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. Bioscience (Microbiology)

Semester III& IV

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. June 2020

Department of Biosciences
Veer Narmad South Gujarat University, Surat

M. Sc. Bioscience (Microbiology)Sem. III							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios (M) -301	Microbial diversity	4	-	70	30	100	4
Bios (M) 302	Omics and Integrative Microbiology	4	-	70	30	100	4
Bios (M) 303	Medical and Pharmaceutical Microbiology	4	-	70	30	100	4
Bios (M) 304	Industrial Microbiology and Fermentation Technology	4	-	70	30	100	4
Bios (M) 305	Practical Based on Bios-301 to 304	-	16	140	60	200	8
Total		**16**	**16**	**420**	**180**	**600**	**24**

M. Sc. Bioscience (Microbiology) Sem. IV							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios (M) 401	Microbial Genetics and Physiology	4	-	70	30	100	4
Bios (M) 402	Applied Microbiology	4	-	70	30	100	4
Bios (M) 403	Research Methodology and Professional Skills	4	-	70	30	100	4
Bios (M) 404	Dissertation/Training	-	12	105	45	150	6
Bios (M) 405	Practical Based on Bios-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 (Micro)**
Course Code	**Bios (M) -301**	**Semester**	**III**
Microbial Diversity			
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 (M) 301:MICROBIAL DIVERSITY

Learning Objective and Outcomes:

This Course will focuses to to give students the knowledge about the microbial diversity. At the end of the course students will be able to

- CO 1 Understand the diversity of microbial world
- CO 2 Classify the microorganism

	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

Unit 1: Diversity and Taxonomy

1.1 Microbial Evolution and division of life: Origins and Early Evolution, Microbial evolution, Introduction to microbial classification, Taxonomic rank, Techniques for determining microbial taxonomy and phylogeny , The major divisions of life, phylogenetic tree, Bergey's manual of systematic bacteriology (Prescott),

1.2Taxonomy of prokaryotes: Procaryotic domains, Classification of Procaryotes and concept of bacterial species, Identification of Procaryotes, Numeric Taxonomy, Polyphasic Taxonomy

1.3Nomenclature and culture collection: Bacterial nomenclature, Etymology of nomenclature, Culture Collections

1.4Biodiversity and Microbial Ecosystems Functioning: Mathematical Approaches and Tools for the Study of Microbial Biodiversity, Variables and Methods for Studying Microbial Diversity, Procedures for the Study of Relations between Microbial Biodiversity-Ecosystem Function

References

1. Joanne Willey, Linda Sherwood, Chris Woolverton, Prescott's Microbiology, 7th edition, McGraw-Hill, 2015.
2. James W. Brown Principles of Microbial Diversity, ASM Press, Washington, 2016
3. David R Boone and George M. Garrity, Bergey's manual of systematic bacteriology 2nd Edition Vol. 1, springer, 2001.
4. Jean-Claude Bertrand,Pierre Caumette Philippe Lebaron et al., Environmental Microbiology: Fundamentals and Applications Microbial Ecology, Springer, 2015.

Unit 2: Phylogeny

2.1 Microbial Diversity: What is Microbial Diversity: Facets of microbial diversity, The fundamental similarity of all living things, Context and Historical Baggage: The evolution of evolutionary thought, Taxonomy and phylogeny, The false eukaryote-prokaryote dichotomy,

2.2 Phylogenetic Information: Deciding which organisms and sequences to use in the analysis, obtaining the required sequence data, Assembling sequences in a multiple-sequence alignment

2.3 Constructing a Phylogenetic Tree: Tree construction: the neighbor-joining method, How to read a phylogenetic tree

2.4 Tree Construction Complexities: Substitution models, Treeing algorithms, Bootstrapping, Alternatives to Small-Subunit rRNA Analysis

References

1. James W. Brown Principles of Microbial Diversity, ASM Press, Washington, 2016
2. David R Boone and George M. Garrity, Bergey's manual of systematic bacteriology 2nd Edition Vol. 1, springer, 2001
3. Jean-Claude Bertrand,Pierre Caumette Philippe Lebaron et al., Environmental Microbiology: Fundamentals and Applications Microbial Ecology, Springer, 2015

Unit 3 Microbial diversity

3.1 The Microbial Zoo: Bacterial Phyla, Few representative bacterial linages: Overview of Primitive Thermophilic Bacteria, Green Phototrophic Bacteria, Proteobacteria, Gram-Positive Bacteria, Spirochetes and Bacteroids, Deinococci, Chlamydiae, and Planctomycetes,

3.2 Bacterial phyla with few or no cultivated species: How do we know about these organisms?, Phyla with few cultivated and no cultivated species, Phylogenetic groups at all levels are dominated by uncultivated sequences, How much of the microbial world do we know about?

3.3 Archaea: General properties of the *Archaea*, Phylum *Crenarchaeota, Euryarchaeota, Korarchaeota, Nanoarchaeota*

3.4 Fungi: Characteristics and Classification of Fungi; Physiology of fungi- Morphology, Ultrastructure and function, Nutrition, Metabolism, Growth and Reproduction; Fungi in the Environment, Macrofungi and Lichens

References

1. James W. Brown Principles of Microbial Diversity, ASM Press, Washington, 2016
2. David R Boone and George M. Garrity, Bergey's manual of systematic bacteriology 2nd Edition Vol. 1, springer, 2001
3. Jean-Claude Bertrand,Pierre Caumette Philippe Lebaron et al., Environmental Microbiology: Fundamentals and Applications Microbial Ecology, Springer, 2015
4. Kevin Kavanagh, 3rd edition, Fungi Biology and Applications, John Wiley & Sons, Inc, 2018
5. Constantine John Alexopoulos, Introductory Mycology, 4th Edition, John Wiley & Sons, 2007
6. H C Dube, An Introduction to Fungi, 4th edition, Scientific publisher, 2012
7. K. R. Aneja, An Introduction to Mycology, New age international publishers, 2015
8. Marjorie Kelly Cowan and Heidi Smith, 5th Edition, Microbiology A systems Approach, McGraw-Hill Education, 2018

Unit 4 Protists and Viruses

4.1Protists:*Algae*:Characteristics and Classification of Algae, Selected Phyla of Algae, Roles of Algae in Nature; *Protozoa*:Characteristics and Classification of Protozoa, Medically Important Protozoa, Slime Molds

4.2 Viruses: History of bacteriophages, plant and vertebrate viruses;Nature of Viruses, Origin of Viruses, Phylogeny and Evolution of Viruses;

4.3 Viruses: Taxonomy, Classification and Nomenclature of Viruses

4.4Satellite Nucleic Acids: Viroids, Virusoid and Prions

References

1. John B. Carter and Venetia A. Saunders, Virology, Principles and Applications, John Wiley & Sons Ltd, 2007
2. Marjorie Kelly Cowan and Heidi Smith, 5th Edition, Microbiology A systems Approach, McGraw-Hill Education, 2018
3. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Microbiology: An Introduction, 13th Edition, Pearson, 2018
4. Marjorie Kelly Cowan and Heidi Smith, 5th Edition, Microbiology A systems Approach, McGraw-Hill Education, 2018
5. Principles of Molecular Virology, 4th Edition, Alan J. Cann, 2005
6. DinabandhuSahoo and Joseph Seckbach, The Algae World, Springer, 2016
7. Lynn Margulis and Michael J Chapman, Kingdoms and domains, Academic press, 2009
8. Brian W J Mahy and Brian W J Mahy Desk Encyclopedia of General Virology, Academic Press Elsevier, 2010
9. N. J. Dimmock, A. J. Easton, K. N. Leppard, 6th Edition, Introduction to Modern Virology, Blackwell Publishing Ltd, 2007

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -302**	**Semester**	**III**
Omics and Integrative Microbiology			
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 (M) -302: OMICS AND INTEGRATIVE MICROBIOLOGY

Learning Objective and Outcomes:

The course mainly emphasize on study concept development and application of omics and integrative science. After learning this course students will be able to understand

- CO 1 Concept, Mechanism and application genomics, Proteomics and metagenomics
- CO 2 Design the experimental protocol for genomics, Proteomics and metagenomics
- CO 3 Analyze the results of for genomics, Proteomics and metagenomics

	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit IGenomics

1.1 **NGS:**Concept, Mechanism and Application of Next Generation Sequencing technology

1.2**Sequencing Data:**Preprocessing of sequencing data, Genomics databases

1.3 **Tools and techniques:** Tools and techniques for Gene finding Genome annotation and

Comparative genomics

1.4**Case study** of Microbial genomics

Reference Books

1. *Michal Janitz. Next-Generation Genome Sequencing, Wiely*
2. *Lloyd Low, Bioinformatics A Practical Handbook of Next Generation Sequencing and Its Applications, World scientific*
3. *Andreas D. Baxevanis, Bioinformatics A Practical Guide to the Analysis of Genes and Protein*
4. *Rastogi, Bioinformatics Methods and application Genomics Proteomics and Drug Discovery, PHI learning*
5. *Jonathan Pevsner, Bioinformatics and functional genomics,*
6. *Primrose S.B, Principles of Gene Manipulation And Genomics,Wiley*
7. *FrédéricDardel, Bioinformatics Genomics and post-genomics,*
8. *Encyclopedia of Genetics, Genomics, Proteomics and Bioinformatics*
9. *Neil, Genomics, Proteomics and clinical bacteriology, Humana Press*

Unit II Proteomics

2.1 **Omics:**From Genomics to Proteomics

2.2 **Tools and techniques:** Wet lab tools and techniques for proteomics data generation

2.3 **Database**: Bioinformatics database and tools for proteomics analysis

2.4 **Case study** of microbial proteomics

Reference Books

1. *Twyman, Principles of Proteomics, Advanced text*
2. *Renie, The Proteomics in Practices, Wiley*
3. *Ian Humphery-Smith, Microbial proteomics, Wiely*
4. *Protein Biochemistry and Proteomics, Amsterdam, Elsevier*
5. *Xing Wang, Functional Proteomics, Humana press*
6. *Neil, Genomics, Proteomics and clinical bacteriology, Humana Press*
7. *Encyclopedia of Genetics, Genomics, Proteomics and Bioinformatics*
8. *Rastogi,Bioinformatics Methods and application Genomics Proteomics and Drug Discovery, PHI learning*
9. *Andreas D. BaxevanisBioinformatics A Practical Guide to the Analysis of Genes and Protein,*

Unit III System and Synthetic Biology

3.1 **Metabolomics:**Concept, tools and techniques and application for metabolomics

3.2 **Application**of metabolomics

3.3 **Systems biology:**Concept, tools and techniques, and application of systems biology

3.4 **Synthetic biology:**Concept, tools and techniques, and application of synthetic biology

Reference Books

1. *Edward E.K. Baidoo, Microbial Metabolomics Methods and Protocols, Humana*
2. *Michael, Metabolomics in Practice, Wiley*
3. *Silas, Metabolome analysis,Wiely*
4. *David, Microbial Metabolomics Applications in Clinical, Environmental, and Industrial Microbiology,Springer*
5. *Bernhard, Systems Biology Properties of Reconstructed Networks, Cambridge University Press*
6. *Hiroaki Kitano, Foundations of Systems Biology, MIT press*
7. *Klipp, Systems Biology in Practice Concepts, Implementation and Application, Wiley*
8. *Pengcheng Fu, Systems Biology And Synthetic Biology, Wiely*
9. *Jens, Metabolomics A Powerful Tool in Systems Biology, Springer*

Unit IVMetaomics Approach

4.1 **Metagenomics:** Fundamental concepts, tools and techniquesof Metagenomics

4.2 **Metagenomics Application**: Revolutionary application of metagenomics

4.3 **Metatranscriptomics and Metaproteomics:** Concepts, tools, technique and application of metatranscriptomics and metaproteomics

4.4 Concepts tools, technique and application for Culturomics

Reference Books

1. *Nelson, Karen, Encyclopedia of Metagenomics, Springer, 2015*
2. *Wolfgang, Metagenomics Methods and Protocols, Humana Press, 2010*
3. Vipin Chandra Kalia, Mining of Microbial Wealth and MetaGenomics, Springer, 2017
4. Jacques Izard, Metagenomics for Microbiology, Elsevier, 2015
5. Camilla Benedetti, Metagenomics methods, applications and perspectives, Nova Publisher, 2014
6. John N. Abelson and Melvin I. Simo, Methods In Enzymology, Academic Press, 2004
7. Edward F. Delong, Methods in Enzymology Microbial Metagenomics, Metatranscriptomics, and Metaproteomics, Elsevier, 2013

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -303**	**Semester**	**III**
Medical and Pharmaceutical Microbiology			
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 (M) -303:MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

***Learning Objective and Outcomes*:**

The course is designed to develop the basic understanding skill required for microbiology student for Medical and pharmaceutical sector. They will be able to

- CO 1 Identify the diseases, Causative agent of various microbial disease of human
- CO 2 Understand the concept and application of epidemiology
- CO 3 Understand the need of microbial procedure in pharm industry
- CO 4 Understand the Quality requirement and management

	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Unit I Disease Biology

1.1 **Microbial Diseases** of the Skin, Eyes, Nervous System, Cardiovascular and lymphatic Systems,

1.2 **Microbial Diseases** of the Respiratory System, Digestive System, Urinary and Reproductive Systems

1.3 **Antimicrobials**: Antimicrobial Chemotherapy, Historical Introduction, Mode of action

1.4 **Drug Resistance:** History of Drug-Resistant Microbes, Evolutionary Biology of Drug Resistance, Pharmacology of Drug Resistance, Antimicrobial Resistance versus the Discovery and Development of New Antimicrobials.

Reference Books

1. *Tortora, Funke and Case, Microbiology -An Introduction 12th Edition , Pearson, 2016*
2. *Robert W. Bauman, Microbiology with disease and body system, 5th Edition, Pearson, 2018*
3. *Roger Finch David Greenwood Richard Whitley S. Ragnar Norrby, Antibiotics and Chemotherapy, 9th Edition,, Elsevier, 2010*
4. *Peter Davey, Mark Wilcox et al., Antimicrobial Chemotherapy,7th Edition, Oxford University Press, 2015*
5. *Douglas L. Mayers, Mechanisms of Drug Resistance Humana Press, 2009*

Unit II Epidemiology

2.1 **Epidemiology:**Introduction to Epidemiology, Measuring disease frequency,

2.2 **Outbreak:** Descriptive epidemiology, Outbreaks Investigations

2.3 **Zoonotic Viruses:**Introduction: Conceptualizing and Partitioning the Emergence Process of Zoonotic Viruses from Wildlife to Humans

2.4 **Zoonotic disease:**Overview of important zoonotic disease, Bioterrorism

Reference Books

1. *Penny Webb and Chris Bain, Essential Epidemiology An Introduction for Students and Health Professionals, Cambridge university press, 2011*
2. *David D. Celentano, Gordis Epidemiology, Elesevier, 2019*
3. *B. Burt Gerstman, Epidemiology Kept Simple, An introduction to traditional and modern epidemiology, 3rd Edition Wiley, 2013*
4. *James E. Childs, Wildlife and Emerging Zoonotic Diseases: The Biology,Circumstances and Consequences of Cross-Species, Springer, 2007*
5. *Zoonotic Disease of Public health Importance, National Institute of Communicable Diseases, 2016*
6. *Rolf Bauerfeind, Zoonoses Infectious Diseases Transmissible from Animals to Humans,4thEidtion, ASM, 2016*

Unit IIIPharmaceutical Microbiology

3.1 **Procedures**: Concepts and technique of Microbiological Assays

3.2 **Assay:**Application of Microbiological Assays

3.3 **QC:**Fundamental and application of Microbiology Quality control

3.4 **QA:**Fundamental and application of Microbiology Quality Assurance

Reference Books

1. *William Hewitt, Microbiological Assays for Pharmaceutical Analysis-A rational approach, CRC, 2005*
2. *Stephen P. Denyer, Rosamund M. Baird, Guide to Microbiological Control in Pharmaceuticals and Medical Devices, 2nd Edition, CRC Press, 2006*
3. *Quality assurance in Microbiology, Rajesh Bhatia, CBS, 2000*
4. *Martine C.Easter, Rapid Microbiological Methods in the Pharmaceutical Industry, , InterpharmCRC, 2005*

Unit IV Quality Management

4.1 **Microbiological processes:**Procedures and application of Microbiological processes in Pharmaceutical industry

4.2 **Quality management**: Study of various quality management systems like GMP, GLP NABL etc.

4.3 **System Management:**Study of various ISO system in for industry like, Quality, Environment and social responsibility management

4.4 **Guideline:**Study of guideline for clinical research

Reference Books

1. *Hugo and Russell's Pharmaceutical Microbiology, , Blackwell Publishing, 2004*
2. *KanishkaBedi, Quality Management, Oxford, 2006*
3. *Guru Prasad Mohanta, Textbook on Clinical Research A Guide for Aspiring Professionals and Professionals, Pharma med, 2019*
4. *S K Gupta, Basic Principles of Clinical Research methodology, ICRI*
5. *Jurg P. Seiler, Good Laboratory Practice: The Why and the How, Springer, 2007*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -304**	**Semester**	**III**
Industrial Microbiology and Fermentation Technology			
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 (M) -304:INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY

Learning Objective and Outcomes:

The course has created to expose students to various industrial microbiology process after completing this course student will be

- CO 1 Able to understand the application of microbial process in the industry
- CO 2 Able to understand the role and responsibility of Microbiologist in Industry
- CO 3 Student will gain exposure to economic value of microbiology

	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit I: Cultivation and Selection of Strains

1.1 Isolation and Screening: New Approaches to Microbial, Isolation and actinomycetes, Screening-Enzymes from Extreme Environments, Cell-Based Screening Methods, Metabolomics for the Discovery of Novel Compounds, Methods To Access Silent Biosynthetic Pathways (Richard)

1.2 Media, Growth: Nutrient Media for Cultivation of Industrial Microorganisms and Generation of Microbial Products;Pathways: Biosynthetic Pathways for Metabolic Products of Microorganisms, Processes for Overproduction of Microbial Metabolites for Industrial Applications

1.3 Stain Improvement: Selection and Improvement of Industrial Organisms for Biotechnological Applications; Culture preservation and inoculum development:storage at reduced temperature, storage in a dehydrated form, quality control of preserved stock, inoculum development, criteria for the transfer of inoculum, Development of inocula for yeast and bacterial processes

1.4 Sterilization: Significance and Processes of Sterility and sterilization

References

1 Richard H. Baltz , Manual of Industrial Microbiology and Biotechnology, ASM Press, 2010
2 Allan Whitaker and Peter F. Stanbury, Principles of Fermentation Technology, 3rd Edition, Elsevier, 2017
3 NdukaOkafor, Modern Industrial Microbiology and Biotechnology 2nd Edition, CRC press, 2018
4 G D Najafpore, Biochemical Engineering and Biotechnology, Elsevier, 2007

Unit 2 Bioreactor and Downstream Processes

2.1 Design of a fermenter: Basic functions of a fermenter, aseptic operation and containment, fermenter body construction, aeration and agitation, aeration system (sparger), achievement and maintenance of aseptic conditions

2.2 Instrumentation and control: Methods of Measuring Process Variables, On-Line Analysis of Other Chemical Factors, Control Systems, Computer Applications in Fermentation Technology

2.3 Downstream Processing-The recovery and purification of fermentation products: Removal of cells and solid matter, Precipitation, Filtration, centrifugation, Cell disruption, chromatography, membrane processes, Drying, Crystallization, whole broth processing

2.4 Biocatalysts, Immobilized Enzymes and Cells: Enzymes class, industrial use, production of enzymes, Immobilization of enzymes and cells and its practical application, Manipulation of microorganisms for higher yield of enzymes; Solid-State Fermentation: Aerobic and Anaerobic

References:

1 Allan Whitaker and Peter F. Stanbury, Principles of Fermentation Technology, 3rd Edition, Elsevier, 2017
2 NdukaOkafor, Modern Industrial Microbiology and Biotechnology 2nd Edition, CRC press, 2018
3 Richard H. Baltz , Manual of Industrial Microbiology and Biotechnology, ASM Press, 2010
4 E.M.T. El-Mansi, Fermentation Microbiology and Biotechnology, 3rd edition, CRC press, 2012
5 Henry C. Vogel, Celeste M. Todaro, Fermentation and Biochemical Engineering Handbook, William Andrew, Elsevier, 2014

Unit 3Fermentation of Industrially Valuable Metabolites

3.1 Production of Enzymes: Amylases, Proteases and other hydrolases

3.2 Production of Antibiotics: Penicillin, Streptomycin, Tetracyclines, Griseofulvin

3.3 Production of Organic acid and Solvents: Citric Acid, lactic acid, acetic acid, Gluconic acid;Solvent**:** Biofuel and Industrial Alcohol, Glycerol, Aceton-butanol

3.4 Production of Amino Acids and Vitamins: Glutamic Acid, L-Lysine and Aromatic Amino Acids; Production of vitamins

References:

1 A H Patel, Industrial Microbiology, 2nd Edition, Trinity, 2016
2 NdukaOkafor, Modern Industrial Microbiology and Biotechnology 2nd Edition, CRC press, 2018
3 G D Najafpore, Biochemical Engineering and Biotechnology, Elsevier, 2007
4 E.M.T. El-Mansi, Fermentation Microbiology and Biotechnology, 3rd edition, CRC press, 2012

Unit 4 Recombinant products and Effluent treatment

4.1**Production of polysaccharides and Polyester:** Dextran, Xanthan Gum and Polyhydroxyalkanoates,

4.2**Optimization:** Scale up and fermentation economics,Statistical Methods for Fermentation Optimization: OVAT and RSM; Theproduction of heterologous proteins

4.3**Escherichia coli produced recombinant protein**: Soluble versus insoluble production

4.4**Effluent treatment and Bi product:** Introduction, Disposal, treatment processes, By-products

References:

1 Allan Whitaker and Peter F. Stanbury, Principles of Fermentation Technology, 3rd Edition, Elsevier, 2017
2 Alexander N. Glazer, Hiroshi Nikaido, Microbial Biotechnology: Fundamentals of Applied Microbiology 2nd edition, Cambridge University Press, 2012
3 Garner G. Moulton, Fed-batch fermentation, Woodhead Publishing, 2014
4 Henry C. Vogel, Celeste M. Todaro, Fermentation and Biochemical Engineering Handbook, William Andrew, Elsevier, 2014

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

Bios (M) -305: Practical Based on BIOS-301 to 304

The Course mainly emphasize on practical skill in molecular biology, genetics and environmental sample analysis. After completion f this course students will achieve:

- **CO1**Ability to apply basic principles of microbial genetics and learn to isolate and identification of microbes by various methods.
- **CO2**Ability to understand the application of microbial critically evaluate a problem and resolve to challenge blindly accepted concepts.
- **CO3**Zeal and ability to understand various formats of sequencing data and its quality assessment.
- **CO4**Will genomic and proteomics data analysis and its applications
- **CO5**Will be able to evaluate community and fuctionalmetagenimics of various animals and its significance

- **CO6**Will develop good experimental and quantitative skills in medical and pharmaceutical microbiology encompassing preparation of laboratory
- **CO7**Reagents, conducting experiments, satisfactory analyses of data and interpretation of results.
- **CO8**Will be able to understand fermentation technology and its applications at industrial level.

	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						
CO7						
CO8						

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

MICROBIAL DIVERSITY

1. Isolation and biochemical identification of Gram Negative bacteria - *E. coli, Enterobacteraerogenes, Proteus vulgaris, Pseudomonas aeruginosa, Shigella dysentery* and *Salmonella species* (*S. paratyphi A and B, S. typhi S. flexineri*) etc.
2. Isolation and biochemical identification of Gram Positive bacteria, *Bacillus species, Staphylococcus aureus*and *Streptococcus species* (*Enterococcus faecalis*) etc.
3. Isolation and identification of Actinomycetes bacteria
4. Isolation and screening of archaea
5. Isolation and identification of industrially important molds and fungi.
6. Isolation and identification of cyanobacteria / Algae
7. A study of Amoeba/ Ciliates /Malarial protozoa etc.
8. Isolation of bacteriophage from sewage water
9. Identification of bacteria by rapid kit and other systems
10. Online tool for bacterial identification based on morphological and biochemical characters
11. In silico analysis of Restriction Fragment Length Polymorphism
12. Identification of Microorganism with 16s rRNA Homology Technique
13. Perform the phylogenetic analysis using Clustal Omega analysis

OMICS AND INTEGRATIVE MICROBIOLOGY

1. Study of Various formats of sequencing data
2. Sequencing data quality assessment
3. Assembly of sequencing data

4. Study of Gene finding tools
5. Genome annotation
6. Study of Genome databases
7. 2 D gel data analysis
8. Proteomic Database and computational analysis
9. Trascriptomics data analysis
10. Community metagenomics study
11. Functional Metagenomics study
12. Metagenomics databases

MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

1. Isolation and identification of Microorganism form clinical sample
2. Antibiotic sensitivity test by disc method
3. MIC and MBC study
4. Microbiological assay for inhibitory substances
5. Microbiological assay for growth promoting substance
6. Microbial limit test
7. Sterility testing
8. Effectively of antimicrobial preservative
9. LAL test
10. Molecular diagnostic technique of pathogens

INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY

1. Screening, production, extraction and purification of industrial enzymes- Amylase/ Protease/ Cellulase/ Pectinase/ Xylanase/Lipase of microorganisms
2. Solid-state fermentation for the production of industrial enzymes
3. Screening of production, extraction and purification of Dextran / Xanthan Gum
4. Screening, production, extraction and purification Poly-Beta Hydroxyl-Butyrate (PHB)
5. Screening, production, extraction and purification of antibiotic Penicillin /Streptomycin
6. Screening, production, extraction and purification of organic acid i.e. Citric Acid/Lactic acid/Acetic acid/Gluconic acid
7. Screening, production, extraction and purification of Amino AcidsGlutamic Acid/L-Lysine etc.
8. Screening, production, extraction and purification of vitamins
9. Screening, production, extraction and purification of alcohol / ethanol
10. Screening, production, extraction and purification of beer / wine
11. Screening, production, extraction and purification of Acetone-butanol

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -401**	**Semester**	**IV**
Microbial Genetics 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 (M) -401:MICROBIAL GENETICS AND PHYSIOLOGY

Learning Objective and Outcomes: The course concentrate on understanding of mutation, mobile element and phage along with microbial bioprocess and physiological aspects of microorganisms. The aim of the course is to provide students with a deeper insight into the microbial genetics and physiological processes. On completion of the course the students will be able to

- CO 1 Describe the Mutation, Mobile Element and Phage genetics details.
- CO 2 Student will be correlate the Microbial Physiology, Anaerobic Bioprocesses and Metabolic Regulation and extremophiles biology.
- CO 3 Student will be explain the traditional to modern aspects with practical application in genetics.

	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit IBacterial and Phage genetics

1.1 **Molecular biology of Gene Transfer in Bacteria:** Transduction, Genetic Transformation, Conjugation and Plasmid Molecular Biology, Recombination

1.2 **Mutagenesis, Mutations, and Mutants**:Biochemical Basis of Mutations,Spontaneous Mutations, Mutagens, Isolation of Mutants, Mutagenesis,Reversion, Suppression, DNA Repair and Simple Recombination (Edward), **Transposable Elements:**Genomic Plasticity, Transposon, Insertion Sequences, Detection, Types of Bacterial Transposons, Transposition, Excision of Transposons, Genetic Phenomena,Phage Mu- DNA and replication, Retroviruses

1.3 **Genetics of other Intemperate Bacteriophages:** T Series phage, Single-Strand DNA Bacteriophages, RNA-Containing Bacteriophages, Bacteriophages Infecting Bacillus subtilis,Bacteriophages Infecting the Archaea

1.4 **Genetics of Temperate Bacteriophages**:Nature of the Temperate Response, Bacteriophage Lambda and Other Lambdoid Phages, P22, P2, P4, P1, SSV1 and SSV2

Reference Books

1. *Stanley R. Maloy, Microbial Genetics, Second Edition, Jones and Bartlett Publishers*
2. *Edward A. Birge,Bacterial and Bacteriophage Genetics 5th Edition, Springer, 2006*

3. *Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, Lewin's GENES XII, Jones & Bartlett, 2018*
4. *Larry Snyder and Wendy Champness, Molecular genetic of bacteria, ASM Press, 2007*
5. *Jeremy W. Dale and Simon F. Park, Molecular Genetics of Bacteria, 5th Edition, John Wiley & Sons, Ltd, 2010*
6. *Albert G. Moat, John W. Foster, Michael P. Spector, Microbial Physiology, 4th Edition, Wiley-Liss, Inc, 2002*

Unit II Microbial Physiology

2.1 **Membrane:**Membrane transport - nutrient uptake and protein excretion

2.2 **Biosynthesis and microbial growth:** Molecular composition of bacterial cells, Assimilation of inorganic nitrogen and sulfate, Biosynthesis of Amino acid, Nucleotide, Lipid, Heme, saccharides, Polysaccharide, Assembly of cellular structure and growth

2.3 **Heterotrophic metabolism on substrates other than glucose:** Hydrolysis of polymers, Utilization of sugars, Organic acid, alcohols and ketones, Amino acid, Degradation of nucleic acid bases, Oxidation of aliphatic hydrocarbons and aromatic compounds, Utilization of methane and methanol, Incomplete oxidation

2.4 **Chemolithotrophy:** Reverse electron transport, Nitrification, Sulfur bacteria, Iron bacteria, Hydrogen and Carbon monoxide oxidation, Chemolithotrophs using other electron donors, CO2 fixation pathways in chemolithotrophs

Reference Books

1. *Byung Hong Kim and Geoffrey Michael Gadd, Bacterial Physiology and Metabolism,Cambridge University Press, 2008*
2. *Stanley R. Maloy, Microbial Genetics, Second Edition, Jones and Bartlett Publishers*

Unit III Anaerobic Bioprocesses and Metabolic Regulation

1.1 **Anaerobic fermentation:** Ethanol, Lactate, Butyrate and acetone-butanol-ethanol fermentations,Mixed acid and butanediol, Propionate, amino acids and nucleic acid bases, dicarboxylic acids

1.2 **Anaerobic respiration:**Denitrification, Metal reduction, Sulfidogenesis, Methanogenesis, Homoacetogenesis, Dehalorespiration,Syntrophic associations, Element cycling

1.3 **Metabolic regulation**: various mechanisms regulating enzyme synthesis

1.4 **Global regulation:** responses to environmental stress**,** various stresses and responses, Regulation through modulation of enzyme, Metabolic regulation and growth, Secondary metabolites,Metabolic regulation and the fermentation industry; Energy, environment and microbial survival- Survival and energy, Reserve materials in bacteria, Resting cells

Reference Books

1. Byung Hong Kim and Geoffrey Michael Gadd, Bacterial Physiology and Metabolism,Cambridge University Press, 2008
2. JyotsnaRathi, Microbial Physiology Genetics and Ecology, Manglam Publications, 2009

Unit IV Extremophiles Biology

4.1 Introduction of extreme life and Concept of an extreme biology (David Wharton)

4.2 Occurrence, Ecology, physiology and biotechnological application of Hyperthermophiles, Thermophiles, Psychrophiles

4.3 Occurrence, Ecology, physiology and biotechnological application of Acidophiles, alkaliphiles, halophiles

4.4 Occurrence, Ecology, physiology and biotechnological application of Piezophiles, Xerophiles, Organic Solvent Tolerant, Radiation Resistant Organisms and polyextremophiles

Reference Books

1. *Om V. Singh, Extremophiles, A John Wiley & Sons, Inc,2013*

2. *Koki Horikoshi, Extremophiles Handbook, Springer*
3. *Ravi V Durvasula and D V Subba Rao, Extremophiles From Biology to Biotechnology, CRC Press, 2018*
4. *Frank Robb GarabedAntranikian& Dennis Grogan Arnold Driessen, Thermophiles CRC Press Taylor & Francis, 2008*
5. *Fred A Rainey, Aharon Oren, Methods in Microbiology Volume 35 Extremophiles, Academic press Elsevier, 2006*
6. *Jean-Claude Bertrand, Environmental Microbiology: Fundamentals and Applications, Springer 2011*
7. *David A.Wharton Life at the Limits Organisms in extreme environments, Cambridge University Press 2002*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -402**	**Semester**	**IV**
Applied Microbiology			
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 (M) -402:APPLIED MICROBIOLOGY

Learning Objective and Outcomes: The subject offers the in-depth knowledge of the concepts, tools, techniques and process related to various field of applied Microbiology. On completion of the course the students will be able to

- CO 1 Understand the application of Microbiology in agriculture, health and environment
- CO 2 Know the responsibility of Microbiologist in the various industrial operation
- CO 3 Understand the relation of Host Microbiome and its application

	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						

Unit I Microbial Mediated Process

1.1 **Biofertilizer**: Concept, production, application, advantage and limitation of Biofertilizer

1.2 **Biopesticide:** Concept, production, application, advantage and limitation of Biopesticide

1.3 **Degradation processes**: Mechanism and application of Microbial Biodegradation and Bio Biodeterioration Process

1.4 **Cleaner Bioprocess:** Mechanism, Strategies and application of Bioremediation, Biogas, Biotransformation, Bioleaching, biomining

Reference Books

1. *Gareth M. Evans, Judith C. Furlong, Environmental Biotechnology Theory and Application, Wiley, 2003*

2. *A M Desmukh, Handbook of Biofertilizers and Biopesticides, Oxford India, 2007*
3. *OpenderKoul, Microbial biopesticides, Tailor and Francis*
4. *Travis, Microbial-Based Biopesticides Methods and Protocols, , Humana Press*
5. *Sangeetha. Environmental Biotechnology, , AAP press*
6. *Surajit Das, Microbial Biodegradation and Bioremediation, Elsevier, 2014*
7. *Alexander, Biodegradation and Bioremediation, 2Ed. Academic Press.*
8. *P Rajendran& P Gunasekaran, Microbial bioremediation, MJP Publishers*
9. *Allsopp, Introduction to Biodeterioration, 2Ed. Cambridge University Press.*

Unit II Waste Management and Nanotechnology

2.1 **Liquid waste:** Domestic water and Industrial waste water microbiology

2.2 **Solid Waste:**Solid Waste management and Biological waste management

2.3 **Nanomaterial**: Types of nanomaterial, properties, promise

2.3.1 **Application of Nanotechnology:** in Bioremediation, Biomedical and health sciences

Reference Books

1. *MukeshDoble Anil Kumar, Biotreatment of Industrial Effluents, Elsevier, 2005*
2. *Gabriel Bitton, Waste Water Microbiology, 3rd Ed, John Wiley & Sons, 2005*
3. *Ram Chandra, Advances in Biodegradation and bioremediation of Industrial Waste, CRC press, 2015*
4. *Nicholas, Butterworth-Heinemann,Handbook of water and waste water technologies, Elsevier, 2001*
5. *InduShekhar Thakur, Environmental Biotechnology, I K International, 2011*
6. *MogensHenze et al, Biological Wastewater Treatment Principles, Modelling and Design, IWA publishing, 2008.*
7. *John Pichtel, Waste management practices Municipal, Hazardous, and Industrial, CRC, 2014*
8. *Ram Prasad and ElisabetAranda, Approaches in Bioremediation The New Era of Environmental Microbiology and Nanobiotechnology, Springer, 2018*
9. *Claudio Nicolini, Nanobiotechnology&Nanobiosciences,Pan Stanford Publishing Pte. Ltd. 2009*
10. *David E. Reisner, Bionanotechnology Global Prospects, CRC Press, 2009*
11. *StergiosLogothetidis, Nanomedicine and Nanobiotechnology, Springer, 2012*

Unit III Applied Approach

3.1 **Microbial fuel:** Concept, production, application, advantage and limitation

3.2 **Industrial Application:** Overview of various biopharmaceutical products: Antibodies and Vaccine

3.3 **Applied Concept:** Fundamental and application of Forensic Microbiology and Space Microbiology

3.4 **Food Microbiology**: Dairy Products, Non-Dairy Products

Reference Books

1. *Biofuels Engineering Process Technology , Biofuels Engineering Process Technology,McGraw hill, 2008*
2. *Gary Walsh, Biopharmaceuticals, 2nd Edition, ohn Wiley & Sons,2003*
3. *Bruce Budowle, Steven E. Schutzer, et al., Microbial Forensics, 2nd Edition, Academic press, 2015*
4. *James M. Jay, Modern Food Microbiology, 7th Edition, Springer, 2005*
5. *Michael P. Doyle and Michael P. Doyle, Food Microbiology: Fundamentals and Frontiers, 4th Edition, ASM Press, 2013*

Unit IV Host-Microbiome

4.1 **Host-microbiome**: Fundamentals, tools and techniques

4.2 **Interaction ofMicrobiome**: Interactions of Host-microbiota, Overview of Plant,Animal and human Microbiome

4.3 **Hologenome**: Symbioses and concept of Hologenome, Hologenome and holobiont theory, Tools and technique, Microbiotas are Part of Holobiont Fitness,

4.4 **Applied aspects of the hologenome**: Altered Microbiota and Their Metabolism in Host Metabolic Diseases, Prebiotics, Probiotics, Synbiotics, and Phage Therapy, Fecal Transplantation (Bacteriotherapy)

Reference Books

1. *Sarah K. Highlander, Encyclopedia of Metagenomics, Springer, 2015*

2. *Eugene Rosenberg and IlanaZilber-Rosenberg, The Hologenome Concept: Human, Animal and Plant Microbiota, Springer, 2013*
3. *Jun Sun and Pradeep K. Dudeja, Mechanisms Underlying Host-Microbiome Interactions in Pathophysiology of Human Diseases, Springer 2018*
4. *Ravindra Pal Singh, Ramesh Kothari, Prakash G. Koringa, Satya Prakash Singh, Understanding Host-Microbiome Interactions - An Omics Approach, Springer Nature, 2017*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -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 (M) -403: RESEARCH METHODOLOGY AND PROFESSIONAL SKILLS

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

	PS01	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. *PetterLaake, Haakon BreienBenestad and BjørnReino 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,SManikandan, 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. *VeerabhadrappaHavinal, 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. *MarialuisaAliotta, 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 (Micro)**
Course Code	**Bios (M) -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 (Paper of 3hrs)**	**150**

Bios (M) -204:DISSERTATION/ TRAINING

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.

	PS01	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

Student 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 (Micro)**
Course Code	**Bios (M) -405**	**Semester**	**IV**
Practical Based on BIOS-401 to 403			
Course type	**Practical**	**Total Credit**	**06**
Teaching time	**Examination Marking Scheme**		
Practical (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
12/week	**45**	**105**	**150**

Bios (M) -405: Practical based on paper 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** Will be able to apply advance techniques in the field of microbiology.
- **CO 2** Students will be able to evaluate the biochemical and physiological aspects of the microbes in the laboratory through various methods.
- **CO 3** Students will be able to isolate the metagenome of the various plants and animals and will be able to understand their coexistence and significance to the environment as well as the flora and fauna.
- **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

	PS01	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

MICROBIAL GENETICS AND PHYSIOLOGY

1. Plasmid Curing from Bacterial Cell
2. Conjugation in Bacteria
3. Transduction in Bacteria
4. Plasmid Profile Analysis
5. Isolation and identification of Auxotrophic mutant
6. Induction of mutation
7. Isolation of thermophiles/ Psychrophiles/Acidophiles/alkaliphiles/ halophiles
8. Study of CO2 sequestering bacteria
9. Cultivation and detection of Anaerobic bacteria
10. Compatible solute production in extremophiles
11. Degradation of aliphatic hydrocarbons by bacteria

APPLIED MICROBIOLOGY

1 PGPR study
2 Microbial Biodegrading study
3 Microbial Bioremediation study
4 Microbiological analysis of domestic water
5 Microbiological analysis of waste water
6 Nano particle preparation
7 Microbiological analysis of food and dairy product
8 Host microbiome data analysis
9 Study on Probiotic

RESEARCH METHODOLOGY AND PROFESSIONAL SKILLS

1. Searching of scientific literature
2. Digital research resources e-ShodhSindhu and Shodhganga at 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 HirakRanjan Dash, Microbial Biotechnology- A Laboratory Manual for Bacterial Systems, Springer, 2015