology
- **CO 3** Students will be also able to explain molecules involved in innate and adaptive immunity and response of immune system in various pathogenic condition

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit I

1.1 **Membrane structure and function:**Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

1.2 **Ultra-structure and function of Bacteria:** Bacterial Nucleoids, Plasmid, Microbial Cell Surfaces, Cytoplasmic Membranes, Capsules, Organs of Locomotion, Pili or Fimbriae

1.3 **Major structural and functional features of eukaryotic cell:** Cell membrane and transport across the cell membrane, Plasma membrane, Cell wall, Extracellular matrix and cell interaction, Nucleus, Endoplasmic reticulum, Golgi complex, Lysosome, Mitochondria, Chloroplast, Peroxisome, Plastids, Vacuoles, Cytoskeleton and Cell movement

1.4 **Organization of genes and chromosomes:**Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.

Reference Books

1. *The Cell – A molecular Approach, Cooper and Hausman*
2. *Cell and Molecular Biology Concepts 6th ed, Gerald Karp,Wiley*
3. *Molecular cell biology, Lodish, WH freeman*
4. *Cell Biology, Devasena, Oxford*
5. *The Physiology and Biochemistry of Prokaryotes by David White,OUP USA*
6. *Cells, Benjamin Lewin, Jones and Bartlett Publishers, Inc*
7. *The Cell, A visual tour of building blocks of life, Jack Challoner, Ivy press*

Unit II

2.1 **Cell division and cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle

2.2 **CellSignaling :**Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways,

2.3 **Cell sensing:**Bacterial and plant twocomponent systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

2.4 **Cellular communication:** General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, regulation of hematopoiesis,neurotransmission and its regulation,

Reference Books

1. *The Cell – A molecular Approach, Cooper and Hausman*
2. *Cell Biologyby Gerald Karp, Wiley*
3. *Molecular cell biology, Lodish, WH freeman*
4. *Cells, Benjamin Lewin, Jones and Bartlett Publishers, Inc*
5. *Cell Biology, Devasena, Oxford*
6. *The Physiology and Biochemistry of Prokaryotes by David White,OUP USA*
7. *Cell Biology, Genetics, Molecular Biology, Evolution &EcologybyVerma P.S. (Author), Agarwal V.K.*
8. *Biology by Peter Raven, George Johnson, Kenneth Mason, Jonathan Losos, Susan Singer, McGraw Hill Education*

Unit III

3.1 **Host parasite interaction:**Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

3.2 **Cancer development:**Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer.

3.3 **Cancer propagation:**Metastasis, interaction of cancer cells with normal cells, apoptosis.

3.4 **Cancer treatment:**Therapeutic interventions of uncontrolled cell growth.

Reference Books

1. *Prescott's Microbiology, Joanne Willey, McGraw-Hill Education*
2. *Immunology, Raj Khanna, Oxford*
3. *The Short Textbook of Medical Microbiology, SatishGupte, jaypee*
4. *Cellular and Molecular Immunology, by Abul K. Abbas, Andrew H Lichtman, Shiv Pillai, Elsevier*
5. *Genes IXby Benjamin Lewin, Jones and Bartlett Publishers*
6. *BIOS Instant notes of immunology, by Peter Lydyard, Alex Whelan, Michael Fanger*

Unit IV

4.1 **Innate and adaptive immune system:** Cells and molecules involved in innate and adaptive immunity

4.2 **Immune cells**: Antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. Generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors.

4.3 **Immune response:**Humoral and cell mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation,

4.4 **Immune disorder:**Hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

Reference Books

1. *Roitt's Essential Immunology Peter J. Delves, Seamus, Wiley-Blackwell*
2. *Kuby Immunology, Jenni Punt, WH Freeman*
3. *Cellular and Molecular Immunology, by Abul K. Abbas, Andrew H Lichtman, Shiv Pillai, Elsevier*

4. *The Elements of Immunology by Khan, Pearson Education India*
5. *Immunology by Ramesh, McGraw Hill Education India*
6. *Immunology, Raj Khanna, Oxford*
7. *The Short Textbook of Medical Microbiology, SatishGupte, jaypee*
8. *BIOS Instant notes of immunology, by Peter Lydyard, Alex Whelan, Michael Fanger*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-103**	**Semester**	**I**
Instrumentations and Biostatistics			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-103:INSTRUMENTATIONS AND BIOSTATISTICS

***Learning Objective and Outcomes*:**

The course is designed to develop the experimental techniques and bio statistical skill for student. At the end of this course the students will be able to explain the principle, construction and working of various analytical instruments. Students will get detailed information about the applications of analytical techniques in Biological sciences. They will be able to

- **CO 1**Understand and use various qualitative and quantitative techniques i.e. microscopic, spectroscopic, chromatographic, etc.
- **CO 2** They will be able to explain various histochemical and immunotechniques for the detection of molecules in living cells. They will learn detection and measurements of different types of radioisotopes as well as electrophysiological methods
- **CO 3** Students will be able to analyse the biological data by manual and computational methods

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit I

1.1 **Centrifugation and basic colorimetery:** Basic concepts of centrifugation. Calculation of g value fromRPM. Density gradient centrifugation. Sedimentation velocity and Sedimentationequilibrium. Separation of sub-cellular components and macromolecules usinghigh speed and ultracentrifugation; UV/Vis spectrophotometry. Beer-Lambert's law and its use in determination of protein/ nucleic acid concentration, Turbidimetry and Nephelometry

1.2 **Microscopic techniques:**Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells,

scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freezefracture methods for EM, image processing methods in microscopy. Other microscopy techniques(Bright-field, Dark-filed, Phase-contrast, Differential interference contrast Microscope, Fluorescence, Polarization, Confocal Scanning, stereomicroscope), Scanning Probe Microscopes (Scanning Tunnelling,Atomic Force, Near-field Scanning Optical, Magnetic Force etc)

1.3 **Atomic spectroscopy:**Flame photometer, Atomic absorption spectroscopy, Mass spectroscopy

1.4 **Chromatography:** Ion exchange, Gel Filtration and Affinity chromatography, HPLC, GC, LC

Reference Books

1. *Modern Experimental Biochemistry, Rodney Boyer, Pearson Education*
2. *Instrumental methods of chemical analysis by Chatwal and Anand, Himalaya Publishing house*
3. *Biochemistry and Molecular biology, Wilson walker, Cambridge*
4. *Handbook of instrumental techniques for analytical chemistry, Frank Settle, Prentice Hall*
5. *Fundamentals and Techniques of Biophysics and Molecular Biology, Pranav Kumar, Pathfinder Publication.*
6. *Research Methodology for biological Sciences by N Gurumani,*

Unit II

2.1 **Fluorescence Spectroscopy:** Basic concepts of excitation and emission. Quenching, Stern-Volmer Plots. Theory and applications of FRET and fluorescence lifetime measurements.

2.2 **Structure determination I:**Fundamentals of CD, IR and Raman spectroscopy and their use in the study ofbiomolecular conformation.

2.3 **Structure determination II:**Fundamentals of X-ray, NMR and cryo-electron microscopy for determination of biomolecular structure.

2.4 **Sequencing technology:**DNA and Protein Sequencing technology

Reference Books

1. *Biochemistry and Molecular biology, Wilson walker, Cambridge*
2. *Fundamentals and Techniques of Biophysics and Molecular Biology, Pranav Kumar, Pathfinder Publication*
3. *Tools and Techniques of Biotechnology, MousumiDebnath, Pointer Publishers*

Unit III

3.1 **Histochemical and Immunotechniques:** Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH; Biosensors

3.2 **Radiolabeling techniques:** Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

3.3 **Electrophysiological methods:** Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.

3.4 **Electrophoresis:**Agarose gel, Native and SDS-PAGE. Isoelectric focusing, 2D-PAGE and its applications; characterization of nucleic acids/protein including Southern, northern and western hybridizations.

Reference Books

1. *Analytical Biochemistry, David Holme and Hazel Peck, Prentice Hall*
2. *Tools and Techniques of Biotechnology, MousumiDebnath, Pointer Publishers*
3. *Fundamentals and Techniques of Biophysics and Molecular Biology, Pranav Kumar, Pathfinder Publication*
4. *Biochemistry and Molecular biology, Wilson walker, Cambridge*
5. *UGC NET Life Science, by Ashish Nagesh, Quaisher J. Hossain, Prashant Kumar,Arihant Publications*

Unit IV

4.1 **Fundamental of statistical analysis:**Basic concepts of design of Experiments, Concepts of precision and accuracy in experimental measurements. Introduction to computational resources for statistical analysis

4.2 **Descriptive Statistics**: Measures of central tendency and dispersal; probability distributions(Binomial,Poisson and normal), Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance;

4.3 **Test of significance:**Student t-test, Analysis of variance, X^2 test,

4.4 O**ther statistical techniques:**Regression and Correlation, Basic introduction to Multivariate statistics

Reference Books

1. *Introduction to Bio-Statistics, Banerjee Pranab Kumar, S Chand & Company*
2. *Biostatistics, Veer Bala Rastogi, Medtech*
3. *Biostatistics Analysis, Zar, Pearson*
4. *Biostatistics for health and life sciences, Rao K Surya, Himalaya Publishing house*
5. *Research methodology, C R Kothari, New Age Publishers*
6. *Principles of Biostatistics by Marcello Pagano, Duxbury Thomson Learning*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-104**	**Semester**	**I**
Fundamentals of Developmental Biology and Physiology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-104:FUNDAMENTALS OF DEVELOPMENTAL BIOLOGY AND PHYSIOLOGY

Learning Objective and Outcomes:

The course has created to exposed student with the fundamental of developmental biology and physiology of the different life forms. The course explores various topics in plant physiology, and biochemistry including primary and secondary metabolism, photosynthesis, respiration, water relations, mineral nutrition, response to environmental stress, roles of plant hormones. After completing this course,

- **CO 1**Students will be able to explain important developmental aspects in plants and animal.
- **CO 2** The students will understand the relationship between structure, function and its relation to various biological processes.
- **CO 3** Student will gain an appreciation of the metabolic and physiological processes for stress adaptation

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit I

1.1 **Basic concepts of development**:Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and celllineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenic in analysis of development.

1.2 **Gametogenesis, fertilization and early development**:Production of gametes, cell surfacemolecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation andformation of germ layers in animals; Embryo sac development and double fertilizationin plants, embryogenesis, establishment of symmetry in plants; seedformation and germination.

1.3 **Morphogenesis and organogenesis in animals**:Cell aggregation and differentiation in*Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis–vulva formation in *Caenorhabditiselegans*, eye lens induction, limb development andregeneration in vertebrates; differentiation of neurons, post embryonic development- larvalformation, metamorphosis; environmental regulation of normal development; sex determination.

1.4 **Morphogenesis and organogenesis in plants**:Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering,floral meristems and floral development in *Arabidopsis* and *Antirrhinum*.

Reference Books

1. *Plant Physiology and Development, Lincoln Taiz, Oxford*
2. *Developmental Biology, Scott F. Gilbert, Sinauer*
3. *BIOS Instant Notes in Developmental Biology, Richard Twyman, Taylor& Francis*
4. *Embryology of Flowering Plants, T.B. BATYGINA, Science Publishers*

5. *Instant Notes, Plant Biology, A.J. Lack & D.E. Evans, Bios*
6. *An introduction to the embryology of angiosperms, Maheswari, McGRAW-HILL*
7. *Biology, Raven and Johnson,2013, McGraw Hill India publication*
8. *Campbell Biology, Jane B. Reece, Pearson Benjamin Cummings*
9. *Chordate Embryology, Verma P.S. and Agarwal V.K., S chand*
10. *Inderbir Singh's Human Embryology, V Subhadra Devi, Jaypee Brothers Medical Publishers*

Unit II

2.1 **Sensory photobiology:**Structure, function and mechanisms of action ofphytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

2.2 **Solute transport and photoassimilate translocation**:uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells,across membranes, through xylem and phloem; transpiration; mechanisms ofloading and unloading of photoassimilates.

2.3 **Secondary metabolites**:Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

2.4 **Stress physiology:**Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Reference Books

1. *Plant Physiology and Development, Lincoln Taiz, Oxford*
2. *Physiology and Molecular Biology of Stress Tolerance in Plants, Rao, Springer*
3. *Introduction to Plant Physiology, William G. Hopkins and Norman P. A., John Wiley & Sons, Inc.*
4. *Campbell Biology, Jane B. Reece, Pearson Benjamin Cummings*
5. *Biology, Raven and Johnson, McGraw Hill India publication*

Unit III

3.1 **Blood and circulation**: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis; Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above; Respiratory system - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

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

3.2 **Digestive system**: Digestion, absorption, energy balance, BMR; Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste

elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

3.4 **Thermoregulation:** Comfort zone, body temperature: physical, chemical, neural regulation, acclimatization; Stress and adaptation

Reference Books

1. *Vander's Human Physiology: The Mechanisms of Body Function, Eric Widmaier, McGraw-Hill Education*
2. *Guyton & Hall Textbook of Medical Physiology: A South Asian Editionby Mario Dr. Vaz, Tony Dr. Raj, Elsevier India*
3. *Human Physiology: An Integrated Approach, Silverthorn, Pearson Education India*
4. *Campbell Biology, Jane B. Reece, Pearson Benjamin Cummings*
5. *Biology, Raven and Johnson,2013, McGraw Hill India publication*

Unit IV

4.1 **Cell death:**Programmed cell death, aging and senescence.

4.2 **Microbial Physiology**: Growth yield and characteristics, strategies of cell division, stress response; Microbial fermentation and production of small and macro molecules.

4.3 **Plant hormones**: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

4.4 **Endocrinology and reproduction**: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

Reference Books

1. *Developmental Biology, Scott F. Gilbert, Sinauer*
2. *BIOS Instant Notes in Developmental Biology, Richard Twyman, Taylor & Francis*
3. *The Physiology and Biochemistry of Prokaryotes, David white*
4. *Introduction to Plant Physiology, William G. Hopkins and Norman P. A., John Wiley & Sons, Inc.*
5. *Plant Physiology and Development, Lincoln Taiz, Oxford*
6. *Vander's Human Physiology: The Mechanisms of Body Function, Eric Widmaier, McGraw-Hill Education*
7. *Guyton & Hall Textbook of Medical Physiology: A South Asian Editionby Mario Dr. Vaz, Tony Dr. Raj, Elsevier India*
8. *Human Physiology: An Integrated Approach, Silverthorn, Pearson Education India*
9. *Campbell Biology, Jane B. Reece, Pearson Benjamin Cummings*
10. *Biology, Raven and Johnson,2013, McGraw Hill India publication*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-105**	**Semester**	**I**
Practical Based on BIOS-101 to 104			
Course type	**Practical**	**Total Credit**	**08**
Teaching time	**Examination Marking Scheme**		
Practical (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
16/week	**60**	**140**	**200**

The Course mainly emphasize on practical skill cell biology, biochemistry, Instrumentation, environmental sample analysis.

- **CO 1**Ability to apply basic principles of chemistry to biological systems and molecular biology.
- **CO 2** Ability to relate various interrelated physiological and metabolic events.
- **CO 3** A general awareness of current developments at the forefront in biochemistry and alliedsubjects.
- **CO 4** Ability to critically evaluate a problem and resolve to challenge blindly accepted concepts.
- **CO 5** Zeal and ability to work safely and effectively in a laboratory.
- **CO 6** Good experimental and quantitative skills encompassing preparation of laboratory
- **CO 7** Reagents, conducting experiments, satisfactory analyses of data and interpretation of results.
- **CO 8** Awareness of resources, and their conservation.
- **CO 9** Ability to think laterally and in an integrating manner and develop interdisciplinaryapproach.
- **CO 10** Overall knowledge of the avenues for research and higher academic achievements in the field of botany and allied subjects.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						
CO7						
CO8						
CO9						
CO10						

BIOS 105: Practical Based on BIOS-101 to 104

Following are the indicative list of the experiments. Changes can be done depending upon the departmental need and availability of the resources

Biochemistry

1. Preparation of buffer and solution of different concentration, Normality and molarity, Determination of pKa
2. Estimation of protein by biuret method
3. Estimation of protein by Lowry's method
4. Estimation of protein by Bradford method
5. Lambda Max for protein and amino acids
6. Determination of molar absorbance coefficient of l-tyrosine
7. Estimation of sugar by Anthrone method
8. Estimation of sugar by DNSA
9. Estimation of sugar by Cole's method
10. Estimation of glucose in human serum (GOD- POD) (kit)
11. Estimation of Ascorbic acid
12. Estimation of lipid and fatty acid
13. To study the effect of pH, temperature, salt and substrate on enzyme activity
14. Determination of Km and Vmax of enzyme.
15. Enzyme inhibition study-**(1)** competitive inhibition **(2)** Uncompetitive inhibition
16. Estimation of Aspartate aminotransferase (AST) &Alanine aminotransferase (AST) (kit)
17. Estimation of Lactate dehydrogenase (LDH) (Kit)

Reference Books

1. *Introductory Practical Biochemistry, Narosa Publishing House*
2. *Laboratory manual in Biochemistry, New Age International (P) Limited, Publisers*
3. *An Introduction to Practical biochemistry by, David T. Plummer, Tata McGraw-Hill Publishing Company Limited*
4. *Biochemistry Practical Manual by Soundravsally Rajendiran & Pooja Dhiman, ELSEVIER*
5. *Laboratory handbook on Biochemistry by S. Shanmugam, T. SathishKumar,PHI Learning Private Limited, New Delhi*
6. *Laboratory Manual of biochemistry by Joy P P, Surya S. and Aswathy C.Kerala Agricultural University*
7. *Lab Workbook, UshwantraoChavan Maharashtra Open University*
8. *Laboratory Protocols in Applied Life Sciences, Bisen, CRC*

Cell Biology and Immunology

1. To study Plant cell, animal cell and bacterial cell
2. To identify the nucleus and nucleolus in onion peel using Toluidine blue
3. Simple staining and negative staining
4. Gram's staining and acid fast staining
5. Special staining: cell wall staining, capsule staining, spore staining
6. To study metachromatic granules in bacteria

7. To study metachromasia by toluidine blue in bone marrow of chicken
8. To isolate liver parenchyma cells and perform viability count (trypan blue exclusion test for cell viability)
9. To isolate chloroplast fraction of the plant cells (spinach) by density gradient centrifugation method
10. To isolate nuclear and mitochondrial fractious of the cells by density gradient centrifugation method and staining by Schiff's reagent &Jenus green-B
11. To perform differential count in human blood smear
12. To perform Total White Blood cell (WBC) and Red Blood Cells (RBC) in human blood
13. To study different phases of mitosis in onion root tip by squash preparation
14. To identify the presence of Barr body in the female buccal epithelial cells
15. Widal test for Typhoid detection/VDRL test for Syphilis (kit)
16. HIV detection test (kit)
17. Malarial parasite detection (kit)

References:

1. *Microbiology A laboratory manual, by James cappuccino and natalie Sherman, Pearson India Education Services Pvt. Ltd.*
2. *Introductory Practical Biochemistry, Narosa Publishing House.*
3. *Life Sciences Protocol manual, DBT Star College Scheme, 2018*
4. *Laboratory manual for Biotechnology By, Ashish Verma, Surjit Das &Anchal Singh, S, Chand*

Instrumentation technique and Biostatistics

1. Validation and Calibration of Balance, pH meter, Centrifuge, Spectrophotometer, laminar air flow, Autoclave, incubator, ion analyser etc. instruments.
2. Exposure to the different imaging techniques
3. Microscopy: Fluorescence, Phase contrast, bright field etc.
4. Flame photometry
5. Atomic absorbance Spectrophotometer (AAS) (Demonstration)
6. Separation of sugar/ fatty acid by Thin Layer Chromatography
7. High performance Thin Layer Chromatography (HPTLC)
8. High performance Liquid Chromatography (HPLC)
9. Gas Chromatography- Mass Spectrometry (GC-MS)
10. Gel-filtration/ Column Chromatography
11. SDS-PAGE analysis of protein
12. ELISA
13. ***Statistical experiments based on the manual and computer:***Descriptive Statistics, t- test, ANOVA, Chi square, Regression, Correlation
14. Graphical representation

Reference Books

1. *Laboratory manual for Biotechnology By, Ashish Verma, Surjit Das &Anchal Singh, S, Chand*
2. *Introductory Practical Biochemistry, Narosa Publishing House*
3. *Laboratory manual in Biochemistry, New Age International (P) Limited, Publishers*
4. *A manual for Biochemistry Protocol by Marcus R Wenk, World Scientific.*

5. *Biostatistics and Microbiology- A survival Manual by Daryl S. Paulson, Springer*

Developmental Biology and Physiology

1. Renal profile
2. Cardiac profile
3. Liver profile
4. Stress response in animals
5. Stress response in microbes
6. Stress response in plants: rate of photosynthesis under different conditions
7. Observation of various developmental stages in animal
8. Sperm viability test
9. Observation of various developmental stages in plants
10. Artificial pollination by emasculation (bagging method)
11. Pollen germination and viability test
12. Demonstration the phenomenon of osmosis using potato osmoscope.
13. Measurement of diffusion pressure and osmotic pressure in plant cell.
14. To study the evolution of Oxygen by isolated chloroplast using Hill oxidants
15. Qualitative and quantitative determinationsof alkaloids, terpenoids, and phenolics in plants
16. To find out stomatal Index in various stress condition
17. To study symbiotic and non-symbiotic bacteria from Rhizosphere.
18. The respiration of mitochondria and oxidative phosphorylation
19. Bacterial growth curve

Reference Books

1. *Biochemistry Practical Manual by SoundravsallyRajendiran&PoojaDhiman, ELSEVIER*
2. *Experiments in Plant Physiology: A Laboratory Manual, Narosa*
3. *An introduction to practical Biochemistry by David T Plummer, Tata McGraw Hill*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-201**	**Semester**	**II**
Evolution and Genetics			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-201:EVOLUTION AND GENETICS

Learning Objective and Outcomes:

The course concentrate on understanding of origin, evolutionary mechanism and genetics aspects of life. The aim of the course is to provide students with a deeper insight into the evolutionary processes. On completion of the course the students will be able to

- **CO 1** Describe the origin, evolutionary mechanism of life forms.
- **CO 2** Student will be correlate the evolution processes with behavior biology, palaeontology and molecular biology.
- **CO 3** Student will be explain the traditional to modern aspects with practical application in genetics.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit I

1.1 **Emergence of evolutionary thoughts Lamarck:**Darwin-concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

1.2 **Origin of cells and unicellular evolution:** Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes;

1.3 **Origin of eukaryotic cells**: Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

1.4 **Paleontology and Evolutionary History:** The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

Reference Books

1. Evolution third edition, Mark Ridley, Blackwell Publishing
2. Evolution, Strickberger, Monroe W, Jones & Bartlett Publishers, Inc.
3.Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Verma and Agarwa, S. Chand
4.Biology, Raven and Johnson,2013, McGraw Hill India publication
5.Life: The Science of Biology, William, W. H. Freeman
6.Campbell Biology, Jane B. Reece, Pearson Benjamin Cummings

Unit II

2.1 **Molecular Evolution**: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein

and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

2.2 **The Mechanisms**: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

2.3 **Brain and Evolution:** Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basisof learning, memory, cognition, sleep and arousal; Biological clocks;

2.4 **Behavior and Evolution:**Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

Reference Books

1. Evolution third edition, Mark Ridley, Blackwell Publishing
2. Evolution, Strickberger, Monroe W, Jones & Bartlett Publishers, Inc.
3. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Verma and Agarwa, S. Chand
4. Biology, Raven and Johnson,2013, McGraw Hill India publication
5. Life: The Science of Biology, William, W. H. Freeman
6. Campbell Biology, Jane B. Reece, Pearson Benjamin Cummings

Unit III

3.1 **Mendelian principles:** Dominance, segregation, independent assortment, Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

3.2 **Gene mapping methods:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

3.3 **Extra chromosomal inheritance:** Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

3.4 **Microbial genetics**: Methods of genetic transfers- transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

Reference Books

1. Molecular biology of the Gene, Watson, Person
2. Principle of Genetics, Tamrine, Tata McGraw Hill
3. Genetics A Conceptual Approach, Benjamin A. Pierce, WH Freeman
4. Genetics, Karvita B. Ahluwalia, New Age
5. Concepts of Genetics, Klug, Cummings, Spence, Person
6. Genetics, Strickberger, Person
7. Principles of Genetics, Gardner, Wiley
8. Molecular Genetics of Bacteria, Larry Snyder, Wendy Champness, American Society for Microbiology

9. Microbial Genetics Paperback, Chaudhuri.The Energy and Resources Institute, TERI
10. Genetic analysis: An Integrated Appraoch by Mark F Sanders, Pearson Education

Unit IV

4.1 **Human genetics:** Pedigree analysis, LOD score for linkage testing, karyotypes, genetic disorders.

4.2 **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.

4.3 **Mutation:** Types, causes and detection, mutant types- lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis; Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

4.4 **Recombination:** Homologous and non-homologous recombination including transposition.

Reference Books

1. Molecular biology of the Gene, Watson, Person
2. Principle of Genetics, Tamrine, Tata McGraw Hill
3. Genetics A Conceptual Approach, Benjamin A. Pierce, WH Freeman
4. Genetics, Karvita B. Ahluwalia, New Age
5. Concepts of Genetics, Klug,Cummings, Spence, Person
6. Genetics, Strickberger, Person
7. Principles of Genetics, Gardner, Wiley
8. Molecular Genetics of Bacteria, Larry Snyder, Wendy Champness, American Society for Microbiology
9. Microbial Genetics Paperback, Chaudhuri, The Energy and Resources Institute, TERI
10. Genetic analysis: An Integrated Approach by Mark F Sanders, Pearson Education

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-202**	**Semester**	**II**
Molecular Biology and Recombinant DNA Methods			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-202:MOLECULAR BIOLOGY AND RECOMBINANT DNA METHODS

Learning Objective and Outcomes:

The subject offers the in-depth knowledge of the concepts, tools, techniques and process related to Molecular biology and recombinant DNA technology with respect to prokaryotic and eukaryotic cell

- **CO 1** Student will able to understand central dogma of life and compare the molecular biological processes among prokaryotic and eukaryotic cell.

- **CO 2** Student will able to describe and apply the recombinant DNA technology
- **CO 3** Student will able to explain the quantification, decoding, cloning and modification of gene and genome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit I

1.1 **Prokaryotic replication system:**Semiconservative nature of replication; Bacterial Replication

1.2 **Eukaryotic Archaeal replication system**Eukaryotic and Archaeal DNA Replication; Breakage, Alignment, and Repair of DNA Strands

1.3 **Transcription:**An Early RNA World, The Structure of RNA, Classes of RNA, Synthesis of an RNA Molecule from a DNA Template; Bacterial Transcription; Eukaryotic and Archaeal Transcription

1.4 **Translation:**RNA Molecules and RNA Processing: capping,elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation

Reference Books

1. Molecular Biology, Robert F. Weaver, McGraw-Hill Higher Education
2. LIR: Cell and Molecular Biology, Chandar, Wolters Kluwer India Pvt. Ltd.
3. Essentials of Molecular Biology, Malathi, Person
4. Cell and Molecular Biology,S.C.Rastogi, New Age international
5. Genes IX Benjamin Lewin, Jones and Barlett
6. Genetics A Conceptual Approach- 5th Ed. Benjamin A. Pierce
7. Principle of Genetics, Tamrine, Tata McGraw Hill
8. Fundamentals of Molecular Biology – Jayanta K. Pal and Saroj S. Ghaskadbi
9. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Verma &Agarwa, S. Chand
10. Molecular biology of the gene, Watson, Pearson

Unit II

2.1 **Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyltRNAsynthetase, and translational proof-reading, translational inhibitors,

2.2 **Protein modification:**Post- translational modification of proteins.

2.3 **Viral Prokaryotic Gene expression control :**Control of gene expression at transcription and translation level for prokaryotes; regulating the expression of phages, viruses

2.4 **Eukaryotic gene expression control:**Control of gene expression at transcription and translation level for eukaryotes

Reference Books

1. Molecular Biology, Robert F. Weaver, McGraw-Hill Higher Education
2. LIR: Cell and Molecular Biology, Chandar, Wolters Kluwer India Pvt. Ltd.
3. Essentials of Molecular Biology, Malathi, Person

4. Cell and Molecular Biology, S.C. Rastogi, New Age international
5. Genes IX Benjamin Lewin, Jones and Barlett
6. Genetics A Conceptual Approach- 5th Ed. Benjamin A. Pierce
7. Principle of Genetics, Tamrine, Tata McGraw Hill
8. Fundamentals of Molecular Biology – Jayanta K. Pal and Saroj S. Ghaskadbi
9. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Verma &Agarwa, S. Chand
10. Molecular biology of the gene, Watson, Pearson

Unit III

3.1 **Gene isolation:**Isolation and amplification of specific nucleic acid sequences, PCR, RT-PCR and qPCR.

3.2 **Enzymes for R DNA technology**: Enzymes used in Recombinant DNA technology; Analysis of DNA polymorphism: RFLP, RAPD and AFLP techniques.

3.2.1 **Vector:**Vector used in Gene cloning: Plasmid, Bacteriophage, M13, Yeast cloningvector, Other Vectors.

3.2.2 **Chimeric DNA and Transformation:** Joining of DNA fragment, Introduction of DNA in host cell.

Reference Books

1. *Principles of Genome Analysis and Genomics, Sandy B. Primrose, Wiley-Blackwell*
2. *Principles of Gene Manipulation, Sandy B. Primrose, Wiley-Blackwell*
3. *Genetic Engineering – Smita Rastogi and Neelam Pathak*
4. *Gene Cloning and DNA Analysis, T. A. Brown, Wiley-Blackwell*
5. *Analysis of Genes and Genomes, Richard J. Reece, John Wiley & Sons, Ltd*
6. *Genetic Engineering, Verma P.S., S Chand & Company*
7. *An Introduction to Genetic Engineering, Nicholl, Cambridge University Press*
8. *Genetic Engineering, Sandhya Mitra, McGraw Hill Education*
9. *Recombinant Dna Technology and Genetic Engineering Paperback, K Rajagopa, McGraw Hill Education*
10. *Recombinant DNA Technology, Keya Chaudhuri, The Energy and Resources Institute, TERI*

Unit IV

4.1 **Library preparation:**Construction of Genomic and cDNA library; Techniques for selection, screening and characterization of transformants.

4.2 **Expression:**Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques.

4.3 **Mutagenesis:***In vitro* mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.

4.4 **Application:**Genomics and its application to health and agriculture, including genetherapy.

Reference Books

1. *Principles of Genome Analysis and Genomics, Sandy B. Primrose, Wiley-Blackwell*
2. *Principles of Gene Manipulation, Sandy B. Primrose, Wiley-Blackwell*
3. *Genetic Engineering – Smita Rastogiand Neelam Pathak*
4. *Gene Cloning and DNA Analysis, T. A. Brown, Wiley-Blackwell*
5. *Analysis of Genes and Genomes, Richard J. Reece, John Wiley & Sons, Ltd*
6. *Genetic Engineering, Verma P.S., S Chand & Company*
7. *An Introduction to Genetic Engineering, Nicholl, Cambridge University Press*
8. *Genetic Engineering, Sandhya Mitra,,McGraw Hill Education*
9. *Recombinant DNA Technology and Genetic Engineering Paperback, K Rajagopa, McGraw Hill*
10. *Education*
11. *Recombinant DNA Technology, Keya Chaudhuri, The Energy and Resources Institute, TERI*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-203**	**Semester**	**II**
Diversity and Ecology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-203:DIVERSITY AND ECOLOGY

Learning Objective and Outcomes:

The course provides the Biodiversity concept and details information of ecology, taxonomy and natural history of Indian subcontinent. The subject elicit the interest of student regarding the nature conservation, natural biodiversity and environmental legislation of India

- **CO 1**Student shall get the information of natural flora, fauna of the world and India with current status of the population dynamics, the human intervention on ecosystem and community.
- **CO 2** Student will get the fundamental knowledge about the applied ecology and its application in conservation biology and sustainable development.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

.

Unit I

1.1 **Principles & methods of taxonomy**: Concepts of species and hierarchical taxa, biological nomenclature, classical &quantitative methods of taxonomy of plants, animals and microorganisms.

1.2 **Levels of structural organization:** Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.

1.3 **Outline classification of plants, animals & microorganisms:** Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa.

1.4 **Natural history of Indian subcontinent:** Major habitat types of the subcontinent, geographic origins and migrations of species. Common Indian mammals, birds. Seasonality and phenology of the subcontinent.

Reference Books

1. *Biodiversity: Perception, Peril and Preservation Prabodh K. Maiti, PHI Learning Private Limited*
2. *The Bio-Diversity of India,Erach Bharucha, Grantha Corporation*
3. *Biogeography and Biodiversity, R. B. Singh, Rawat Pubns*
4. *An Introduction to Biodiversity, Prithipalsingh, Ane books*

5. *An Advanced Textbook on Biodiversity, K. V. Krishnamurthy*
6. *BiodiversityMeasurement and estimation, Hawksworth, Chapman*

Unit II

2.1 **Organisms of health & agricultural importance:** Common parasites and pathogens of humans, domestic animals and crops.

2.2 **Organisms of conservation concern:** Rare, endangered species. Conservation strategies.

2.3 Methods in field biology: Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods.

2.4 **Biodiversity:**Bioresource and uses of biodiversity,pollution and environment related law, EIA

Reference Books

1. *Biodiversity: Perception, Peril and Preservation Prabodh K. Maiti, PHI Learning Private Limited*
2. *The Bio-Diversity of India,Erach Bharucha, Grantha Corporation*
3. *Biogeography and Biodiversity, R. B. Singh, Rawat Pubns*
4. *An Introduction to Biodiversity, Prithipalsingh, Ane books*
5. *An Advanced Textbook on Biodiversity, K. V. Krishnamurthy*
6. *Biodiversity Measurement and estimation, Hawksworth, Chapman*
7. *Environmental Sciences C Santra*

Unit III

3.1 **The Environment:** Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

3.2 **Population Ecology**: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

3.3 **Species Interactions:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

3.4 **Community Ecology**: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Reference Books

1. *Fundamentals of Ecology, Eugene Odum, Cengage*
2. *Concepts of Ecology, Kormondy Edward, Pearson Education*
3. *Elements of Ecology, Smith, Pearson Education*
4. *Fundamentals of Ecology and Environmental Biology, S. C. Santra*
5. *Essentials of Ecology and Environmental Science, Rana, PHI*
6. *Ecology: he Experimental Analysis of Distribution and Abundance, Person*
7. *The Ecology Book (Big Ideas Simply Explained),DK, DK publication*
8. *Fundamentals of Ecology, M. Dash, McGraw Hill Education*
9. *Ecology: Concepts and Applications, Manuel C Molles, McGraw-Hill Higher Education*
10. *First Ecology, Alan, Oxford*
11. *Ecology and Environment, PD Sharma, RastogiPublications*

Unit IV

4.1 **Ecological Succession:** Types; mechanisms; changes involved in succession; concept of climax.

4.2 **Ecosystem Ecology:** Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, and P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

4.3 **Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

4.4 **Applied Ecology:** Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches; Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).Bioremediation and phytoremediation

Reference Books

1. *Fundamentals of Ecology, Eugene Odum, Cengage*
2. *Concepts of Ecology, Kormondy Edward, Pearson Education*
3. *Elements of Ecology, Smith, Pearson Education*
4. *Fundamentals of Ecology and Environmental Biology, S. C. Santra*
5. *Essentials of Ecology and Environmental Science, Rana, PHI*
6. *Ecology: he Experimental Analysis of Distribution and Abundance, Person*
7. *The Ecology Book (Big Ideas Simply Explained),DK, DK publication*
8. *Fundamentals of Ecology, M. Dash, McGraw Hill Education*
9. *Ecology: Concepts and Applications, Manuel C Molles, McGraw-Hill Higher Education*
10. *First Ecology, Alan, Oxford*
11. *Ecology and Environment, PD Sharma, RastogiPublications*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-204**	**Semester**	**II**
Bioinformatics, IPR, Biosafety & Bioethics			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-204:BIOINFORMATICS, IPR, BIOSAFETY & BIOETHICS

Learning Objective and Outcomes:

The most valuable knowledge need to learn the student is the moral values and ethics along with the gaining of the knowledge of the interdisciplinary subject. The course provide the information and knowledge of the IPR, Biosafety and B

- **CO 1**Student will be utilized the available biological database, online resources and tools.

- **CO 2** Student will be able to understand and perform the bimolecular structure visualization, sequences alignment, modelling and drug discovery
- **CO 3** Student will be able to understand the regulation and importance of IPR and patent along with the ethical concern
- **CO 4** Student will be able to understand the Biosafety requirement and practice it during his/her practical and research work

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Unit I

1.1 **Major Bioinformatics Resources**: Sequence databases, Gene Expression database: GEO, SAGE, 3D Structure Database: PDB, NDB, Knowledge driven Databases & utility, Pattern Sequence: InterPro, Prosite, Pfam, ProDom, Gene Ontology.

1.2 **Database Searches:** Keyword-based searches using tools like ENTREZ and SRS Sequence-based searches: BLAST and FASTA.

1.3 **Sequence Analysis, Basic concepts:** Sequence similarity, identity and similarity, definitions of homologues, orthologues, paralogues, Tandem and Interspersed repeats, repeat finding, Scoring Matrix, Pairwise sequence alignments

1.4 **Multiple alignment**: Multiple sequence alignments(MSA), Application in Taxonomy and phylogeny, Comparative genomics.

Reference Books

1. Bioinformatics: Principles and Applications, Zhumur Ghosh, Oxforrd
2.Bioinformatics, Orengo, Advanced Text
3.Introduction to genomics, Arthur lesk, Oxford
4.Bioinformatics, Ratogi, PHI
5.Bioinformatics Bosu, Oxford
6.Introduction to Bioinformatics Paperback, Lesk, Oxford
7.Introduction to Bioinformatics, Teresa Attwood, Pearson Education
8.Essential bioinformaics, Jin Xiong, Cambridge University Press
9.Bioinformatics: Sequence and Genome Analysis, Mount, CBS

Unit II

2.1 **Structural Biology:** 3-D structure visualization and simulation, Basic concepts in molecular modeling: different types of computer representations of molecules. External coordinates and Internal Coordinates, Molecular Mechanics, Force fields etc.

2.2 **Proteins:** Secondary structure elucidation using Peptide bond, phi, psi and chi torsion angles, Ramachandran map, anatomy of proteins – Hierarchical organization of protein structure –like CATH,SCOP, FSSP; DNA & RNA secondary and tertiary structures, t-RNA tertiary structure.

2.3 **Classification and comparison of protein 3D structures:** Secondary structure prediction: Algorithms viz. Chou Fasman, GOR methods, Tertiary Structure prediction: Fundamentals of the methods for 3D structure prediction (sequence similarity/identity of target proteins of known structure, fundamental principles of protein folding etc.) Homology/comparative modeling, fold recognition, threading approaches, and *ab initio* structure prediction methods. CASP. Computational design of Promoters, Proteins & Enzymes

2.4 **Application in drug design:** Chemical databases like NCI/PUBCHEM. Fundamentals of Receptor-ligand interactions. Structure-based drug design: Identification and Analysis of Binding sites and virtual screening. Ligand based drug design: Structure Activity Relationship – QSARs &Pharmacophore etc. *In silico* predictions of drug activity and ADMET.

Reference Books

1. Bioinformatics: Principles and Applications, Zhumur Ghosh, Oxforrd
2.Bioinformatics, Orengo, Advanced Text
3.Introduction to genomics, Arthur lesk, Oxford
4.Bioinformatics, Ratogi, PHI
5.Bioinformatics Bosu, Oxford
6.Introduction to Bioinformatics Paperback, Lesk, Oxford
7.Introduction to Bioinformatics, Teresa Attwood, Pearson Education
8.Essential bioinformaics, Jin Xiong, Cambridge University Press
9.Bioinformatics: Sequence and Genome Analysis, Mount, CBS

Unit III

3.1 **IP:**Types of IP Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP. IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS.

3.2 **Patent Databases:**Invention in context of "prior art"; Patent databases; Searching International
Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation.

3.3 **Patent Types:**Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patentapplication; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties;Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure forfiling a PCT application.

3.4 **Patent Application:**Patent application- forms and guidelines, fee structure, time frames; Types of patentapplications: provisional and complete specifications; PCT and

convention patentapplications; International patenting-requirement, procedures andcosts; Financialassistance for patenting-introduction to existing schemes; Publication of patents-gazette of India, status in Europe and US Patenting by research students, lecturers and scientists-University/organizational rules in India and abroad, credit sharing by workers, financial incentives, Patent infringement- meaning, scope, litigation, case studies and examples.

Reference Books

1. IPR, Biosafety and Bioethics, Goel and Parashar, Person

2.A Book on Indian Patenting System and Patent Agent Examination, Sheetal Chopra, Notion Press

3.A Book on Indian Patenting System and Patent Agent Examination, Sheetal Chopra, Notion Press

4.Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Anil Kumar, Ramakrishna, Notion Press

5.Intellectual Property Rights (IPRs): TRIPS Agreement & Indian Laws, E. T. Lokganathan, New Century Publications

6.How to Patent an Idea in India, Prasad Karhad

7.Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science Paperback, Yali Friedman, Logos Press

Unit IV

4.1 **Biosafety fundamentals**: Introduction; Historical Background; Introduction to Biological SafetyCabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels ofSpecific Microorganisms; Recommended Biosafety Levels forInfectious Agents andInfected Animals;

4.2 **Biosafetyregulation :**Biosafety guidelines-Government of India; Definition of GMOs &LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.Transgenic animals and plants, molecular approaches to diagnosis andstrain identification.

4.3 **Bioethics:** Concepts; Philosophical considerations; Epistemology of Science; Ethical Terms; Principles & Theories; Relevance to Biotechnology; Ethics and the Law Issues: Genetic Engineering, Stem Cells, Cloning, Medical techniques, Trans-humanism, Bioweapons; Research concerns - Animal Rights, Ethics of Human Cloning, Reproduction and Stem Cell Research;

4.4 **Emerging issues:** Biotechnology's Impact onSociety; DNA on the Witness Stand - Use of genetic evidence in civil and criminal court cases; Challenges to Public Policy – To Regulate or Not to Regulate; Improving public understanding of biotechnology products to correct misconceptions.

Reference Books

1. *IPR, Biosafety and Bioethics, Goel And Parashar, Person*
2. *Bioethics and Biosafety M.K. Sateesh, I K International Publishing House*

3. *Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Anil Kumar, Ramakrishna, Notion Press*
4. *Biosafety and Regulation for Genetically Modified Organisms, Xue, lpha Science International Ltd*
5. *Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science Paperback, Yali Friedman, Logos Press*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-205**	**Semester**	**II**
Practical Based on BIOS-201 to 204			
Course type	**Practical**	**Total Credit**	**08**
Teaching time	**Examination Marking Scheme**		
Practical (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
16/week	**60**	**140**	**200**

The Course mainly emphasize on practical skill cell biology, biochemistry, Instrumentation, environmental sample analysis.

- **CO 1**Ability to apply basic principles of chemistry to biological systems and molecular biology.
- **CO 2** Ability to relate various interrelated physiological and metabolic events.
- **CO 3** A general awareness of current developments at the forefront in biochemistry and alliedsubjects.
- **CO 4** Ability to critically evaluate a problem and resolve to challenge blindly accepted concepts.
- **CO 5** Zeal and ability to work safely and effectively in a laboratory.
- **CO 6** Good experimental and quantitative skills encompassing preparation of laboratory
- **CO 7** Reagents, conducting experiments, satisfactory analyses of data and interpretation of results.
- **CO 8** Awareness of resources, and their conservation.
- **CO 9** Ability to think laterally and in an integrating manner and develop interdisciplinaryapproach.
- **CO 10**Overall knowledge of the avenues for research and higher academic achievements in thefield of biochemistry and allied subjects.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						
CO7						
CO8						
CO9						
CO10						

BIOS 205: Practical based on paper 201 to 204

Following are the indicative list of the experiments. Changes can be done depending upon the departmental need and availability of the resources

Evolution and Genetics

1. Fossils study
2. Mendelian genetics
3. Chromosome banding techniques
4. Study of polytene chromosome in larva
5. A study of Lampbrush chromosome
6. To perform Peripheral Blood Lymphocyte Culture (PBLC) and to observe metaphase chromosomes by wet-dry preparation
7. To perform Micronucleus Assay
8. MTT Assay
9. Petite mutant in yeast
10. Fluctuation test
11. Conditional mutation
12. UV Mutagenesis in *E. coli*
13. Ames test
14. Isolation of a streptomycin-resistant mutant by gradient plate technique
15. Molecular Phylogenetic analysis

Reference Books

1. *Laboratory manual for Genetic Engineering by S. John venison, PHI learning Private Ltd.*
2. *Life Science Protocol manual DBT, Star College Scheme 2018*
3. *Microbiology – A laboratory Manual by James Cappuccino and Natalie Sheman, Pearson*
4. *Laboratory Protocols in Applied Life Sciences, Bisen, CRC*

Molecular Biology and Recombinant DNA methods

16. Isolation of DNA from Plant
17. Agarose gel electrophoresis
18. RAPD
19. Isolation of DNA from blood
20. Isolation of Bacterial Genomic DNA
21. PCR
22. Amplified rDNA Restriction Analysis (ARDRA)/RFLP
23. Isolation of plasmid vector pUC19 by alkaline lysis method
24. Metagenome isolation
25. Primer design
26. T-A Cloning in bacteria
27. Transformation of vector pUC19 into *E. coli* DH5 alpha and Demonstration of blue-white selection for DH5 alpha and pUC19 vector

Reference Books

1. *Laboratory manual for Genetic Engineering by S. John venison, PHI learning Private Ltd.*
2. *Life Science Protocol manual DBT, Star College Scheme 2018*

3. *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications by R. Ian Freshney*
4. *Microbiology – A laboratory Manual by James Cappuccino and Natalie Sheman, Pearson*

Diversity and Ecology

28. Study of biodiversity by Quadrant analysis
29. Primary productivity in fresh water bodies
30. Construction of Winogradsky column
31. Soil Biofilms by the Buried Slide Technique
32. Biological analysis of water (MNP, BOD, SPC)
33. Biological analysis of Soil i.e. total viable count
34. Physico-chemical analysis of water
35. Physico-chemical analysis of Soil
36. Air quality study
37. Cultivation and isolation of Microorganisms (Bacteria, fungi, Mushroom etc.)
38. Carbon Credit and foot print

Reference Books

1. *Laboratory Manual of Microbiology, Biochemistry and Molecular Biology by Jyoti Saxena et al, Scientific publication India*
2. *Microbiology – A laboratory Manual by James Cappuccino and Natalie Sheman, Pearson*
3. *IS manuals*
4. *Guide manual water and wastewater analysis, Central Pollution Control Board*
5. *American Public Health Association*
6. *Handbook of soil analysis by Marc Pansu, Jacques Gautheyrou, Springer*
7. *Hand Book of Water, Air and Soil Analysis, Anand Dev Gupta, International E - Publication*

Bioinformatics, IPR, Biosafety and Bioethics

39. Biological databases search
40. Sequence alignments
41. Protein structure prediction
42. Molecular Docking
43. QSAR study
44. Genomes annotation
45. Proteomics database search
46. Patent database search
47. Diversity indices calculation by PAST
48. GMO detection using cotton seeds

Reference Books

1. *Practicals in Bioinformatics, P. Shanmughavel, Pointer Publishers*
2. *Bioinformatics: A Practical Manual Kasturi K (Author), K. Sri Lakshmi, PharmaMed Press*
3. *Current protocol, wiley.com*
4. *Cold Spring Harbor Protocols*

SYLLABUS

M.Sc. Biosciences (Botany)

Sem. III and IV

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. June 2020

Department of Biosciences

Veer Narmad South Gujarat University, Surat

M.Sc. Biosciences (Botany)Semester- III							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios -(B)-301	Phycology, Mycology and Plant Pathology	4	-	70	30	100	4
Bios -(B)-302	Advances in Archegoniatae and Paleobotany	4	-	70	30	100	4
Bios -(B)-303	Developmental Biology	4	-	70	30	100	4
Bios -(B)-304 (Elective)	(i) Medicinal Plants OR (ii) Plant Biotechnology OR (iii) Horticulture	4	-	70	30	100	4
Bios -(B)-305	Practical Based on Bios -(B)-301 to 304	-	16	140	60	200	8
Total		**16**	**16**	**420**	**180**	**600**	**24**

M.Sc. Biosciences (Botany) Semester- IV							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios -(B)-401	Angiosperm taxonomy	4	-	70	30	100	4
Bios -(B)-402	Plant Anatomy and Histo-Chemical Techniques	4	-	70	30	100	4
Bios -(B)-403	Research Methodology and Professional Skills	4	-	70	30	100	4
Bios -(B)-404	Dissertation/Industrial Training	-	12	105	45	150	6
Bios -(B)-405	Practical Based on Bios -(B)-401 to 403	-	12	105	45	150	6
Total		**12**	**24**	**420**	**180**	**600**	**24**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-301**	**Semester**	**III**
Phycology and Mycology and Plant Pathology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS -(B)-301 – PHYCOLOGY AND MYCOLOGY AND PLANT PATHOLOGY

Learning Objectives and Course Outcomes: .

- **CO 1**This Course focuses on the classification and general accounts of Algae and Fungi. It also includes interaction between plant and pathogen.
- **CO 2** After learning units I, II & III the students will able to understand the classification of algae and fungi including general account of different classes.
- **CO 3** Students will be able to understand, in unit IV, the interaction between pathogen and plant. Learn the defense mechanism of plants against pathogen along with general interaction with non-pathogenic microbes.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit-IClassification and Evolution in Algae

1.1 Classification (Fritsch's system and G. M. Smith system), pigments and storage food material, thallus organization, cellular organization, reproduction, life cycle patterns andalternati of generationsin the Algae.Molecular taxonomy and recent developments in the algal classification.

1.2 General characters and type study of Cyanophyta, Chlorophyta, Euglenophyta, Xanthophyta.

1.3 General characters and type study of Bacillariophyta, Phaeophyta and Rhodophyta.

1.4 Origin of sex in the algae, Evolution in the algae, Fossil Algae.

Ref.

1. Brodie, J. and Lewis, J. (2007). (Ed.) Unravelling the algae: the past, present and future of algal systematics. CRC press, New York, pp. 335.
2. Bellinger, E. G. and Sigee, D. C. (2010). Freshwater algae: Identification and use as bioindicators. Wiley-Blackwell, UK, pp. 271.
3. Graham, L. E. and Wilcox, L. W. (2000). Algae. Prentice-Hall, Inc. pp. 640.
4. Lee, R. E. (2008). Phycology. Cambridge University Press, pp. 547.
5. Delevoryas Theodore, 1966. Plant Diversificaiton, Pub. Holt, Rinehart and Winston, Inc.
6. Gangulee HC, Kar AS, 1989. College botany Vol-II, Books and Allied (P) Ltd.

Unit-IIAlgae for Environment and Human Welfare

2.1 Algal Biotechnology: Algal culturing techniques in the laboratory, tissue and cell culture studies in seaweeds, cryopreservation, aquaculture (micro and macro algae

cultivation).Algae in bioengineering,Chlamydomonas and Porphyra as modern experimental systems.

2.2 Algeae and Environmen: Bioremediation.Algae as pollution indicators.Algae in global warming-carbon capture by algae.Photo-bioreactors and raceway ponds.Biofertilizer-Nitrogen fixation in heterocyst.Algal blooms and cyanobacterial toxins.

2.3 Algal biofuels: Algal biodiesel, bio-ethanol and biological hydrogen production.

2.4 Industrial Phycology (Products, processes and applications): Seaweeds polysaccharides like Agar, Carrageenan and Alginates. Spirulina-single cell protein. Bioactive compounds from algae. Extracellular products and antimicrobial substances of cyanobacteria.

Ref.

1. Sahoo D., Seckbach J., 2015. The Algae World, Springer.
2. Barsanti L., Gualtieri P., 2014. Algae Anatomy, Biochemistry And Biotechnolgy, 2nd Ed., CRC Press, Taylor & Francis Group.
3. Fritsch, F.E.1945. The Structure and Reproduction of Algae. Cambridge University Press.
4. Vashishta, B.R.1999. Algae. S.Chand & Company, New Delhi.
5. Sharma O.P., 2007. Text book of algae.Tata McGrawHill, ISBN 007451928-X.
6. Dey and Harborne, 1997. Plant Biochemistry, Academic Press. (pg.273-Nitrogen fixation)

Unit-IIITaxonomy and salient features of Fungi

1.1 Classification, general characters, thallus organization, life cycle patterns,reproductive structures of Myxomycotina, Zygomycotina, Mastigomycotina,Ascomycotina, Basidiomycotina and Deuteromycotina.An outline of classification system proposed by Ainsworth or Alexopoulos.

1.2 Fungi and Biotechnology: DNA barcoding for taxonomic identification of fungi. Economic importance of fungi, Fermentation technology &Enzyme and Production technology.

1.3 Evolution in Fungi. Fossil fungi-Occurrence and their significance.Chromista – Its present status in classification; general characters, classification up to orders.

1.4 Lichen: types, morphology and reproduction.

Ref.

1. Roger, 2011, Fungi, Algae, and Protists. Britannica Educational Publishing.
2. Mccoy Peter, 2016. Radical Mycology-A Treatise On Seeing & Working With Fungi. Chthaeus Press.
3. Carlile 2001. The Fungi, 2nd Ed, Academic Press.
4. Weber 2007. Introduction to Fungi. Cambridge University Press.
5. Alexopolus, C. J., Minms, C. W. and Blackwell, M. (1999). (4th edn) Indtroductory Mycology.Wiley, New york. Alford, R. A..
6. Deacon, J. W. (2006). Fungal biology. (4th Ed.) Blackwell publishing, ISBN. 1405130660.
7. Kendrick, B. (1994). The fifth kingdom (paperback), North America, New York, Publisher: 3rd edition, ISBN- 10: 1585100226.
8. Kirk et al., (2001). Dictionary of the fungi, 9th edition, published Wallingford : CABI, ISBN: 085199377X.
9. Mehrotra, R. S. and Aneja, K.R. (1990). An introduction to mycology. New age publishers, ISBN 8122400892.
10. Miguel U., Richard, H. and Samuel, A.(2000). Illustrated dictionary of the Mycology, Elvira Aguirre Acosta, Publisher: St. Paul, Minn: APS press, ISBN 0890542570.
11. Webster, J. and Rpland W. (2007). Introduction to fungi. (3rd Ed.), Cambridge University Press, 978-0-521-80739-5.

Unit-IVPlant Pathology

2.1 Plant- Pathogen Interaction

- Penetration and entry by plant pathogens
- Direct interaction models

- Indirect interaction models
- Case studies of economically important crop plants with causative agents:
  - Plant-virus interactions with emphasis on potyviruses and horticultural crops.
  - Plant-bacterial interactions with emphasis on *Erwinia* sp. and potatoes.
  - Plant-fungus interactions with emphasis on *Magnaporthe* sp. and rice.
  - Plant-nematode interactions with emphasis on *Meloidogyne* sp. and tomato.
  - Plant-insect interactions with emphasis on *Pieris* sp. and crucifers.
- Plant microbial interaction (symbiotic-Rhizobacteria, mycorrhiza, non-symbiotic)

2.2 Defense mechanisms (structural, chemical, SAR). Defense Response Genes.

2.3 Management of plant disease through biological control.

2.4 Defence through Genetically Engineering Disease-Resistant Plants.

Ref.

1. Agarios, G. N. (2005). Plant Pathology, 5th ed. Elsevier.
2. Chakraborty Supriyo, 2018. Plant Molecular Genetics, Scientific Pub.
3. Singh BD and Shekhawat NS, 2018. Molecuar Plant Breeding, Scientific Pub.
4. Aneja KR, 2003. Experiemntas in Microbilogy, Plant Pathology and Biotechnology, 4th Ed., New Age International Pub.
5. Kiraly Z, Klement Z, Solymosy F, Voros J, 1974. Methods in plant Pathology, Elsevier.
6. Mehrotra, R.S. and Aggarwal, A. (2013) Fundamentals of Plant Pathology, 2 Ed., Tata McGrawHill.
7. Mehrotra, R.S. (2000). Plant Pathology, Tata McGraw Hill.
8. Mims, C. A. et al (2000).MIMS' Molecular pathogenesis of Infectious Disease, 5th Ed. Academic Press.
9. Mitra, S. (2007). Genetic Engineering-Principles and Practise. Macmillan India Ltd, New Delhi.
10. Pandey, B. P. (2005) Plant Pathology: Pathogen and Plant disease, S. Chand & Company Ltd. New Delhi.
11. Buchanan B, Gruissem G and Jones R (2000) Biochemistry and Molecular Biology ofPlants. American Society of Plant Physiologists, USA.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-302**	**Semester**	**III**
Advances in Archegoniatae and Paleobotany			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS -(B)-302 – ADVANCES IN ARCHEGONIATAE AND PALEOBOTANY

Learning Objective and Course Outcomes:

- **CO 1**This Course focuses on the classification and general accounts of Bryophytes, Pteridophytes, Gymnosperms and Fossil Records. It also includes the understanding of fossil formation and fossil study.
- **CO 2** After learning units I, II & III the students will able to understand the classification of Bryophytes, Pteridophytes and Gymnosperms including fossil records.
- **CO 3** Students will be able to understand, in unit IV, the formation of fossils and the method to study the fossils.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit-IBryophytes

1.1 Criteria and recent trends in the classification of Bryophytes. Origin and evolution of bryophytes. Vegetative and reproductive innovations of early land plants. Evolution of sporophytes in Bryophytes. Hormonal regulation of gametophyte development in bryophytes. A comparative study of phylogeny, habitat, morphology, anatomy, life cycle, gametophyte and sporophyte organization (with special reference to Indian forms):

- Takakiales, Calobryales, Monocleales, Sphaerocarpales, Marchantiales, Jungermanniales.

1.2 A comparative study of phylogeny,habitat, morphology, anatomy, life cycle, gametophyte and sporophyte organization(with special reference to Indian forms):

- Anthocerotales, Sphagnales, Andreaeales and Bryales.

1.3 Bryogeography and conservation . Economic importance of Bryophytes, Role of bryophytes in ecosystem dynamics and in the global carbon budget. Bryophyte association with microorganism and animals.Biologically active compounds in Bryophytes.

Ref.

1. Cavers, F. 1976. The Inter relationship of the Bryophyta. S.R. Technic (Book House), Ashok Rajpath, Patna.
2. Dyer, A.F. and Duickett, J.G. (Ed.). 1984. The experimental Biology of Bryophytes. Academic Press.
3. Parihar. N.S.1980. An Introduction to Embryophyta Vol. I. Bryophyta. Central Book Depot.
4. PremPuri, 1981. Bryophytes: Morphology, Growth and differentiation. Atma Ram and Sons, New Delhi.
5. Vashishta, P.C. 1999. Bryophyta. S. Chand & Co. New Delhi.

6. Shaw AJ and B Goffinet (2000) Bryophyte Biology. Cambridge University Press.
7. Geissler and Greene SW (1982) Bryophyte Taxonomy, methods, practices and floristic exploration. J Cramer, Germany.
8. Richardson DHS (1981) The Biology of mosses. John Wiley & Sons, Inc New York.
9. Arumugam N, Annie Ragland, Kumaresan V, 2010. Bryophytes. ISBN :9789384826123.
10. Delevoryas Theodore, 1966. Plant Diversificaiton, Pub. Holt, Rinehart and Winston, Inc.

Unit-IIPteridophytes

2.1 Origin and evolution, alternation of generation in Pteridophytes, capogamy and aposspory. Morphological diversity and evolution of vegetative organs in Pteridophytes. The sporophyte- microphyll and megaphylls; sporangia structure, position, ontogeny types. The gametophytes: Germination of fern spore, Development of fern prothallus.Classification and comparative study of *Psilopsida, Lycopsida, Sphenopsida* and *Pteropsida.*

2.2 Heterospory: Occurrence, causes and significance. Stelar theory; Telome theory.Fossilized Pteridophytes (*Rhynia, Lepidocarpon, Sphaenophyllum, Zygopteris , Pteridospermales*).

2.3 Culture of fern gametophyte for experimental investigation, Photomorphogenesis. Model system in *Ceratopteris, Trichomanes, Osmunda, Marsilea*. Symbiotic fungal associations in early land plants, Poikelohydry, Desiccation tolerance.

Ref.

1 Eames, E.J. 1983. Morphology of vascular plants. Standard University Press.
2 Rashid, A. 1999. Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
3 Sharma, O.P. 1990. Textbook of Pteridophyta. Macmillan India Ltd. Delhi.
4 Sporne, K.R. 1986. The morphology of Pteridophytes. Hutchinson University Press.
5 SundaraRajan, S. 1999. Introduction to Pteridophyta. New Age International Publishers, New Delhi.
6 Dyer AF (Ed) (1979) The experimental Biology of Ferns. Academic London.
7 Sharma, 2014. Pteridophyta, McGraw Hill.
8 Delevoryas Theodore, 1966. Plant Diversificaiton, Pub. Holt, Rinehart and Winston, Inc.

Unit-IIIGymnosperm

3.1 Classification of gymnosperms with general account on Pteridospermales (*Calymmatotheca*, *Hoeninghausi*), Glosopteridales, Caytoniales (*Caytonia*), Cycadales, Bennettitales (*Williamsonia* sp.), Pentoxylales and Corditales (*Cordaites* sp.)

3.2 Distribution, life cycle, anatomy and cone organization of Ginkgoales (*Ginkgo biloba*), Coniferales (Ephedrales (*Ephedra* sp.) Gnetales (*Gnetum* sp.) and Welwitschiales (*Welwitschia* sp.).

3.3 Origin of Gymnosperms: Evolution of pollination mechanisms and embryogeny of gymnosperms. Origin of gymnosperm stele. Homospory, Anisospory, Heterospory to ovule, Evolution of integument.

3.4 Propagation of conifers using plant tissue culture, somatic embryogenesis and synthetic seeds of conifers.Acclimatization and adaptive responses of conifers to environmental stresses. Impact of coniferous forest on human life.

Ref.

1. Vashishta, P.C. 1999. Gymnosperms, S. Chand & Company Ltd. New Delhi.
2. Bhatnagar SP and Moitra A (1996) Gymnosperms. New Age International (P) Limited, Publishers, New Delhi.
3. Singh Hardev (1978) Embryology of Gymnosperms. Encyclopedia of Plant Anatomy. Vol X Gebruder Borntraegrl, Berlin, Stuttgart.
4. Chamberlain, C.J. 2000. Gymnosperms. C B S Publishers and Distributors, New Delhi.
5. Chamberlain, C.J. 1955. Gymnosperms. Structure and Evolution.
6. Biswas, C. and Johri, B.M. 1999. The Gymnosperms. Narosa Publishing House, New Delhi.
7. Sporne, K.R.1986. Morphology of Gymnosperms. Hutchinson University Press.

Unit-IV Palaeobotany

4.1 Principles of Palaeobotany and geological time scale.

4.2 Processes of fossilization and types of fossils.

4.3 Methods of study of fossils and dating techniques.

4.4 Concept of organ genera in palaeobotany with fossil history of Bryophytes, Pteridophytes and gymnosperms-Psilophytopsida (*Asteroxylon, Horneophyton*), Lycopsida (*Protolepidodendron, Miadesmia, Stigmaria*), Filicopsida (*Zygopteris, Cladoxylon*), Cycadopsida (*Lyginopteris,Heterangium*).

Ref.

1. Arnold C.A., 1972. Introduction to Paleobotany.
2. Andrews H.N., 1961.Studies in Paleobotany.
3. Shukla A.C. and Mishra S.D. 1975. Principles of Paleobotany.
4. Stewart W.N., 1983. Paleobotany and the evolution of plants.Cambridge.
5. Sambamurty A.V.S.S., 2010. A Textbook of Bryophytes, Pteridophytes, Gymnospermsand paleobotany.
6. Annie Ragland, Kumaresan V., 2017. Pteridophytes, Gymnosperms and Palaeobotany. ISBN: 9789386519337.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-303**	**Semester**	**III**
Developmental Biology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-303 – DEVELOPMENTAL BIOLOGY

Learning Objective and Outcomes:

- **CO 1**This Course focuses on the development of male and female reproductive organs of flowering plants called angiosperms. It gives complete idea of spore and gamete formations, gametophyte development in angiosperms and fertilization process.
- **CO 2** After learning units I, II & III the students will able to understand starting from the development of anther and ovule to the process of double fertilization leads to the development of embryo and endosperm.
- **CO 3**Students will be able to understand, the morphology of pollen grains and its application in various fields

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit-I Reproductive Biology

1.1 Development of flower: Transition to flowering - vegetative to reproductive evocation, floral homoerotic mutations in *Arabidopsis*, *Antirrhinum* and *Petunia*. Axis development in flower.
1.2 Gender expression in monoecious and dioecious plants.
1.3 Development and Structure of Anther and the process of Microsporogenesis.
1.4 Development and Structure of Ovule and the process of Megasporogenesis.

Unit-II: Gametophyte Development

2.1 Developmental biology of male and female gametophytes. Regulation of anther and ovule.
2.2 Male sterility- mechanisms and applications, pollen embryogenesis.
2.3 Different types of embryo sacs, ultra structure of embryo sac, nutrition.
2.4 Pollen-pistil interaction. *In vivo* and *in vitro* pollen germination, pollen tube growth and guidance, self-compatibility mechanisms, incongruity.

***Ref.* (Unit I & II)**

1. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd. New Delhi.
2. Johri, B.M. 1984. 1984. Embryology of Angiosperms. Springer Verlag. Berlin.
3. Maheswari, P. 1980. Recent Advances in the Embryology of Angiosperms.

4. Pandey, A.K. 1997. Introduction to Embryology of Amngiosperms. CBS Publishers and Distributors, New Delhi.

Unit-III Fertilization and Embryogenesis

3.1 Process of double fertilization, development of embryo and endosperm. Types of endosperms.

3.2 Evolutionary trend of pollination and pollinators.

3.3 Pollen wall development, pollen embryo.

3.4 Embryogenesis and seed development: Polarity during embryogenesis, pattern mutants, *in vitro* fertilization, apomixis, polyembryony.

Ref.

1. Pandey, S.N. and Chadha, A. 2000. Embryology. Vikas Publishing House Pvt. Ltd. New Delhi.
2. Parihar NS (1993) An Introduction to Embryophyta: Vol I – Bryophyta, Vol II –Pteridophyta, Central Book Dept. Allahabad.
3. Raghavan V (2000) Developmental Biology of Flowering Plants, Springer, Netherlands
4. Raghavan V (1997). Molecular Embryology of Flowering Plants. Cambridge. University Press.
5. Richards AJ (1986) Plant Breeding System, George Allen and Unwin.
6. Shivanna KR (2003) Pollen Biology and Biotechnology, Science Publishers.

Unit-IV: Palynology

4.1 Introduction, Pollen morphology, Palynotaxonommy.

4.2 Aeropalynology, Melissopalynology, Forensic palynology, Pollen allergy

4.3 Paleopalynology&Evolutoinary trends among pollen grains.

4.4 Pollen Biotechnology

Ref.

1. Kashinath Bhattacharya, 2006. A Textbook of Palynology. New Central Book Agency.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-304(i)**	**Semester**	**III**
Medicinal Plants (Elective)			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-304(i) – MEDICINAL PLANTS (ELECTIVE)

Learning Objective and Outcomes:

- **CO 1**This Course focuses on medicinal plants, parts used, ethnomedicine, Indian system of medicine, and modern herbal science, pharmacognosy and phytochemistry.

- **CO 2** After learning this student will be able to identify medicinal plants, will have the knowledge of herbal wealth of Gujarat and the method of conducting ethnomedicinal study and modern laboratory techniques for studing medicinal plants.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

Unit-IHistory of Herbal Science

1.1 History and development of herbal science in India and abroad:Sushrut, Charak (1 AD), Theophrastus (370 – 285 BC), Dioscorides (1 AD), Adanson.

1.2 Introduction to the literature on medicinal plants:Sushrut Samhita, CharakSamhita, Vagbhatta Samhita, SharangdharSamhita, NighantuAdarsh of BapalalVaidya. Ethnovate heritage.

1.3 Introduction to Ayurvedic Pharmocopiaof India and contemporary literature on medicinal plants.

1.4 Data bases of medicinal plants.

Ref.

1. Anjaria J., Parabia M.H., Dwivedi S. and Reddy M.N. (2002): Ethnovet Heritage- Indian EthnoVeterinary Medicine: An Overview. Pathik Enterprise, Ahmedabad.
2. Chopra R.N., Nayar S.L. and Chopra I.C. (1969): Glossary of Indian Medicinal Plants. Publication and Information Directorate, CSIR, New Delhi.
3. DerMarderosian A. and Beutler J.A. (Co edt. by) (2002): The Review of Natural Products (Volume I- II) (2ndedn.). Facts and Comparisons, Missouri, USA.
4. Kirtikar K.R. and Basu B.D. (1998): Indian Medicinal Plants (I to VIII Volumes) (2^{nd}edn.) (4^{th} Reprint) BishenSinghMahendrapal Singh, Dehradun
5. Rastogi R.P. and Mehrotra B.N. (1993): Compendium of Indian Medicinal Plants (Volumes I – VI). CSIR, Lucknow and Publication & Information Directorate, New Delhi.

Unit-IIIIdentification and Application of Medicinal Plants

2.1 Identification, distribution and importance of Undergroundparts (roots, tubers, suckers): *Asparagus racemosus, Asparagus adscendens, Chlorophytumtuberosum, Chlorophytumborivilianum, Dashmool (Ideal vs. Reality),*

Bombaxmalabarica(*Shemalmusli*), *Boerhaviadiffusa, Tephrosiapurpurea, Withaniasomnifera.*

2.2 Identification, distribution and importance of Bark:*Terminaliaarjuna,Tecomellaundulate, Moringaoleifera.*

2.3 Identification, distribution and importance of Leaves:*Justiciaadhatoda, Centellaasiatica, Ocimum sanctum, Vitexnegundo, Cassia angustifolia, Abrusprecatorius.*

2.4 Cultivation and processing of medicinal plants: *Withania somnifera, Chlorophytum tuberosum, Andrographis paniculata, Cassia angustifolia, Plantago ovata.*

Ref.

1. Ambasta S. P. (1986): The Useful Plants of India. Publication & Directorate, CSIR, New Delhi.
2. Sumy, Ved D.K. and Krishnan (2000): Tropical Indian Medicinal Plants Propagation Methods (1stEdn.) Foundation for Revitalization of Local Health Traditions, Banglore.
3. Handa S.S. and Kaul M.K. (edt. by) (1997): Supplement to Cultivation and Utilization of Medicinal Plants. Regional Research Laboratory, CSIR, Jammu-Tawi, J&K, India.

Unit-III Organoleptic Classification of Herbs and Pharmacology

3.1 Organoleptic Classification of herbs yielding Flowers:*Madhuca indica, Careya arborea, Hibiscus rosasinensis.*

3.2 Organoleptic Classification of herbs yielding Seeds & Fruits:*Emblica officinale, Embelia tsjerum-cottam, Semecarpus anacardium, Terminalia chebula, Terminalia bellirica, Gmelina arborea, Cassia tora, Cassia sophera.*

3.3 Organoleptic Classification of herbs yielding Exudates & Gums:*Sterculia urens, Acacia nilotica, Anogeissus latifolia, Bombax malabarica, Commiphora wightiana, Boswellia serrata.*

3.4 Pharmacological screening of herbal drugs:Evaluation of anti-diabetic agents, Evaluation of anti-malarial activity and Evaluation of anti-inflamatary activity.

Ref.

1. Anonymous (2002): WHO Monographs on selected Medicinal Plants (Volume I-II). World Health Organization, Geneva.
2. Mukherjee Pulok K and Houghton Peter J, 2009. Evaluation of Herbal Medicinal Products-Perspectives on quality, safety and efficacy. Pharmaceutical Press.

Unit-IVPharmacognosy and Phytochemistry

5.1 Significance of Pharmacognosy.Introduction and Development of Standardization Parameters: Bitter value, Foaming index, Swelling index, Heavy metals, Afflatoxins

5.2 Glycosides: Anthraquinones, isothiocynates, flavonols, lactones,saponins and cardiac glycosides.

5.3 Alkaloids: Indoles, isoquinolines, tropanes, pyridine and piperidine, steroidal alkaloids.

5.4 Phenols and tannins: types, structure, role and applicaiton.

Ref.

1. Anonymous (1998): Quality Control Methods for Medicinal Plants Materials. World Health Organization, Geneva.
2. Anonymous (1999): Indian Herbal Pharmacopoeia (Volume I, II,III). Joint Publication of Regional Research Laboratory (CSIR), Jammu and Indian Drug Manufacturers' Association.
3. Khadabadi SS, Deore SL, Baviskar BA, 2016. Experimental Pharmacognosy & Phytochemsitry, Studera Press, Nwq Delhi.
4. Bhat S.V., Nagsampampagi B.A. and Sivakumar M. (2005) Chemistry of Natural Products, Narosa Publishing house, New Delhi.

5. Chauhan M. : Microscopic profile of powdered drug used in Indian System of Medicine (Volume I).
6. Evans W.C. (2002): Pharmacognosy (15thEdn.). Saunders Publications.
7. Harborne J. B. (1973): Phytochemical Methods. Chapman and Hall, London.
8. Mukherjee P.K.(2002): Quality Control of Herbal Drugs- An Approach to Evaluation of Botanicals (1stEdn.). Business Horizons Pharmaceutical Publishers, New Delhi, India.
9. Sadasivam S. and Manickam A (1996): Biochemical Methods (2nd. Edn.).New Age International Publishers, Tamilnadu Agriculture University, Coimbtore.
10. Raman N. (2005): Phytochemical Techniques and Plant Tissue Culture. Department of Botany, University of Madras, Chennai.
11. Ragunathan K. and Mitra R. (comp. &edt. by) (1999): Pharmacognosy of Indigenous Drugs (Volumes I – II) (Reprint). Central Council for Research in Ayurveda and Siddha, New Delhi, India.
12. Choma IM, Grzelak EM, 2010. Bioautography detection in thin-layer chromatography. J. of Chromatography A, 1218 (2011) 2684–2691.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-304(ii)**	**Semester**	**III**
Plant Biotechnology (Elective)			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-304(ii) - PLANT BIOTECHNOLOGY (Elective)

Learning Objective and Outcomes:

- **CO 1**This Course focuses on the steps involved during the development of transgenic plants, its applications, DNA fingerprinting and Plant tissue culture.
- **CO 2** After learning units I & II, the students will able to understand the process of the development of transgenic plants and their applications.
- **CO 3** After learning units III & IV, students will have an insight on different types of DNA fingerprinting techniques and importance of Plant tissue culture techniques.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit-I Development of Transgenic Plant

1.1 Steps involved in the development of transgenic plants including the role of plant tissue culture.
1.2 Identification and isolation of the gene (Immunoprecipitation, gDNA and cDNA library, development of ESTs, PCR).
1.3 Isolation of DNA (genomic and plasmid) from various sources- Method and Principle.
1.4 Method of molecular cloning including vector, promoter, terminator, markers etc.

Ref.

1 Ausubel Frederick M., Roger Brent, Robert E. Kingston, David D. Moore, J.G. Seidman, John A. Smith, Kevin Struhl (2003) Current Protocols in Molecular Biology. John Wiley & Sons (ISBN: 047150338X).
2 Brown T.A. Gene cloning.
3 Brown T.A. Genomes 3.
4 Channarayappa (2007). Molecular Biotechnology: Principles and Practices, CRC Press, ISBN-10: 1420051571, ISBN-13: 978-1420051575.
5 Dong Hao, Zhao Yijun, Wang Yingli and Li Hongmin, 2014. Recombinant proteins expressed in lettuce. Indian Journal of Biotechnology, 13 (4), pp 427-436.

Unit-II Methods of Gene Insertion and Applications of Transgenic Plants

2.1 Target cells for transformation and different methods of gene insertion.
2.2 Principle and protocol for Agrobacterium mediated gene transfer. Application of ELISA and Q-PCR for the detection of transgenic plant.
2.3 Applications of Transgentic Plants: Biotic and abiotic stress resistance, case and issue of

Bt-Cotton and Bt-Brinjal, Herbicide resistance. Issues related with GM crops.

2.4 Molecular farming, enhancing nutrition (Golden Rice), post-harvest losses (Flavr Savr) and male sterile lines.

Ref.

1 Borton K.A., Binns A.N. 1983. Regeneration of intact Tobacco plants containing full length copies of genetically engineered T-DNA and transmission of T-DNA to R1 progeny. Cell 32:1033-1043.
2 Chawla H S, Introduction to Plant Biotechnology by, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, 3rd Ed., ISBN- 9788120417328.
3 Das H.K. (2007) Textbook of Biotechnology, 3rd Ed., Wiley India (P) Ltd. (ISBN:81-265-1014-5).
4 Glick Bernard R., Pasternak Jack J. and Patten Cheryl L. (2010). Molecular Biotechnology-Principles and Applications of Recombinant DNA, 4th Ed., ASM Press (ISBN: 978-1-55581-498-4).
5 Gupta P K, 2004. Biotechnology and Genomics.
6 Antoniou M, Robinson C, Fagan J, 2012. GMO Myths and Truths, Earth Open Source.
7 Mousumi Debnath - Principle of Genetic engineering
8 Old and Primerose. Principle of gene manipulation.

Unit-III Molecular Breeding and Introduction of Plant Tissue Culture (PTC)

3.1 Application of molecular markers. Concept of dominant and co-dominant markers with examples of RAPD and RFLP.

3.2 Various techniques of molecular markers (SCAR, SSR, ISSR, SCoT, SNP, CAPS etc). Marker-Trait Association for Molecular Breeding.

3.3 Plant Tissue Culture (PTC): Introduction, applications and techniques (with the respective explants).

3.4 Micro-propagation: Ex-plant sterilization, various culture media and preparation, PGRs (types and interaction), inoculation method, culture conditions and hardening.

Ref.

1 Primrose and Twyman. Principles of Gene Manipulation & Genomics (7th Ed.).
2 Singh BD and Shekhawat NS, 2018. Molecuar Plant Breeding, Scientific Pub.
3 Purohit S.S. Biotechnology-Fundamentals and Applications. 4th Ed., Agrobios Pub. ISBN:8177542591.
4 Rastogi Smita and Pathak Neelam (2009) Genetic Engineering, 1st Ed. Oxford (ISBN-13: 978-0-19-569657-8; ISBN-10: 0-19-569657-3).
5 Rehm HJ, Reed G., Puhler A. and Stadler P. (1993). Biotechnology vol-2: Genetic Fundamentals and Genetic Engineering, Wiley India (ISBN: 978 81 265 2529 4).
6 Roger L. Miesfeld, 1999. Applied Molecular Genetics. Wiley-Liss Pub. (ISBN:0 471 15676 0).
7 Sandhya Mitra (1996) Genetic Engineering-Principles and Practice, Macmillan Pub. 1st Ed. (ISBN:0333-92547-5).
8 Satyanarayana U. (2005) Biotechnology, (ISBN:81 87134 90 9)
9 Singh B D (1998) Biotechnology, Kalyani Publishers, Ludhiana.
10 Tamarin Robert H. Principles of Genetics, Tata McGrow (ISBN 13: 978007048667b; ISBN 10: 0070486670).
11 Watson et al., Recombinant DNA: Genes and Genomes - A Short Course.
12 Winnacker Ernst L. From Genes to Clones.

Unit-IV Plant Tissue Culture (PTC)-Techniques and Applications

4.1 Method and application of cell culture including production of secondary metabolites.

4.2 Somaclonal and gametoclonal variations-Method and examples. *In vitro* pollination and fertilization.

4.3 Wide hybridization and Embryo rescue. Somatic embryogenesis and artificial seeds.

4.4 Haploid production. Protoplast isolation, somatic hybridization and cybridization.

Ref.

1. Bhojwani S.S. and Razdan M.K. (1996). Plant tissue culture: Theory and Practice- Elsevier.

2. De Kalyan Kumar (2008). Plant Tissue Culture.
3. George Edwin F., Hall M.A., De Klerk Geert-Jan. Plant Propagation by Tissue Culture, Vol.1, 3rd Ed.
4. Razdan M.K. Introduction to plant tissue culture.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-304(iii)**	**Semester**	**III**
Horticulture(Elective)			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-304(iii) - HORTICULTURE (Elective)

Learning Objective and Outcomes:

- **CO 1**This Course focuses on the scope of horticulture and its applications.
- **CO 2** After learning this the students will able to understand the process of plant propagatin techniques, identify ornamental and other useful species, their cultivation.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

Unit – I Scope of Horticulture and its Branches

1.1 Horticulture and its branches of study, brief history, scope, importance, necessity, advantages, prospectus and problems with respect to some horticultural crops. Biotechnology in the fields of horticulture-Concepts of tissues culture and its various applications in horticulture (micro-propagation).

1.2 Soil science: Its formation, types, component, properties (biological, chemical and physical). Acid Saline, alkaline soil and their reclamation, minerals nutrition and stress physiology.

1.3 Fertilizers: organic manures, biofertilizers and chemical fertizlizers. Significanceof Rhizosphere microbiome.

1.4 Basic principles of irrigation, system and methods of irrigation.Possibility use of saline water in irrigation.Introduction of Hydroponics and Fogponics.

Ref.

1. Bhojwani, S.S. 1996. Plant Tissue Culture: Application and Limitations. Elsevier Science Publishers.
2. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, ther Netherlands.
3. Raghavan,V,1999. Developmental Biology of Flowering plants.Sringer – Verlag, New York.
4. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
5. Taiz, L, and Zeiger, E. 1998, Plant Physiology (2nd edition), Sinaer Associates, Inc.,Publishers, Massachusetts, USA.
6. Tomas, B. and Vince-Prue, D. 1997. Photoperiodism in Plants (2nd edition), Academic Press,San Diego,USA.
7. Bewley,J.D. and Black,M. 1994, Seeds:Physiology of Development and Germination.Plenum Press, New York.
8. Mushroom Cultivation Technology – by by R. Gogoi, Y. Rathaiah, T.R. Borah.
9. Mushroom Cultivation – 2018 by S.C. Tiwari & Pankaj Kapoor.

Unit – II Orchard and Garden Managment

2.1 Propagation methods: Selection and preparation of stock and scion, compatibility. Plant Propagation by sexual and asexual methods.Green House and Poly House Design and Applicaiton.

2.2 Planning and layout of orchards. Selection of species and orchard management in terms of soil, manure/fertilizer, erosion protection, mulching methods, irrigaton, drainage, identification and control of disease, use of pesticide and integrated pest management.

2.3 Landscape architecture: Different types of landscapes. Theme gardening: gardening in small places, kitchen gardening, terrace gardening, pots making, vertical gardening, use of different containers, esthetics behind gardening. The rock garden, succulents (*Sedum*, *Echeveria, Haworthia, Kalanchoe*) and cacti; aquatic garden. Bonsai, topiary, indoor&outdoor plants, home herbal garden.Different kinds of lawns, species and maintanace.

Ref.

1. Landscape Architecture In India, - 2013 by mohammad Shaheer, Geeta Wahi Dua, Adit Pal.
2. Landscape Architecture – Import, 5 May 2017 by Ryker Nelson.
3. Roy A. Larson, 1980. Introduction to Floriculture.
4. Asanthakumar K. and Bulti Merga, 2017. A Handbook on Floriculture And Landscaping.

Unit – III Olericulture and Cultivation Techniques

3.1 Definition and scope of Olericulture, importance of vegetables in human diet. Classification of vegetables crops, Types of vegetable garden, Location and site for vegetarian garden. Climate and soils for vegetables, Crop rotation.

3.2 Growing Vegetables-Transplantation&direct sown, irrigation and manuring of vegetable crops, Intercultural Operations in vegetables crops, Harvesting and marketing.

3.3 Cultivation of vegetable crops obtained from families Cucurbitaceae , Leguminosea, Solanaceae, Malvaceae, Amarantheceae, Chenopodiaceae, Zingiberaceae and Araceae.

3.4 Vegetable Preservation-Present Status, future scope, Nutritive value of fresh and processed vegetables, canning, dehydration and chemical preservation.

Ref.

1. Handbook Of Horticulture – 2003 by Chandha K L
2. Fundamentals Of Horticulture – 2018 by Jitendra Singh, Kalyani Publishers
3. Horticulture at a Glancer for ICAR's Exams, JRF, SRF, NET, ARS, IARI, Ph.D Paperback – 2016 by D Ram & B B Singh, DG,ICAR Trilochan Mohapatra
4. Kumar N. 2010. Introduction To Horticulture.
5. Sutaria R.N., 1988. A text book of Systematic Botany.

Unit – IV Pomology and Floriculture

4.1 Scope and importance of pomology and floriculture, Role of fruits in human nutrition, Classification of fruit crops.

4.2 Cultivation of tropical, sub-tropical and temperate fruits and flowers speceis.

4.3 Cold sorage and gamma-irradiaton, its importance; ripening chamber and fruit ripening. Processing of fruits including dehydraton, canning, pickleing andpuree making.

4.4 Harvesting and processing of orchard products (fruits and flowers). Shelflife and marketing of fruits and flowers.

Ref.

1. Textbook of Pomology by Edgar Crombie Syrawood Publishing House,2016.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-305**	**Semester**	**III**
Practical Based on Bios -(B)-301 to 304			
Course type	**Core Compulsory**	**Total Credit**	**08**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
16/week	**60**	**140**	**200**

BIOS-(B)-305 – Practicals Based on Bios-(B)-301 to 304

Following are the indicative list of the experiments. Changes can be done depending upon the departmental need and availability of the resources.

- **CO 1**Students will learn methods of algal culture and mushroom cultivation.
- **CO 2** Students will learn microbes and DNA isolation techniques from the plants.
- **CO 3** Study of morphology and anatomy of thalloid and leafy forms of Bryophytes
- **CO 4** Study structural modification in Marchantiales, Jungermanniales, Isobryales and Hypnobryales.
- **CO 5** Students will learn use of DNA fluorochromes to localize nuclei during pollen and ovule development and in-vitro methods of pollen germination.
- **CO 6** Students will learn various aspects and parameters affecting the plant development.
- **CO 7** In elective subjects student will learn various methods to prepare extract from the plants of medicinal importance
- **CO 8** Students will also learn techniques to isolate and identify metabolites from the plant extract
- **CO 9** Students will learn application of biotechnology for plant tissue culture and preparation of media to culture plant in-vitro
- **CO 10** Students will learn preparation of panchgavya and its importance in plant development.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						
CO7						
CO8						
CO9						
CO10						

Bios -(B)-301 – Phycology and Mycology and Plant Pathology

Algae

1. Study of thallus structures of different groups of algae through preparation of whole mounts and sections.(based on the available speciemens, field trip collections and permanent slides).
2. Algal culture technique.
3. Assessment of phytoremediation potential of the algae.

Fungi

4. Mushroom cultivation.
5. Study of the representative genera belonging to Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina with respect to asexual and sexualstructures and fruiting body (Ascocarp/Basidiocarp). (based on the available speciments and permenet slides)
6. Study of Lichen.(based on the available speciments and permenet slides)

Plant Pathology

7. Characterization of disease symptoms and identification of pathogenic organisms.
8. Isolation of microbes and gram staining of bacteria from infected plants/rhizosphere soil/seed borne fungi.
9. Isolation of *Bacillus thuringiensis* from soil sample and endospore staining.
10. Study the antimicrobial activity of *Trichoderma* fungi.
11. Isolation of DNA from fungus.
12. Estimation of total phenols and O-didhydroxyphenols (sugarcane and groundnut) as biochemical markers of enhanced resistance.
13. Estimation of activity of Phenylalanine ammonia lyase in healthy and diseased leaves (sugarcane).
14. Effect of phytoalexins on microbial growth.
15. Determination of Minimum Inhibitory Concentration (MIC) by pesticide.

Note: All the practicals should be based on the available speciments, permenet slides and existing facilities..

Bios -(B)-302 Advances in Archegoniatae and Paleobotany

1. Study of morphology and anatomy of thalloid and leafy forms of Bryophytes.: *Riccia, Targionia, Cyathodium, Plagiochasma, Dumartiera, Asterella (Fimbriaria), Conocephalum, Lunularia, Marchantia, Riccardia (Anura), Pellia, Porella, Anthoceros, Notothylas, Spahagnum, Pogonatum and Funaria.* (As per availability of specimens).
2. Study structural modification in Marchantiales, Jungermanniales, Isobryales and Hypnobryales.
3. Monographic study of the sporophyte body of*Osmunda, Ophioglossum, Lygodium, Gleichenia, Cyathea, Pteris, Dryopteris, Adiantum and Polypodium*. (As per availability of specimens)
4. Study of fern gametophyte and variation is sorai (permanent slides & charts). Study permanent slide of Protonema of bryophyte.
5. Cytological studies of bryophytes/ferns.
6. Spore viability test of pteridophyte.
7. Study of vegetative and reproductive parts of gymnosperms.
8. Comparative anatomy of conifers and gnetales (permanent slides).

9. Study of specimens and permanent slides of fossils.

Bios -(B)-303-Developmental Biology

1. T.S. of an immature anther from floral bud to study the development of pollen.
2. Dissectin of an ovule to observe the cotyledon and radical in mature embryo.
3. Study of the stages of pollen and ovule development using permanent slides and electron micrographs.
4. Pollen *in vitro* germination methods: Sitting drop culture, suspension culture, surface culture.
5. Study of palynotaxonomy through pollen morphology of different families (Typhaceae, Gramineae, Casuarinaceae, Nyctaginaceae, Mimosaceae, Asclepiadaceae).
6. Observation of pollen in honey samples.
7. Correlation between fertility (stainability), viability (TTC and FDA staining) and germinability (*in vitro*) of pollen grains.
8. Assessment of stigma receptivity by localizing peroxidases, non-specific esterases and phosphatases.
9. Aniline blue fluorescence method to localize pollen tubes to study different aspects of pollen-pistil interaction.
10. Use of DNA fluorochromes to localize nuclei during pollen and ovule development.
11. Study of post-fertilization stages of zygoteto embryo development with the help of permanent slides and electron micrographs.

Bios -(B)-304(i) Medicinal Plants (Elective)

1. Preparation of plant extract by soxhlet and calculation of percentageyield.
2. Extraction of essential oil through clevenger apparatus.
3. Isolation of curcumin from *Curcuma longa*.
4. Evaluate antimicrobial potential of medicinal plants.
5. Perform Thin Layer Chromatography from the plant extract.
6. Bioautography detection in thin-layer chromatography.
7. Calculation of foaming index and swelling index.
8. Preparation and characterization of ash obtained from plant material.
9. Quantitative estimation of phytochemicals from plants (alkaloids, flavonoids, tannins, phenols, terpenoids).
10. Testing of ghee and honey.
11. Identificaiton of herbal drugs (whole dried samples of root, seeds, bark, fruit, flower, leaves).

Bios-(B)-304(ii) - Plant Biotechnology (Elective)

1. Isolationand detectin of plant genomic DNA.
2. DNA barcoding through amplification of ITS by PCR.
3. Performing DNA fingerprinting (SCAR& RAPD).
4. Construction of phylogenetic tree from RAPD data analysis.
5. Isolation of protein from plant and separation through SDS-PAGE.
6. Preparation of MS media for PTC.
7. Inoculation of leaf & node explants for callus induction & mass-multiplication.

8. Inoculation of Banana sucker for micropropagation.
9. Preparation of sodium alginate beads for encapsulation of somatic embryo or cells.

Bios-(B)-304(iii) - Horticulture (Elective)

1. Propagation Methods : Cutting. Air Layering and Grafting.
2. Olericulture of Fenugreek and Coriander for kitchen gardening.
3. Preparation of Panchagavya.
4. Effect of Panchgavya on Seed Germination in compare to control.
5. Analysis of Panchagavya (pH, Phosphate, Potassium, Organic Carbon, Ammonical Nitrogen, Nitrate Nitrogen, Total Bacterial Count, Phosphate Solubilizing Bacteria, Potassium Solubilizing Bacteria)
6. Preparation of Vermicompost
7. Analysis of Vermicompost (pH, Phosphate, Potassium, Organic Carbon, Ammonical Nitrogen, Nitrate Nitrogen)
8. Extractionof pigment from plants.
9. Natural dye and dying process (Bandhani).
10. DNA isolation from fruits.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-401**	**Semester**	**IV**
Angiosperms Taxonomy			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-401 - ANGIOSPERMS TAXONOMY

Learning Objective and Outcomes:

- **CO 1**This Course focuses on angiosperm taxonomy including different classification systems, rules for nomenclature, floristic diversity, economic botany and modern methods of taxonomical study, APG.
- **CO 2** After learning this the students will able to identify plant species correctly and will understand the concepts, merits and demerits of classical systems of classification, methods and importance of naming of plant and to study the process of evoluation at work. The importance of plant for human welfare will be understood.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

Unit-I Classification of Angiosperms and Capacity Building in Plant Taxonomy

1.1 Definition, aims and principles (alpha and omega taxonomy).History of plant classification. Systems of Classification-Artificial, Natural and Phylogenetic with examples.

1.2 Study of Bentham and Hooker's system of classification.

1.3 Adopted principles, Concepts of primitive and advanced characters,Merits and Demerits of the classification systems (Engler & Prantle, Bessey, Hutchinson and Takhtajan). Angiosperm Phylogeny Group (APG) Classification.

1.4 Institutions/organizations/ministry of India: Botanical Survey of India (BSI), Gujarat Biodiversity Board, NMPB, Directorate of Medicinal & Aromatic Plants Research, MoEFCC, Ayush, ICMR, NIF, Shristi etc.

Ref.

1 Bhattacharya, Hait and Ghosh, 2007. A Textbook of Botany (vol-2), New Central Book Agency, ISBN 81-7381-555-0, Rs.350/-, pg.746.

2 Gurcharan Singh, 2010. Plant Systematics-An Integrated Approach, Third Edition, Science Pub., ISBN 978-1-57808-668-9.

3 Mondal AK, 2007. Advanced Plant Taxonomy, New Central Book Agency (P) Ltd.

Unit-IIPlant Nomenclature and Taxonomic Literature

1.1 Origin and significance of binomial nomenclature. Understanding of ICBN (International Code of Botanical Nomenclature).

1.2 Nomenclature rules: ranks of taxa, rules of priority, alternative names, effective and valid publications, author's citation, retention and choice of names etc.

1.3 NameTypes (Synonym, Tautonym, Typonyms, Metanyms,Homonym, Hyponyms, Autonym, Basionym and Nomen nudum). Typificatoin (Holotype, Isotype, Paratype, Syntype,Lectotype,Neotype, Topotype).

1.4 Construction of taxonomic keys (indented and bracketed) and their utilization. Intrduction to the Flora of Different States and Taxonomic Litratures (The Flora of British India Vol. I-VII- J.D. Hooker;Indian Medicinal Plants-Kirtikar & Basu;Hortus Malabaricus- Van Rheede;The flora of the Presidency of Bombay-Theodore Cooke; Species Plantarum& Genera Plantarum-Linnaeus; Manual of cultivated plant-Bailey H.

Ref.

1 Ashok Kumar, 2001. Botany in Forestry and Environment. Kumar Media (P) Ltd., ISBN 81-900502-0-6, Rs.177/-, pg.716.

2 Mukerjee Sushil Kumar, 1994. College Botany (Vol-III), New Central Book Agency, ISBN 81-7381-308-6, Rs.125, pg.487.

3 Sambamurty A.V.S.S., 2005. Taxonomy of Angiosperms, I.K. International Pvt. Ltd., ISBN 81-88237-16-7, Rs. 295/-, pg.892.

4 Pandey B.P., 2007. Botany for Degree Students (B.Sc. Second Year), S. Chand, ISBN 81-219-2810-9, pg.879.

Unit-IIIFloristic Studies, Biodiversityand Evolutoin of Angiosperms

3.1 Overview of Flora of Gujarat (G.L. Shah), Glimsis of the interesting plants of the world.

3.2 Century and National Parks.Biodiversity hotspots of India. Botanical Gardens: Rani Jijamata Udhyan-Mumbai, Waghai, Ooty, Coonoor, National Botanical Research Institute-Lucknow, Kolkota etc.

3.3 Origin and Evolution of Angiosperms: Theories and Fossil Records.

3.4 Evolutoin of characters in angiosperms.

Ref.

1. Shah G.L., 1978.Flora of Gujarat. Pub. Sardar Patel Univrsity.
2. Bhattacharya, Hait and Ghosh, 2007. A Textbook of Botany (vol-2), New Central Book Agency, ISBN 81-7381-555-0, Rs.350/-, pg.746.
3. Sutaria R.N., 1988. A text book of Systematic Botany.
4. Sammbamurthy AVSS, 2016. A Textbook of Modern Economic Botany, CBS Publishers.
5. Hill Albert F. Economic Botany-A Textbook of Useful Plantsand Plant Products. McGRAW-HILL.
6. Daniel M., 2009. Taxonomy Evolution at Work, Narosa Pub., ISBN 978-81-7319-959-2.
7. Delevoryas Theodore, 1966. Plant Diversificaiton, Pub. Holt, Rinehart and Winston, Inc.

Unit-IV Modern Trends in Plant Taxonomy

4.1 DNABarcoding: Significance, sequence candidatesand methodology.

4.2 Modern concepts and trends in plant taxonomy as supportive evidences:Cytotaxonomy, Chemotaxonomy

4.3 Numerical Taxonomy (Taximetrics), Molecular Taxonomy, Cladistics.

4.4 Problems in evolutionary taxonomy: Monophyly and polyphyly, Parallelism and convergence, Homology and analogy.

Ref.

1. Dikshit Anupama, Siddiqui M.O., Pathak Ashutosh, 2016. Taxonomy of Angiosperms (Basic Concepts, Molecular Aspects & Future Prospects), Studera Press, ISBN 978-93-85883-07-1.
2. Sivarajan, V.V. 1999. Principles of Plant Taxonomy Oxford & IBH Publishing Co. Pvt Ltd. New Delhi.
3. Daniel M., 2009. Taxonomy Evolution at Work, Narosa Pub., ISBN 978-81-7319-959-2.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-402**	**Semester**	**IV**
PLANT ANATOMY AND HISTO-CHEMICAL TECHNIQUES			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-402 - PLANT ANATOMY AND HISTO-CHEMICAL TECHNIQUES

Learning Objective and Outcomes:

- **CO 1**This Course focuses on plant anatomy and anatomical techniques including the method of sectioning, fixation, staining to study the anatomical features of the plant.
- **CO 2** After learning this the students will able to understand the different anatomical features of the plant. Student will be able to understand different types of microtome, particular stain to locate phytochemical and the method of tissue processing for electron microscopy.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

Unit-I Histological Development (Vascular plants)

1.1 Meristems, patterns of cell fate, determination and lineage in root and shoot, leaf growth and differentiation.Leaf development, plastochron, phyllotaxy, development of trichomes and stomata.

1.2 Cambial variants, Secondary growth, wood development and its diversity.

1.3 Nodal Anatomy and evolution of vascular Plants.

1.4 Xylem and phloem differentiation and ultrastructure.

Ref.

1. Cutler, D. F. 1978. Applied Plant Anatomy. Orient Longman Publishers, New Delhi.
2. Easu, 1987. The Anatomy of seed plants. Wiley Eastern Ltd. New Delhi.
3. Fahn, A. 1989. Plant Anatomy, Peragamon Press, Oxford, New York.
4. Gahan, P.B. 1984. Plant Histochemistry and Cytochemistry, Academic Press, London.
5. Carlquist T.S. Comparative plant anatomy.
6. Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.
7. Cutler DF (1978). Applied Plant Anatomy, Longman, United Kindom.
8. Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.

Unit-IIWood Anatomy and Anatomical Adaptations

3.1 Anatomical adaptations for special habitats, biotic and abiotic stresses.

3.2 Applications of anatomical studies in systematics, archaeology, climate studies, pharmacology, forensic sciences and biomedical research.

3.3 Structure of wood,reaction wood, wood development and environmental factors, types of wood and wood defects.

3.4 Anatomical responses towards the Environmental Pollution.

Ref.

1. Dickinson WC (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.

2. Fahn A (1974) Plant Anatomy, Pergmon Press, USA & UK.
3. Fosket DE. (1994) Plant, Growth and Development: A Molecular Approach, Academic Press.
4. Hopkins WG. (2006). The Green World: Plant Development, Chelsea House Publication
5. Howell SH. (1998) Molecular Genetics of Plant Development, Cambridge University Press.
6. Leyser O and Day S (2003) Mechanism of Plant Development, Blackwell Press
7. Mauseth JD (1988). Plant Anatomy, The Benjamin/ Cummings Publisher, USA
8. Nair MNB (1998). Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia.

Unit-III Histo-chemical techniques-I

3.1 Scope of histochemistry and cytochemistry in Biology.

3.2 Chemistry of fixation.Types and application of biological stains-vital stains and fluorochromes.

3.3 Tissue processing techniques for light microscope.

3.4 Types of microtomes-Rotary, Sledge, Freezing Cryostat and Ultratomes.

Ref.

1. Gary, P. 1964. Hand Book of basic microtechnique, John Wiley & Sons, New York.
2. Johanson, W.A. 1984. Plant Microtechnique. McGraw Hill.
3. Ruzin, Z.E. 1999. Plant Microtechnique and Microscopy. Oxford University Press, New York.

Unit-IV Histo-chemical techniques-II

4.1 Tissue processing techniques for electron microscopy (SEM and TEM).

4.2 Detection and localization of primary metabolites- Carbohydrates (PARS reaction), Proteins (Coomassie brilliant blue staining), Lipids (Sudan Black method). Introduction to other methods.

4.3 Enzyme histochemistry (General design and applications).Effect of pollution on the Phytochemicals content and secondary metabolites–A study in context to Histochemistry.

Ref.

1. Harris, Electron microscopy in Biology.
2. Johanson, W.A. 1982. Botanical Histochemistry-Principles and Practice. Freeman & Co.
3. Kierman, J.A. 1999. Histological and Histochemical Methods. Butterworth Publications, London
4. Poarse, histochemistry, Vol. I and Vol.II.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-403**	**Semester**	**IV**
RESEARCH METHODOLOGY AND PROFESSIONAL SKILLS			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-403 - RESEARCH METHODOLOGY AND PROFESSIONAL SKILL

Learning Objective and Outcomes:

The course is design to train student for research activity and communication skill at the end of the course student will be

- **CO 1**Able to understand the research problem and design and research work
- **CO 2**Able to write, prepare poster and present oral presentation
- **CO 3** Able to prepare CV and face the interview

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit I: Basic of Research Methodology

1.1 Philosophy of the natural sciences: Traditional philosophy of science, Hypotheticodeductive method, the empirical turn in philosophy of science,

1.2 Research Methodology: Objective, Motivation, Types approach, Significance, method, methodology, research process, good research, Researchers in India;

1.**3 Research problems and Design:**Research problems:Definition, selection of problems, Defining problems, technique; Research Design: Meaning, Need, features, concept, types, and Experimental design;

1.4 Sampling design: Survey, design, steps, criteria, characteristics, types, random sample and sampling

Reference Books

1. *C R Kothari Research Methodology 2nd Ed, New Age International Publication, 2004*
2. *Petter Laake, Haakon Breien Benestad and Bjørn Reino Olsen, Research methodology in the medical and biological sciences, Academic Press Elsevier, 2007*
3. *Yogesh Kumar Singh, Fundamental of Research methodology and statistics, New Age International (P) Limited, Publishers, 2006*
4. *Phyllis G. Supino and Jeffrey S. Borer, Principles of Research Methodology- A Guide for Clinical Investigators, Springer, 2012*

Unit II: Thesis Preparation

2.1 Preparing a dissertation: Formatting guidelines, sections, raw data, tips, requirement

2.2 Thesis writing: Title, Introduction, Review of literature, methodology, Result, Discussion, references, additional components

2.3 Strategies for writing thesis: Eleven steps strategies

2.4 Defense of the thesis or dissertation: Structure of the oral examination, Preparation for the examining committee session,Conduct of the oral examination, Decision making regarding the oral defense, Follow-up

Reference Books

1. *R Raveendran, B Gitanjali,S Manikandan, A practical Approach to PG dissertation, 2nd Eidtion, PharmaMed Press, 2012*
2. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*
3. *James E. Mauch and Namgi Park, 5th Edition, Guide to the Successful Thesis and Dissertation, Marcel Dekker, Inc, 2003.*

Unit III: Scientific Presentation and Management

3.1 Writing a research Proposal and research Paper: Research Proposal: Components, writing, funding sources for bioscience research, peer review; Research Paper: Structure, Strategy, aim and content of paper, submission, peer-review

3.2 Delivering effective presentation: Oral presentation: Planning, Preparation, practicing, delivering, answering and evaluating presentation; Poster: Planning, Preparation and presentation

3.3 Management fundamental: Characteristics, nature, function, process, profession, role, level and evolution

3.4 Entrepreneurship fundamental: Concept, Evolution, Characteristics, Entrepreneur Intrapreneur, Ultrapreneur, role, barrier,

Reference Books

1. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*
2. *Jennifer Peat, Scientific Writing- Easy when you know how, BMJ Books. 2002*
3. *Janice R. Matthews and Robert W. Matthews, Successful Scientific Writing, 3rd Edition, Cambridge University Press, 2008*
4. *Veerabhadrappa Havinal, Management and entrepreneurship, New Age International publishers,2009*

Unit IV:Communication and Research Skills

4.1 Before Writing: Academic Writing, Writer's Mindset, Strategies to avoid procrastination

4.2 Elements of English Grammar: Basic Terms and Definitions, Similar meaning, different spelling, Similar spelling, different meaning, Proofreading, word uses, Active versus Passive Voice

4.3 Research information system: Computer and ICT in research, Ethics in communication

4.4 Networking: Networking, CV and interview preparation

Reference Books

1. *Marialuisa Aliotta, Mastering Academic Writing in the Sciences, CRC press, 2018*
2. *Janice R. Matthews and Robert W. Matthews, Successful Scientific Writing, 3rd Edition, Cambridge University Press, 2008*
3. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS (B)-404**	**Semester**	**IV**
Dissertation/ Training			
Course type	**Core Compulsory**	**Total Credit**	**06**
Teaching time	**Examination Marking Scheme**		
Practical / Lab (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
12/week	**45**	**105**	**150**

BIOS(B)-404:DISSERTATION/ TRAINING

Learning Objective and Outcomes:

The course provides wide knowledge about research, experimental & sampling design,

- **CO 1**Data collection, analysis & interpretation of data and allows student to present the research data in scientific method
- **CO 2** Gains skill to solve problems using appropriate research method and inferential statistical tools
- **CO 3** Learns to collect literature collection, literature citation, and components of research report – Text, tables, figures, and bibliography.
- **CO 4** Critically analyse and evaluate the knowledge and understanding in relation to the agreed area of study.
- **CO 5** Integrate theory and practice.
- **CO 6** Develop responses on the basis of the evaluation and analysis undertake.
- **CO 7** Writing of dissertations, project proposals, project reports, research papers.
- **CO 8** Intellectual Property Rights – Biopiracy, copyrights, patent and traditional knowledge and plagiarism.
- **CO 9** Demonstrate advanced critical research skills in relation to career development or work-related learning studies.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						
CO7						
CO8						
CO9						

Student shall take anyone option from Dissertation or Training as per following guideline

Dissertation

- Students have to take up a small research project under the supervision of a teacher from the department or may carry the work in an industry / NGO / private laboratory with required facility/other university or institution.
- If a student is doing project outside the university all other arrangements are to be made by the student.
- Student has to submit the dissertation before the last date for the submission as declared by the university.

Training

Students have to undergo for attest 30 days training in any Industry or other organization under the supervision of the any faculty of the department.

At the end of the training student has to submit the detailed training report including the scientific review on the relevant topic of his training

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-405**	**Semester**	**IV**
Practical Based on Bios -(B)-401 to 403			
Course type	**Core Compulsory**	**Total Credit**	**6**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
12/week	**45**	**105**	**150**

BIOS-(B)-405 – PracticalsBased on Bios -(B)-401 to 403

The course is developed to cultivate practical expertise in the students in the field of microbiology. After completion of the course the students:

- **CO 1** plant anatomy and anatomical techniques including the method of sectioning, fixation, staining to study the anatomical features of the plant
- **CO 2** Student will be able to understand different types of microtome, particular stain to locate phytochemical
- **CO 3** method of tissue processing for electron microscopy.
- **CO 4** Students will be able to use various software to evaluate their scientific data and will be able to their thesis, articles and reviews scientific manner.
- **CO 5** Will be able to search the articles, journals, patents on various databases

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Following are the indicative list of the experiments. Changes can be done depending upon the departmental need and availability of the resources

Bios-(B)-401 - Angiosperms Taxonomy

1. Method for taxonomic description of angiosperm species.
2. Method to identify plant using Flora of Gujarat.
3. Type study of angiosperm families.
4. Identification of local flora from campus and surrounding area.
5. Technique of Herbarium preparation.
6. Taxonomic status, parts used and applicaiton of food, industrial and drug plants.
7. Isolation of plant DNA.
8. PCR amplification of ITS sequence.
9. Taxonomic identification through DNA barcoding using NCBI/BOLD database.

Bios-(B)-402 - Plant Anatomy And Histo-Chemical Techniques

1. Study of apical meristems with the help of dissections, whole mount preparations, sections and permanent slides.
2. Origin and development of epidermal structures (Stomata, trichomes, glands and lenticels).
3. Measurement of stomatal density and stomatal index on leaf/plant surfaces.
4. Study of xylem and phloem elements using maceration, staining, light and electron micrographs (xerophytes, hydrophytes and halophytes).
5. Study of secretory structures (nectaries and laticifers).
6. Study of nodal anatomy.
7. Study of secondary growth (normal and unusual) of selected woods with the help of wood microtome and permanent slides.
8. Demonstratoin of hand microtome and preparation of permanent slides.

Bios-(B)-403 - Research Methodology And Professional Skill

1. Searching of scientific literature
2. Digital research resources e-ShodhSindhu and Shodhgangaat INFLIBNET
3. Online grammar checking in scientific writing
4. References management by online tools
5. Plagiarisms checking
6. Preparation of graphs and tables to present the scientific data
7. Searching of approved and Index-Journal- UGC CARE, NAAS collection and Web of sciences/Scopus.
8. Searching of proper journals based on title and abstract of your research.
9. Preparation of scientific poster
10. Oral presentation on scientific topic
11. Preparation of curriculum vitae
12. Mock interview and group discussion skill

Reference

Surajit Das and Hirak Ranjan Dash, MicrobialBiotechnology- ALaboratory Manualfor Bacterial Systems, Springer, 2015.