

BHAVNAGAR UNIVERSITY

BHAVNAGAR

(NACC Accreditation Grade “B”)

CREDIT AND SEMESTER SYSTEM

SYLLABUS

MASTER OF SCIENCE (M.Sc.)

LIFE SCIENCES

(In Force From Academic Year: 2010-2011)

तमसो मा ज्योतिर्गमय

DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR

M.Sc. Botany\Zoology\Microbiology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : I

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	I	I	Cell Biology and Molecular Biology	B.Sc. Botany / Microbiology / Zoology.	
2	II	I	Biochemistry		
3	III	I	Instrumentation in Biological Sciences		
4	IV	I	Practicals		

Name of the Subject: (M.Sc.) Botany\Zoology\Microbiology

SEMESTER - I

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	I	I	Cell Biology and Molecular Biology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	II	I	Biochemistry	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	III	I	Instrumentation in Biological Sciences	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	IV	I	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
Assignment / Study Tour	: 05
Attendance	: 05
Seminar	: 10
Test	: 10
Total Marks	: 30

SEMESTER I

M.Sc. Botany

Paper No: I

Title of the Paper: Cell Biology and Molecular Biology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	General Cellular Status of prokaryotic and eukaryotic cells. cell organelles: Mitochondria, Golgi bodies, Endoplasmic Reticulum, Chloroplast and Ribosomes.	12	14 + 6 = 20
Unit 2	Cell cycle: Cell division and its types (somatic and reduction division). Regulation of normal and abnormal type of cell divisions. Cell differentiation. Simple tissues.	12	14 + 6 = 20
Unit 3	Cytoskeleton: Organization and function of microtubules, microfilaments and Intermediate filaments, cell theory. Basic features of genetic code, variation in the genetic code, second genetic code, Wobble hypothesis.	12	14 + 6 = 20
Unit 4	Resume of DNA structure, central dogma of molecular biology, DNA replication, DNA repair system, DNA polymerase, Exonucleases, Endonucleases, homing and retrohoming Endonucleases, Topoisomerases, Gyases, Methylases, Ligases and Protein Factors. Superhelical Density, C-value paradox, Cot curves.	12	14 + 6 = 20
Unit 5	Structural features of r-RNA, t-RNA and m-RNA. Transcription, RNA polymerases, Bacterial promoters, RNA processing in Bacteria and Eukaryotes, Ribozymes and reverse transcriptase, RNA foot printing. Regulation of Transcription: Operon model, Positive and Negative control. DNA Sequencing: Maxam and Gilbert, Sanger's and Automated Method.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. Analysis of Genes and Genomes – Richard Reece
2. Cell – A molecular approach – 2007.
3. Cell Physiology – A. C. Giese
4. Cell and Molecular Biology – De Robertis and De Robertis.
5. Essential Techniques in Cell Biology – Bhatnagar, Murthy, Chinoy, V.C. Shah.
6. Genetis VIII – Lewin.
7. Molecular Biology – Freifeldre.
8. Molecular Biology of Cell – Albert et. al., (Garland)
9. Molecular Cell Biology – Lodish et. al., Scientific American books.
10. Reproduction in Eukaryotic cells – Prescott, D. M., Academic press.
11. Cell – Swanson and Webster.

SEMESTER I**M.Sc. Botany****Paper No: II****Title of the Paper: Biochemistry****Marks: 100****Credits : 04****Marks: Semester End Examination : 70****Continuous Internal Evaluation : 30**

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Proteins: Structure, classification, properties and functions. Amino acids and peptides. Methods for protein purification. Amino acid sequencing for proteins. Protein metabolism: Synthesis and degradation.	12	14 + 6 = 20
Unit 2	Carbohydrates: Structure, classification, properties and functions. Glycoconjugates: Proteoglycans, glycoproteins and glycolipids. Carbohydrate metabolism: Glycolysis, TCA cycle, gluconeogenesis.	12	14 + 6 = 20
Unit 3	Lipids: Structure, classification, properties and functions, biological membranes. Metabolism: Biosynthesis and degradation of lipids. Vitamins: Classification, chemistry and function.	12	14 + 6 = 20
Unit 4	Enzymes: Apoenzyme, coenzyme and prosthetic groups. Properties, classification, functions and mode of action of enzymes and coenzymes.	12	14 + 6 = 20
Unit 5	Hormones: Chemistry, mode of action and function of plants, animals and microbial hormones.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:**Assignment / Study Tour : 05 Marks****Attendance : 05 Marks****Seminar : 10 Marks****Test : 10 Marks****Total Marks : 30****Reference Books:**

1. Biochemistry by Lehninger, Nelson, Cox
2. Biochemistry by N. P. Sharma.
3. Principles and Techniques of Biochemistry and Molecular Biology (6th edition) by Keith Wilson and John Walker.
4. Biochemistry by Stryer.

SEMESTER I

M.Sc. Botany

Paper No: III

Title of the Paper: Instrumentation in Biological Sciences

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Methods: Measurements of pH, Conductivity, EDTA, Acid Base and Dichromate titrations, Centrifugation, Microscopy.	12	14 + 6 = 20
Unit 2	Microtechniques: Cell culture technique and its potential use, Histological and Histochemical staining.	12	14 + 6 = 20
Unit 3	Techniques: Chromatography: Paper chromatography – Unidimensional and two dimensional, thin layer chromatography (TLC), High pressure liquid chromatography (HPLC), Electrophoretic techniques – paper electrophoresis, gel electrophoresis, its application in biological sciences.	12	14 + 6 = 20
Unit 4	Instrumentation: Colorimetry, Spectrophotometry, Flame photometry and their applications in biological sciences.	12	14 + 6 = 20
Unit 5	Atomic adsorption spectrophotometry (AAS), Mass spectrometric techniques (MS), Nephelometry and Turbidimetry.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books:

1. An Introduction to Practical Biochemistry by Plummer.
2. Environmental science and Biotechnology : Theory and techniques by A. G. Murugesan and C. Rajakumari.
3. Instrumental methods of chemical analysis by B. K. Sharma.
4. Microscopy for students by J. D. Casartelli, McGraw, Hill pub.
5. Principles and techniques of biochemistry and molecular biology (6th edition) by Keith Wilson and John walker, Cambridge Edition.

SEMESTER I

M.Sc. Botany

Paper No: IV

Title of the Paper: Practicals

Marks: 100

Credits : 15

Practical exercised based on paper I to III

Detailed Syllabus

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Botany\Zoology\Microbiology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : **II**

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	V	II	Genetics, Evolution and Biostatistics	B.Sc. Botany / Microbiology / Zoology.	
2	VI	II	Environmental Biology and Biotechnology		
3	VII	II	Radiation Biology and Immunology		
4	VIII	II	Practicals		

Name of the Subject: (M.Sc.) Botany\Zoology\Microbiology

SEMESTER - II

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	V	II	Genetics, Evolution and Biostatistics	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	VI	II	Environmental Biology and Biotechnology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	VII	II	Radiation Biology and Immunology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	VIII	II	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
Assignment / Study Tour	: 05
Attendance	: 05
Seminar	: 10
Test	: 10
Total Marks	: 30

SEMESTER II

M.Sc. Botany

Paper No: V

Title of the Paper: Genetics, Evolution and Biostatistics

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Gene concept and interaction of genes (complementary gene effects, epistasis and its Types) Mendel's work on heredity, Mendel's mono and dihybrid experiments. Neo- Mendelism, Mendel's Laws.	12	14 + 6 = 20
Unit 2	Linkage and crossing over, coupling and repulsion hypothesis, sex linked inheritance. Lethality in animals and humans. Non-chromosomal inheritance.	12	14 + 6 = 20
Unit 3	Principles and theories of organic evolution. Mutation and its types, molecular basis of evolution, speciation. Application of computers in statistics, advantage of using a computer, computer codes, computer programme languages. MS Excel – statistical functions, descriptive statistics, t-test, ANOVA, correlation, regression, Chi-square test.	12	14 + 6 = 20
Unit 4	Definition and scope Biostatistics: Population and sample: Sampling, sample size, sampling distribution, finite and infinite population, necessity of sampling, methods of sampling. Variables: Variables in Biology, Collection, classification and tabulation of data, Diagrams and Graphs. Need, usefulness, guidelines, types of diagram. Frequency distribution: Definition, relative and percent relative frequencies, discrete and continuous frequency distribution, cumulative frequency distribution, frequency graphs.	12	14 + 6 = 20
Unit 5	Descriptive statistics, Average: Definition, objectives, types of averages. Deviation: Mean deviation, standard deviation, interpretation of standard deviation, standard error, coefficient of variation, Probability: Probability scale, definitions, types and rules of probability, applications of probability, Venn diagrams. Hypothesis testing: Hypothesis and null hypothesis, sampling distribution, level of Significance, Student's t-test, ANOVA – one way and two ways, correlation, coefficient of correlation, regression, Chi-square test.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. An introduction to biostatistics, 2nd Revised ed., by Urunmani.
2. Animal cytology and Evolution by White.
3. Biostatistics by P. K. Sen.
4. Cytology, genetics and Evolution by P. K. Gupta.
5. Cell dynamics by Springer and verlang wiin.
6. Evolution by Lull.
7. Evolution by Dobzhanky.
8. Evolution by Savage.
9. Foundation of Genetics by A.C.Pai, McGraw Hill Pub.
10. Genetics by Farnsworth, (Hyper and Row).
11. Genetics by Verma and Agarwal.
12. Genetics by Winchester, Oxford IBH Publication.
13. Genetics: New Frontiers by Chopra, Joshi, Sharma, Bansal.
14. Genetics. The thread of Life by Philippe Kourilsky.
15. Genetics and Origin of species by Dobzhanky, Columbia Univ. Press.
16. Introduction to Evolution (Ind. Edition) by Moody.
17. Principle of Genetics by Gardner, Wiley Eastern Pvt. Ltd.
18. Population, species and Evolution by Major.

SEMESTER II

M.Sc. Botany

Paper No: VI

Title of the Paper: Environmental Biology and Biotechnology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Man and environment: International efforts to tackle environmental pollution. Pollution of water and treatment of polluted waters	12	14 + 6 = 20
Unit 2	Air pollution: Oxides of carbon, other green house gases, ozone, Sulphur dioxide, oxides of nitrogen, hydrocarbons and particulate air pollution. Central control devices for air pollution.	12	14 + 6 = 20
Unit 3	Soil pollution: Biocides, solid waste pollution. Noise pollution. Bioinformatics: Overview of Bioinformatics, Database types, Genomics and Proteomics, Human Genome Project, DNA microarrays.	12	14 + 6 = 20
Unit 4	Definition and scope of, Recombinant DNA Technology (Genetic Engineering), restriction enzymes, reverse transcriptase, ligation and transformation. Cloning vectors: Plasmids, Cosmids, Phagemids, Phages, Artificial chromosomes, cloning strategies. PCR methods and applications. Production of insulin, human growth hormone and vaccines by RDT. Site-directed mutagenesis, oligonucleotide directed mutagenesis.	12	14 + 6 = 20
Unit 5	Transgenic plants for resistance against insect pests, viruses, herbicides, bacterial and fungal pathogens for higher photosynthesis, nitrogen fixation and better seeds. Biosafety concerns with transgenic plants. Transgenic animals for human proteins. Biotechnological applications of animal cell and tissue culture.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. Air pollution effects on biodiversity by Barker.
2. Air pollution control theory by Crawford.
3. Analysis of Genes and Genomes by Recharl Reece.
4. A text book on Biotechnology by H. D. Kumar.
5. Biotechnology by J. Higgins.
6. Biotechnology, 3rd Ed. by John. E. Smith, Cambridge University Press.
7. Biotechnology by P. K. Gupta.
8. Biotechnology. The Biological principles by Trevan, M. D. et al.
9. DNA damage and Repair in Human Tissue by Sutherland and Woodhead.
10. Environmental biology by P. S. Verma.
11. Environmental biotechnology by S. K. Agarwal.
12. Environmental toxicology by Satake.
13. Principals of Gene Manipulation by Primroze.
14. Recombinant DNA techniques by Rodriguez & Tait.
15. Water pollution by Kudesia.

SEMESTER II**M.Sc. Botany****Paper No: VII****Title of the Paper: Radiation Biology & Immunology****Marks: 100****Credits : 04****Marks: Semester End Examination : 70****Continuous Internal Evaluation : 30**

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Introduction: Discovery of radiations, radioactive materials and their biological effects. The atom, nuclides, radio nuclides. Characteristics and source of alpha, beta, X and gamma rays and their interaction with matter.	12	14 + 6 = 20
Unit 2	Biological effects: Radiation effects on biomolecules. Chromosomes, microorganisms, plants, mammals, blood and hematopoietic tissues, digestive system, reproductive system, skin and hair, bones.	12	14 + 6 = 20
Unit 3	Radiation detection and uses: Units, measurements of radiation, utility in different fields of biological sciences. Hazards of radiation. Complement system, properties and mode of action.	12	14 + 6 = 20
Unit 4	Antigens: Definition, types and properties. Antibodies: definition, classes, cellular mechanism of production. Antigen –antibody reactions. Monoclonal antibodies: Definitions, productions, uses. Immunity: Definition and types of immunity. Autoimmunity.	12	14 + 6 = 20
Unit 5	Hypersensitivity, types (classes) of hypersensitivity reactions, vaccines. Vaccines: Types, DNA vaccines, malaria vaccines, edible vaccines, Interferon: Types, properties and mode of action.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:**Assignment / Study Tour : 05 Marks****Attendance : 05 Marks****Seminar : 10 Marks****Test : 10 Marks****Total Marks : 30****Reference Books:**

1. Environmental pollutions- Radiation by Prasad & Chaudhari.
2. Essential Immunology-Ivan. M. Roitt.
3. Fundamentals of Radiobiology by Bacq Alexander, 2nd ed., Pergaman Press, New York.
4. Immunology by Anant Narayan & Paniker.
5. Immunochemistry by Glynn & Steward.
6. Immunology by Gordsby, Kindt, Osborne & Kuby.
7. Immunodiagnosics : Principles and Practice by S. C. Rastogi.
8. Instrumentation Methods of chemical Analysis by B. K. Sharma.
9. Radiation biology by A. P. Casarett, Prentice Hall.
10. R.F. and microwave radiation safety by Ronald Kitchen.

Detailed Syllabus

(With effect from Academic Year 2010 – 2011)

SEMESTER II**M.Sc. Botany****Paper No: VIII****Title of the Paper: Practicals****Marks: 100****Credits : 15**Practical exercised based on paper V to VII

Detailed Syllabus

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Botany

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : **III**

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	IX	III	Taxonomy, Conservation and Utility of Plants	Students of M.Sc. Life Sciences Who have cleared SEM - I	
2	X	III	Plant Physiology and Metabolism.		
3	XI	III	Plant Development and Reproduction		
4	XII	III	Practicals		

Credit and Semester System Syllabus in force from June 2010 -2011

Name of the Subject: (M.Sc.) Botany

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	IX	III	Taxonomy, Conservation and Utility of Plants	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	X	III	Plant Physiology and metabolism.	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	XI	III	Plant Development and Reproduction	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	XII	III	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
Assignment / Study Tour	: 05
Attendance	: 05
Seminar	: 10
Test	: 10
Total Marks	: 30

SEMESTER III

M.Sc. Botany

Paper No: IX

Title of the Paper: Taxonomy conservation and utility of plants

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Principles of taxonomy: the species concept – taxonomic hierarchy, species, genus, family and other categories. International code of Botanical Nomenclature; Taxonomic tools: method of field studies, herbarium, floras, contribution of cytology, palenology, phytochemistry and ecology in taxonomy, computers and GIS.	12	14 + 6 = 20
Unit 2	Systems of angiosperm classification: Bentham and Hooker. Bessey, Huchinson, Englar and prantal: their comparative merits and demerits. Current trends in angiosperms taxonomy based on cytotaxonomy, chemotaxonomy and numerical taxonomy.	12	14 + 6 = 20
Unit 3	Conservation: principles, extinctions, environmental status of plants. In situ conservation: international efforts (IUCN, UNEP, UNESCO, WWF, ICSU, FAO, CAB international, WCMC, ISBI): Protected areas: Sanctuaries, National parks, biosphere Reserves, Coral reefs.	12	14 + 6 = 20
Unit 4	Ex situ conservation : germplasm collection, botanical gardens, seed banks, 'test tube' gene bank, pollen banks, field gene banks, DNA banks;Activities of BSI, NBPGR, ICAR, CSIR, DBT.	12	14 + 6 = 20
Unit 5	Origin, evolution, botany, cultivation and uses of (i) food, forage and fodder crops, (ii) fibre croups, (iii)medicinal and aeromatics plants, (iv) oil- yielding crops,(v) paper making.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

SEMESTER III

M.Sc. Botany

Paper No: X

Title of the Paper: plant physiology and metabolism

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Membrane transport and translocation of water and solute: Plant – water relations, mechanism of water transport through xylem, transpiration, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins. Mineral nutrition: Criteria of essentiality of elements, macro and Micro nutrients, role of essential elements, mineral deficiency symptoms and plant disorders	12	14 + 6 = 20
Unit 2	Photochemistry and photosynthesis: General concept and historical background, photosynthetic pigments and light harvesting complexes. Photooxidation of water, mechanism of electron and proton transport, carbon assimilation – the C4 cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.	12	14 + 6 = 20
Unit 3	Respiration and lipid metabolism: Overview of plant Respiration. Glycolysis, the TCA cycle, electron transport and ATP synthesis. Pentose phosphate pathways, glyoxylate cycle, alternative oxidase system, structure and function of lipids, fatty acids biosynthesis. Synthesis of membrane lipids, structural lipids and storage lipids and their catabolism.	12	14 + 6 = 20
Unit 4	Nitrogen fixation, nitrogen and sulphur metabolism: overview of plant Respiration. Nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation. Sulfate uptake, transport and assimilation.	12	14 + 6 = 20
Unit 5	The flowering process: Photoperiodism and its significance. Endogenous clock and its regulation, floral induction and development – genetic and molecular analysis, role of vernalization. Stress physiology: Plant response to biotic and abiotic stress. Mechanism of biotic and abiotic stress tolerance, HR and SAR, water deficit and drought resistance, oxidative stress.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. Plant physiology – C.P. Malik
2. Plant physiology - Devlin & Witham
3. Plant physiology – Mukherji, A. K. Ghosh
4. Collage Botany by Das, Datta, Ganguly.

SEMESTER III**M.Sc. Botany****Paper No: XI****Title of the Paper: plant development and reproduction.****Marks: 100****Credits : 04****Marks: Semester End Examination : 70****Continuous Internal Evaluation : 30**

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Introduction: unique features of plant development; differences between animal and plant development. Cell wall: gross structure; chemical composition; formation; electron microscopic structure. Shoot development: organization of the shoot apical meristem (SAM); control of cell division and cell to cell communication.	12	14 + 6 = 20
Unit 2	Tissue differentiation: especially xylem and phloem: secretory ducts and laticifers; wood development in relation to environmental factors. Leaf growth and differentiation: determination; phyllotaxy; control of leaf form; differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.	12	14 + 6 = 20
Unit 3	Root development: organization of root apical meristem (RAM); cell fates and lineages; vascular tissue differentiation; lateral roots; root hairs; root-microbes interactions. Vegetative propagation: natural vegetative propagation(by root, stem, and leaf) artificial method of vegetative propagation (layering, cutting and grafting)	12	14 + 6 = 20
Unit 4	Male gametophytes: structure of anthers: microsporogenesis, role of tapetum; pollen development and gene expression; male sterility; sperm dimorphism and hybrid seed production; pollen germination, pollen tube growth and guidance; pollen storage; pollen allergy; pollen embryos. Female gametophytes: ovule development; megasporogenesis; organization of the embryos sac, structure of the embryo sac cells.	12	14 + 6 = 20
Unit 5	Seed development and fruit growth: endosperm development during early, maturation and desiccation stages, embryo genesis, ultra structure and nuclear cytology; cell lineages during late embryo development; storage protein of endosperm and embryo; polyembryony; apomixes; embryo culture; dynamics of fruit growth; biochemistry and molecular biology of fruit maturation. Latent life dormancy: importance and types of dormancy; seed dormancy; overcoming seed dormancy; bud dormancy.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Detailed Syllabus

(With effect from Academic Year 2010 – 2011)

SEMESTER III**M.Sc. Botany****Paper No: XII****Title of the Paper: Practicals (Botany)****Marks: 100****Credits : 15**Practical exercised based on paper IX to XI

Detailed Syllabus

(With effect from Academic Year 2010 – 2011)

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Botany

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : IV

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	XIII	IV	Plant ecology	Students of M.Sc. Life Sciences Who have cleared SEM - II	
2	XIV	IV	Biotechnology and biodiversity of plants		
3	XV	IV	Marine botany		
4	XVI	IV	Practicals		

Name of the Subject: (M.Sc.) Botany

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	XIII	IV	Plant ecology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	XIV	IV	Biotechnology and biodiversity of plants	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	XV	IV	Marine botany	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	XVI	IV	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
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Assignment / Study Tour	:	05
Attendance	:	05
Seminar	:	10
Test	:	10
Total Marks	:	30

SEMESTER IV

M.Sc. Botany

Paper No: XIII

Title of the Paper: Plant ecology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Vegetation organization: Phytosociological characters of plant communities and methods of their study, biological spectrum, autecological approach and ecological indicators.	12	14 + 6 = 20
Unit 2	Edaphic factor: definition and composition of soils, origin and formation of soil, soil profile, soil classification, properties of soils, soil erosion, soil conservation.	12	14 + 6 = 20
Unit 3	Ecosystem organization : biosphere, biotic and abiotic components, ecological balance, food chain, ecological pyramids, energy flow and biogeochemical cycles, homeostasis	12	14 + 6 = 20
Unit 4	Ecosystem: Types, terrestrial and fresh water ecosystems. Climate change: Greenhouse gasses (CO ₂ , CH ₄ , N ₂ O, CFCs), Ozone hole, consequences of climate change(CO ₂ fertilization , global warming, sea level rises, acid rain, UV radiation), Phytoremediation.	12	14 + 6 = 20
Unit 5	Population ecology: Population growth curves, biotic potential, death rates, age structures, fluctuations and equilibrium.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books:

1. Ecology – Odum
2. Plant Ecology – P. D. Sharma
3. Plant Ecology by Vasishtha.
4. Phytogeography and Plant Ecology by S.Kumarasen.

SEMESTER IV

M.Sc. Botany

Paper No: XIV

Title of the Paper: Biotechnology and Biodiversity of plants

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation: 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Plant cell and tissue culture: general introduction, history. Scopes, concept of cellular differentiation, totipotency. Organogenesis and adventive embryogenesis: fundamental aspect of morphogenesis; somatic embryogenesis and androgenesis, mechanisms techniques and utility.	12	14 + 6 = 20
Unit 2	Somatic hybridization: protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievement and limitation of protoplast research. Application of plant tissue culture: clonal propagation, artificial seed, production of hybrids and somaclones, production of seed, production of secondary metabolites/ natural products, cryopreservation and germplasm storage.	12	14 + 6 = 20
Unit 3	Biodiversity: concept, scope, constraints of plant biodiversity. Genetic diversity: Nature, measurement, determinants.	12	14 + 6 = 20
Unit 4	Species diversity: species inventory, diversity of major groups, indices for measurement; alpha, beta and gamma diversity. Ecosystems diversity: classification, measurement, major types.	12	14 + 6 = 20
Unit 5	Values and uses of biodiversity: biodiversity values, ethical and aesthetic values, methodologies for valuation.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

- 1) Assignment / Study Tour : 05 Marks
- 2) Attendance : 05 Marks
- 3) Seminar : 10 Marks
- 4) Test : 10 Marks

Total Marks : 30

SEMESTER IV **M.Sc. Botany**
Title of the Paper: Marine botany
Credits : 04

Paper No: XV
Marks: 100

Marks: Semester End Examination : 70
Continuous Internal Evaluation: 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Marine environment: history of oceanography; oceans of the world. Continental drift; sea as a biological environment, main division and zones of marine environment. Physical factors: temperature , light, pressure, sound velocity, sedimentation , dynamic factors, waves , tides, currents, their effects on marine flora , fauna, and microorganisms.	12	14 + 6 = 20
Unit 2	Chemistry of sea water: chemical composition, chlorinity, salinity, pH, dissolved gases, minerals, nutrients and organic matter. Pollution: major pollutant (sewage, agricultural discharges, industrial wastes, dredging, oils, radioactive, elements) and their effects on marine biota, bioremediation.	12	14 + 6 = 20
Unit 3	Marine phytoplankton: types, distribution, biomass, productivity, and factors affecting productivity. Marine algae: salient features (morphology, structures, reproduction, And classification) of marine <i>Chlorophyta</i> , <i>Phaeophyta</i> , and <i>Rhodophyta</i> : algal floras of India.	12	14 + 6 = 20
Unit 4	Marine angiosperm: sea grasses, halophytes, mangroves, coastal floras of India.	12	14 + 6 = 20
Unit 5	Physiology of Marine angiosperm: seed germination, salt uptake and translocation, nitrogen metabolism and photosynthesis. Economic utility: uses of marine aglae, algal products and of mangroves.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks
Attendance : 05 Marks
Seminar : 10 Marks
Test : 10 Marks
Total Marks : 30

SEMESTER IV **M.Sc. Botany**

Paper No: XVI

Title of the Paper: Practicals (Botany)
Credits : 15

Marks: 100

Practical exercised based on paper XIII to XV

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Microbiology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : I

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	I	I	Cell Biology and Molecular Biology	B.Sc. Botany / Microbiology / Zoology.	
2	II	I	Biochemistry		
3	III	I	Instrumentation in Biological Sciences		
4	IV	I	Practicals		

Name of the Subject: (M.Sc.) Microbiology

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	I	I	Cell Biology and Molecular Biology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	II	I	Biochemistry	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	III	I	Instrumentation in Biological Sciences	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	IV	I	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
Assignment / Study Tour :	05
Attendance :	05
Seminar :	10
Test :	10
Total Marks :	30

SEMESTER I

M.Sc. Microbiology

Paper No: I

Title of the Paper: Cell Biology and Molecular Biology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	General Cellular Status of prokaryotic and eukaryotic cells. cell organelles: Mitochondria, Golgi bodies, Endoplasmic Reticulum, Chloroplast and Ribosomes.	12	14 + 6 = 20
Unit 2	Cell cycle: Cell division and its types (somatic and reduction division). Regulation of normal and abnormal type of cell divisions. Cell differentiation. Simple tissues.	12	14 + 6 = 20
Unit 3	Cytoskeleton: Organization and function of microtubules, microfilaments and Intermediate filaments, cell theory. Basic features of genetic code, variation in the genetic code, second genetic code, Wobble hypothesis.	12	14 + 6 = 20
Unit 4	Resume of DNA structure, central dogma of molecular biology, DNA replication, DNA repair system, DNA polymerase, Exonucleases, Endonucleases, homing and retrohoming Endonucleases, Topoisomerases, Gyrases, Methylases, Ligases and Protein Factors. Superhelical Density, C-value paradox, Cot curves.	12	14 + 6 = 20
Unit 5	Structural features of r-RNA, t-RNA and m-RNA. Transcription, RNA polymerases, Bacterial promoters, RNA processing in Bacteria and Eukaryotes, Ribozymes and reverse transcriptase, RNA foot printing. Regulation of Transcription: Operon model, Positive and Negative control. DNA Sequencing: Maxam and Gilbert, Sanger's and Automated Method.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books:

1. Analysis of Genes and Genomes – Richard Reece
2. Cell – A molecular approach – 2007.
3. Cell Physiology – A. C. Giese
4. Cell and Molecular Biology – De Robertis and De Robertis.
5. Essential Techniques in Cell Biology – Bhatnagar, Murthy, Chinoy, V.C. Shah.
6. Genetis VIII – Lewin.
7. Molecular Biology – Freifeldre.
8. Molecular Biology of Cell – Albert et. al., (Garland)
9. Molecular Cell Biology – Lodish et. al., Scientific American books.
10. Reproduction in Eukaryotic cells – Prescott, D. M., Academic press.
11. Cell – Swanson and Webster.

SEMESTER I**M.Sc. Microbiology****Paper No: II****Title of the Paper: Biochemistry****Marks: 100****Credits : 04****Marks: Semester End Examination : 70****Continuous Internal Evaluation : 30**

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Proteins: Structure, classification, properties and functions. Amino acids and peptides. Methods for protein purification. Amino acid sequencing for proteins. Protein metabolism: Synthesis and degradation.	12	14 + 6 = 20
Unit 2	Carbohydrates: Structure, classification, properties and functions. Glycoconjugates: Proteoglycans, glycoproteins and glycolipids. Carbohydrate metabolism: Glycolysis, TCA cycle, gluconeogenesis.	12	14 + 6 = 20
Unit 3	Lipids: Structure, classification, properties and functions, biological membranes. Metabolism: Biosynthesis and degradation of lipids. Vitamins: Classification, chemistry and function.	12	14 + 6 = 20
Unit 4	Enzymes: Apoenzyme, coenzyme and prosthetic groups. Properties, classification, functions and mode of action of enzymes and coenzymes.	12	14 + 6 = 20
Unit 5	Hormones: Chemistry, mode of action and function of plants, animals and microbial hormones.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:**Assignment / Study Tour : 05 Marks****Attendance : 05 Marks****Seminar : 10 Marks****Test : 10 Marks****Total Marks : 30****Reference Books:**

1. Biochemistry by Lehninger, Nelson, Cox
2. Biochemistry by N. P. Sharma.
3. Principles and Techniques of Biochemistry and Molecular Biology (6th edition) by Keith Wilson and John Walker.
4. Biochemistry by Stryer.

SEMESTER I

M.Sc. Microbiology

Paper No: III

Title of the Paper: Instrumentation in Biological Sciences

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Methods: Measurements of pH, Conductivity, EDTA, Acid Base and Dichromate titrations, Centrifugation, Microscopy.	12	14 + 6 = 20
Unit 2	Microtechniques: Cell culture technique and its potential use, Histological and Histochemical staining.	12	14 + 6 = 20
Unit 3	Techniques: Chromatography: Paper chromatography – Unidimensional and two dimensional, thin layer chromatography (TLC), High pressure liquid chromatography (HPLC), Electrophoretic techniques – paper electrophoresis, gel electrophoresis, its application in biological sciences.	12	14 + 6 = 20
Unit 4	Instrumentation: Colorimetry, Spectrophotometry, Flame photometry and their applications in biological sciences.	12	14 + 6 = 20
Unit 5	Atomic adsorption spectrophotometry (AAS), Mass spectrometric techniques (MS), Nephelometry and Turbidimetry.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books:

1. An Introduction to Practical Biochemistry by Plummer.
2. Environmental science and Biotechnology : Theory and techniques by A. G. Murugesan and C. Rajakumari.
3. Instrumental methods of chemical analysis by B. K. Sharma.
4. Microscopy for students by J. D. Casartelli, McGraw, Hill pub.
5. Principles and techniques of biochemistry and molecular biology (6th edition) by Keith Wilson and John walker, Cambridge Edition.

SEMESTER I

M.Sc. Microbiology

Paper No: IV

Title of the Paper: Practicals

Marks: 100

Credits : 15

Practical exercised based on paper I to III

Detailed Syllabus

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Microbiology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : **II**

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	V	II	Genetics, Evolution and Biostatistics	B.Sc. Botany / Microbiology / Zoology.	
2	VI	II	Environmental Biology and Biotechnology		
3	VII	II	Radiation Biology and Immunology		
4	VIII	II	Practicals		

Name of the Subject: (M.Sc.) Microbiology

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	V	II	Genetics, Evolution and Biostatistics	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	VI	II	Environmental Biology and Biotechnology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	VII	II	Radiation Biology and Immunology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	VIII	II	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
Assignment / Study Tour :	05
Attendance :	05
Seminar :	10
Test :	10
Total Marks :	30

SEMESTER II

M.Sc. Microbiology

Paper No: V

Title of the Paper: Genetics, Evolution and Biostatistics

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Gene concept and interaction of genes (complementary gene effects, epistasis and its Types) Mendel's work on heredity, Mendel's mono and dihybrid experiments. Neo- Mendelism, Mendel's Laws.	12	14 + 6 = 20
Unit 2	Linkage and crossing over, coupling and repulsion hypothesis, sex linked inheritance. Lethality in animals and humans. Non-chromosomal inheritance.	12	14 + 6 = 20
Unit 3	Principles and theories of organic evolution. Mutation and its types, molecular basis of evolution, speciation. Application of computers in statistics, advantage of using a computer, computer codes, computer programme languages. MS Excel – statistical functions, descriptive statistics, t-test, ANOVA, correlation, regression, Chi-square test.	12	14 + 6 = 20
Unit 4	Definition and scope Biostatistics: Population and sample: Sampling, sample size, sampling distribution, finite and infinite population, necessity of sampling, methods of sampling. Variables: Variables in Biology, Collection, classification and tabulation of data, Diagrams and Graphs. Need, usefulness, guidelines, types of diagram. Frequency distribution: Definition, relative and percent relative frequencies, discrete and continuous frequency distribution, cumulative frequency distribution, frequency graphs.	12	14 + 6 = 20
Unit 5	Descriptive statistics, Average: Definition, objectives, types of averages. Deviation: Mean deviation, standard deviation, interpretation of standard deviation, standard error, coefficient of variation, Probability: Probability scale, definitions, types and rules of probability, applications of probability, Venn diagrams. Hypothesis testing: Hypothesis and null hypothesis, sampling distribution, level of Significance, Student's t-test, ANOVA – one way and two ways, correlation, coefficient of correlation, regression, Chi-square test.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. An introduction to biostatistics, 2nd Revised ed., by Urunmani.
2. Animal cytology and Evolution by White.
3. Biostatistics by P. K. Sen.
4. Cytology, genetics and Evolution by P. K. Gupta.
5. Cell dynamics by Springer and verlang wiin.
6. Evolution by Lull.
7. Evolution by Dobzhanky.
8. Evolution by Savage.
9. Foundation of Genetics by A.C.Pai, McGraw Hill Pub.
10. Genetics by Farnsworth, (Hyper and Row).
11. Genetics by Verma and Agarwal.
12. Genetics by Winchester, Oxford IBH Publication.
13. Genetics: New Frontiers by Chopra, Joshi, Sharma, Bansal.
14. Genetics. The thread of Life by Philippe Kourilsky.
15. Genetics and Origin of species by Dobzhanky, Columbia Univ. Press.
16. Introduction to Evolution (Ind. Edition) by Moody.
17. Principle of Genetics by Gardner, Wiley Eastern Pvt. Ltd.
18. Population, species and Evolution by Major.

SEMESTER II

M.Sc. Microbiology

Paper No: VI

Title of the Paper: Environmental Biology and Biotechnology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Man and environment: International efforts to tackle environmental pollution. Pollution of water and treatment of polluted waters	12	14 + 6 = 20
Unit 2	Air pollution: Oxides of carbon, other green house gases, ozone, Sulphur dioxide, oxides of nitrogen, hydrocarbons and particulate air pollution. Central control devices for air pollution.	12	14 + 6 = 20
Unit 3	Soil pollution: Biocides, solid waste pollution. Noise pollution. Bioinformatics: Overview of Bioinformatics, Database types, Genomics and Proteomics, Human Genome Project, DNA microarrays.	12	14 + 6 = 20
Unit 4	Definition and scope of, Recombinant DNA Technology (Genetic Engineering), restriction enzymes, reverse transcriptase, ligation and transformation. Cloning vectors: Plasmids, Cosmids, Phagemids, Phages, Artificial chromosomes, cloning strategies. PCR methods and applications. Production of insulin, human growth hormone and vaccines by RDT. Site-directed mutagenesis, oligonucleotide directed mutagenesis.	12	14 + 6 = 20
Unit 5	Transgenic plants for resistance against insect pests, viruses, herbicides, bacterial and fungal pathogens for higher photosynthesis, nitrogen fixation and better seeds. Biosafety concerns with transgenic plants. Transgenic animals for human proteins. Biotechnological applications of animal cell and tissue culture.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. Air pollution effects on biodiversity by Barker.
2. Air pollution control theory by Crawford.
3. Analysis of Genes and Genomes by Richard Reece.
4. A text book on Biotechnology by H. D. Kumar.
5. Biotechnology by J. Higgins.
6. Biotechnology, 3rd Ed. by John. E. Smith, Cambridge University Press.
7. Biotechnology by P. K. Gupta.
8. Biotechnology. The Biological principles by Trevan, M. D. et al.
9. DNA damage and Repair in Human Tissue by Sutherland and Woodhead.
10. Environmental biology by P. S. Verma.
11. Environmental biotechnology by S. K. Agarwal.
12. Environmental toxicology by Satake.
13. Principals of Gene Manipulation by Primroze.
14. Recombinant DNA techniques by Rodriguez & Tait.
15. Water pollution by Kudesia.

SEMESTER II

M.Sc. Microbiology

Paper No: VII

Title of the Paper: Radiation Biology & Immunology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Introduction: Discovery of radiations, radioactive materials and their biological effects. The atom, nuclides, radio nuclides. Characteristics and source of alpha, beta, X and gamma rays and their interaction with matter.	12	14 + 6 = 20
Unit 2	Biological effects: Radiation effects on biomolecules. Chromosomes, microorganisms, plants, mammals, blood and hematopoietic tissues, digestive system, reproductive system, skin and hair, bones.	12	14 + 6 = 20
Unit 3	Radiation detection and uses: Units, measurements of radiation, utility in different fields of biological sciences. Hazards of radiation. Complement system, properties and mode of action.	12	14 + 6 = 20
Unit 4	Antigens: Definition, types and properties. Antibodies: definition, classes, cellular mechanism of production. Antigen –antibody reactions. Monoclonal antibodies: Definitions, productions, uses. Immunity: Definition and types of immunity. Autoimmunity.	12	14 + 6 = 20
Unit 5	Hypersensitivity, types (classes) of hypersensitivity reactions, vaccines. Vaccines: Types, DNA vaccines, malaria vaccines, edible vaccines, Interferon: Types, properties and mode of action.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books:

1. Environmental pollutions- Radiation by Prasad & Chaudhari.
2. Essential Immunology-Ivan. M. Roitt.
3. Fundamentals of Radiobiology by Bacq Alexander, 2nd ed., Pergaman Press, New York.
4. Immunology by Anant Narayan & Paniker.
5. Immunochemistry by Glynn & Steward.
6. Immunology by Gordsby, Kindt, Osborne & Kuby.
7. Immunodiagnosics : Principles and Practice by S. C. Rastogi.
8. Instrumentation Methods of chemical Analysis by B. K. Sharma.
9. Radiation biology by A. P. Casarett, Prentice Hall.
10. R.F. and microwave radiation safety by Ronald Kitchen.

SEMESTER II

M.Sc. Microbiology

Paper No: VIII

Title of the Paper: Practicals

Marks: 100

Credits : 15

Practical exercised based on paper V to VII

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Microbiology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : **III**

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	IX	III	Environmental Microbiology	Students of M.Sc. Life Sciences Who have cleared SEM - I	
2	X	III	Microbial Genetics		
3	XI	III	Microbial Taxonomy		
4	XII	III	Practicals		

Name of the Subject: (M.Sc.) Microbiology

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	IX	III	Environmental Microbiology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	X	III	Microbial Genetics	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	XI	III	Microbial Taxonomy	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	XII	III	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
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Assignment / Study Tour	:	05
Attendance	:	05
Seminar	:	10
Test	:	10
Total Marks	:	30

SEMESTER III

M.Sc. Microbiology

Paper No: IX

Title of the Paper: Environmental Microbiology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Concept and Dynamics of Ecosystem: Environment: Basic concept, global environmental problems, components, food chain and energy flow. Types and complexity of ecosystem, Biogeochemical cycles. Microbial leaching of metal ores. Environmental pollution. Eutrophication and its control. Siderophores.	12	14 + 6 = 20
Unit 2	Waste Treatment: Types and characteristic of waste, waste water characterization, Principles and aims of biological waste treatment. Waste treatment processes. Anaerobic waste water treatment.	12	14 + 6 = 20
Unit 3	Biodegradation: Principles and mechanism of biodegradation. Factors influencing biodegradation. Biodegradation of hydrocarbons, lignin, dyes, pesticides, recalcitrant compounds, Biopulping and bioleaching, PHB biosynthesis and its degradation. Biosurfactants and their applications.	12	14 + 6 = 20
Unit 4	Bioremediation: Principles of bioremediation, biosorption and bioaccumulation, bioconversions, co-metabolism. In situ and ex situ techniques of bioremediation. Use of GMO in bioremediation.	12	14 + 6 = 20
Unit 5	Extreme Environment: Temperature, pH, high solute concentration, low nutrients, Microorganisms and their molecular adaptations to extreme environments. Biotechnological applications of extremophiles.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books for Environmental Microbiology:

- Alexander, M. (1971). Microbial ecology. John Wiley & Sons, Inc, New york.
- Alexander, M. (1971). Introduction to soil microbiology. John Wiley & Sons, Inc, New york.
- Ec Eldowney, S. Hardman, D. J. and waite, S. (1993). Pollution: Ecology and biotreatment. Longman Scientific Technical.
- Baker, K. H. and Herson, D. S. (1994). Bioremediation. McGraw Hill Inc., New york.
- K. C. Marshall (1985). Advances in microbial ecology Vol – 8. Plenum Press.
- Burns R. G. and Slater H. (1982). Experimental Microbial ecology. Blackwell Scientific Publications, Oxford, London.
- Vanghan, D. and Malcolm, R. E. C. (1985). Soil organic matter and biological activity. Martinus Nighoff W. Junk Publishers.
- Brock, T. D., Madigan, M. T. Biology of Microorganisms. Prentice Hall Int. Inc.
- R. M. Maier, I. L. Pepper and G. P. Gerba. Environmental Microbiology.

SEMESTER III

M.Sc. Microbiology

Paper No: X

Title of the Paper: Microbial Genetics

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Mutation: Gene as unit of mutation and recombination, types, mechanisms, molecular nature of mutations, effects, mutagens, genetic analysis, uses.	12	14 + 6 = 20
Unit 2	Genetic exchange in bacteria: Transformation, transduction, conjugation, lysogeny. Recombination: molecular basis of recombination.	12	14 + 6 = 20
Unit 3	Regulation of gene: Process and control of transcription and translation. Operon concept: <i>lac</i> , <i>ara</i> , <i>trp</i> , <i>his</i> operons. Genetic basis of cancer: Oncogenes, control of cell proliferation, DNA and RNA tumor viruses.	12	14 + 6 = 20
Unit 4	Transposable elements : Insertion sequences, transposons and retranposons. Plasmid: Properties, types, detection, transfer, replication, compatibility, control of copy number etc.	12	14 + 6 = 20
Unit 5	Recombination DNA technology: Recombinant DNA, types of vectors, insertion of DNA in a vector, detection methods for recombinant molecule expression in host cell. Gene libraries. Transgenic microbes. Production pf protein from cloned genes. Applications of recombinant DNA technology.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books for Environmental Microbiology:

1. Short Course in bacterial genetics. J. H. Miller. (1992). CSH. Laboratory.
2. Microbial genetics. Maloy et al. (1994). Jones and Bartlett Publishers.
3. Molecular genetics of bacteria: J. W. Dale. (1994). John Wiley and Sons.
4. Modern Microbial genetics. Streips and Yasbin (1991). Niley Ltd.
5. Microbial genetics. D. Freifelder. (2002). Jones and Bartlett Publishers, Inc.
6. Genes III. (2004). Benjamin Lewin.

SEMESTER III

M.Sc. Microbiology

Paper No: XI

Title of the Paper: Microbial Taxonomy

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Classification of Microorganisms: Introduction- Haeckel's 3 kingdom concept, four kingdom classification by Margulis and Copeland. Whittaker's 5 kingdom classification, 3 domain concept by Carl Woese. Differences between the 3 domains. Classification and salient features of bacteria according to Bergey's manual of systematic bacteriology 2 nd ed (2002).	12	14 + 6 = 20
Unit 2	Taxonomic Ranks, molecular taxonomy, biochemistry and serology in bacterial classification. Numerical taxonomy, phylogeny, molecular chronometer, evolutionary distance.	12	14 + 6 = 20
Unit 3	Bacterial diversity: Mycoplasmas, Rickettsias, Chlamydiae, anoxygenic and oxygenic photosynthetic microbes. Unculturable and culturable bacterial diversity, conventional and molecular methods of studying bacterial diversity, diversity indices, Polyphasic approach for analysis of microbial diversity, Metagenomic DNA. Multicellular behaviour of selected microbes.	12	14 + 6 = 20
Unit 4	Mycology: General features of fungi. Classification, structure and reproduction of fungi, parasexual cycle. Characteristic of genera important in industry, biodegradation and disease of animals and humans.	12	14 + 6 = 20
Unit 5	Virology: Classification and ultra structure of viruses, viral genome types and virus related agents (viroids, prions, satellite, viruses etc.). Description of some bacterial, plant and animal viruses.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books for Microbial Taxonomy:

1. Brock, T.D., Madigan, M.T. Biology of microorganisms Prentice Hall Int.Inc.
2. The Prokaryotes (1991). A. Balows, A. G. Thuper, M. Dworkin, W. Harder, K. Schleifer. Springer verlag.
3. Bridge, E. A. (1992). Modern Microbiology. W. M. C. Brown, publishers, Oxford, England.
4. Stainer R. Y., Ingraham. J. L., Wheelis M. J., Painter P. R. (1999). General microbiology. MacMillan Educational Ltd. London.
5. Bergey's manual of systematic bacteriology.
6. Colwd , D. (1999). Microbial Diversity . Academic Press.
7. Dube, H. C. Introduction to fungi. Vikas Publishers.
8. fundamentals of Mycology. J. H. Burnett. Edward, Arnold crane Russak Publishers.
9. Dimmock, N. J., Primrose S. B. (1994). Introduction to Modern virology IV Ed, Blackwell Scientific Publications. Oxford.
10. Topley and Wilson's (1995). Text book on principles of Bacteriology, Virology and Immunology. Edward Arnold, London.

SEMESTER III

M.Sc. Microbiology

Paper No: XII

Title of the Paper: Practicals (Microbiology)

Marks: 100

Credits : 15

Practical exercised based on paper IX to XI

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Microbiology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : **IV**

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	XIII	IV	Microbial Physiology and Biochemistry.	Students of M.Sc. Life Sciences Who have cleared SEM - II	
2	XIV	IV	Industrial Microbiology		
3	XV	IV	Marine Microbiology		
4	XVI	IV	Practicals		

Name of the Subject: (M.Sc.) Microbiology

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	XIII	IV	Microbial Physiology and Biochemistry.	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	XIV	IV	Industrial Microbiology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	XV	IV	Marine Microbiology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	XVI	IV	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
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Assignment / Study Tour	:	05
Attendance	:	05
Seminar	:	10
Test	:	10
Total Marks	:	30

SEMESTER IV

M.Sc. Microbiology

Paper No: XIII

Title of the Paper: Microbial Physiology and Biochemistry

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Growth of Bacteria: Growth curve, growth kinetics, measurement of growth, synchronous and asynchronous growth, batch and continuous culture of bacteria. Cell division cycle: Cell division cycle in yeasts, edks and cyclins as regulators. Cell division cycle in filamentous fungi. Bacterial sporulation and its genetics, dormancy. Biomembranes and transport mechanisms, chemotaxis.	12	14 + 6 = 20
Unit 2	Bioenergetics: Entropy, enthalpy, laws of thermodynamics, free energy change, standard free energy change, equilibrium constant. Relationship between free energy change, equilibrium constant and spontaneity of a reaction. Microbial photosynthesis : Oxygenic and anoxygenic photosynthesis, Calvin's cycle, C ₃ – C ₄ pathway, reductive TCA cycle. Hydroxypropionate pathway. Microbial oxidation of sulphur, iron, hydrogen and nitrogen.	12	14 + 6 = 20
Unit 3	Respiratory metabolism: Aerobic and anaerobic, fermentation of carbohydrates and proteins. Electron transport system in bacteria and eukaryotes, rotational mechanism of ATP synthesis, Glyoxylate pathway. Cell signaling and signal transduction.	12	14 + 6 = 20
Unit 4	Control of metabolic reactions: Principles of regulatory mechanisms. Allosteric enzymes, control of enzyme activity and enzyme synthesis. control of enzyme activity and enzyme synthesis, <i>lac</i> operon, <i>ara</i> operon. Transcription attenuation (<i>trp</i> operon). Binding efficiency of RNA polymerase, antitermination, sigma factors. RNAi (RNA interference). Global regulation: Two – component signal transduction system, stringent response, <i>ntr</i> and <i>pho</i> system in response to N and P starvation. <i>ArcAB</i> and <i>fnr</i> system, bioluminescence and its control.	12	14 + 6 = 20
Unit 5	Secondary metabolites and secondary metabolism: Antibiotics, multiple drug resistance, biochemical mechanisms of drug resistance, plasmids and transposons in resistance, bacteriocins. Microbial toxin.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books for Microbial Physiology and Biochemistry:

1. Principles of Biochemistry, Lehninger. (2000). 3rd ed. Nelson and Cox (worth) publisher.
2. Biochemistry, Stryer. (2001). 5th ed. W. H. Freeman.
3. Caldwell, D. R. 1995. Microbial Physiology and Metabolism Brown Publishers.
4. Moat and Foster, J. W. (1999). Microbial physiology. Wiley.
5. Brun, Y. N. and Shimkets, L. J. (2000). Prokaryotic development. ASM press.
6. Stainer, R. Y., Ingraham, J. L., Wheelis, M. L., Painter, P. R. (1986). General Microbiology, MacMillan Education Ltd. London.

SEMESTER IV

M.Sc. Microbiology

Paper No: XIV

Title of the Paper: Industrial Microbiology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Microorganisms in fermentation Industries: isolation: sources and sampling strategies, methods for isolation, enrichment methods. Screening selection: types, screening artifacts. Genetics improvement of strains: production variants by mutation, gene manipulation, cloning over production of native protein. Yeast strain improvement for ethanol production. Maintenance: preservation methods.	12	14 + 6 = 20
Unit 2	Bioreactors: Concept, design, types factors affecting selection of bioreactor. Immobilization of cells and enzymes: Physical and chemical methods, applications of various immobilized cells and enzymes. Sterilization by various approaches, aeration and agitation.	12	14 + 6 = 20
Unit 3	Upstream and Down stream processing: Product recovery (down stream processing): separation, disintegration, enrichment by various methods. Purification: crystallization, chromatography methods. Drying. Process control: Measuring and set up of various physical, chemical and biological parameters. Antifoam agents: Sterilization, types, devices for the addition of antifoam agents, antifoam detection device. Scale up of microbial processes.	12	14 + 6 = 20
Unit 4	Fermentation technology: fermentative production of solvent (ethyl alcohol), organic acids (citric acid), amino acids (glutamic acid), exopolysaccharides (xanthan, dextran), antibiotics (penicillin, streptomycin), enzymes (amylase, protease) and vitamins (cobamide) by microorganisms. Biochemical mechanisms, fermentative processes, recovery, bioprocess economics.	12	14 + 6 = 20
Unit 5	Transformation and microbial biomass production: steroid transformation: introduction, various applications, biotransformation of steroids and sterols, biotransformation pathway, biotransformation technology. SCP: selection of microorganisms, substrates and processes. Optimization of conditions, recovery. Edible mushrooms.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books for Industrial Microbiology:

1. Industrial microbiology. G. Reed (Editor), CBS Publishers, (AVI publishing Company)
2. Biology of industrial microorganisms. A. L. Demain.
3. Genetics and biotechnology of industrial microorganisms. C. L. Hershnergev, S. W. Queeners, Q. Hegeman. American Society of Microbiology.
4. Stanbory P. F. A. Whitakar Hall. (1995). Principles of fermentation Technology. Porgaman, Mc Neul and Harvey.
5. Fermentation – A practical approach, IRL.
6. Material and methods in fermentation. G. L. Solomons. (1969). AP.
7. Microbial technology. Vol. I and II. Pappler H. J. Jovanovich Publishers.
8. Microbial technology. Casida. L. E. John Wiley and Sons.
9. Progress in Industrial Microbiolgy Vol. 9. D. J. D. Hockenull. Cambridge University Press.

SEMESTER IV

M.Sc. Microbiology

Paper No: XV

Title of the Paper: Marine Microbiology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Marine environment: history of oceanography; oceans of the world. Continental drift; sea as a biological environment, main division and zones of marine environment. Physical factors: temperature , light, pressure, sound velocity, sedimentation , dynamic factors, waves , tides, currents, their effects on marine flora , fauna, and microorganisms.	12	14 + 6 = 20
Unit 2	Chemistry of sea water: chemical composition, chlorinity, salinity, pH, dissolved gases, minerals, nutrients and organic matter. Pollution: major pollutant (sewage, agricultural discharges, industrial wastes, dredging, oils, radioactive, elements) and their effects on marine biota, bioremediation.	12	14 + 6 = 20
Unit 3	Marine bacteria Diversity : Types and characteristics of marine bacteria with emphasis on structural and behavioral adaptations to marine environment. Factors influencing cultivation and enumeration of marine microbes. Unculturable marine bacterial diversity.	12	14 + 6 = 20
Unit 4	Marine extremophiles and their biotechnological applications, Marine fungi and viruses, The microbial loop. Bioactive compounds from marine microbes.	12	14 + 6 = 20
Unit 5	Microbial indicators of marine pollution, biodegradation, biodeterioration, biofouling, biocorrosion, biofilms	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books for Marine Microbiology:

1. Marine microbiology - Austin
2. Munn, C. B. (2004). Marine Microbiology: Ecology and application. Garland Science.
3. Biodegradation and Bioremediation. Martin Alexander.
4. Microbiology – Ronald Atlas
5. Marine Microbiology: Ecology and Applications, Taylor and Francis. Scientific Publishers Brothers.

SEMESTER IV

M.Sc. Microbiology

Paper No: XVI

Title of the Paper: Practicals (Microbiology)

Marks: 100

Credits : 15

Practical exercised based on paper XIII to XV

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Zoology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : I

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	I	I	Cell Biology and Molecular Biology	B.Sc. Botany / Microbiology / Zoology.	
2	II	I	Biochemistry		
3	III	I	Instrumentation in Biological Sciences		
4	IV	I	Practicals		

Name of the Subject: (M.Sc.) Zoology

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	I	I	Cell Biology and Molecular Biology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	II	I	Biochemistry	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	III	I	Instrumentation in Biological Sciences	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	IV	I	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
Assignment / Study Tour	: 05
Attendance	: 05
Seminar	: 10
Test	: 10
Total Marks	: 30

SEMESTER I

M.Sc. Zoology

Paper No: I

Title of the Paper: Cell Biology and Molecular Biology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	General Cellular Status of prokaryotic and eukaryotic cells. cell organelles: Mitochondria, Golgi bodies, Endoplasmic Reticulum, Chloroplast and Ribosomes.	12	14 + 6 = 20
Unit 2	Cell cycle: Cell division and its types (somatic and reduction division). Regulation of normal and abnormal type of cell divisions. Cell differentiation. Simple tissues.	12	14 + 6 = 20
Unit 3	Cytoskeleton: Organization and function of microtubules, microfilaments and Intermediate filaments, cell theory. Basic features of genetic code, variation in the genetic code, second genetic code, Wobble hypothesis.	12	14 + 6 = 20
Unit 4	Resume of DNA structure, central dogma of molecular biology, DNA replication, DNA repair system, DNA polymerase, Exonucleases, Endonucleases, homing and retrohoming Endonucleases, Topoisomerases, Gyrases, Methylases, Ligases and Protein Factors. Superhelical Density, C-value paradox, Cot curves.	12	14 + 6 = 20
Unit 5	Structural features of r-RNA, t-RNA and m-RNA. Transcription, RNA polymerases, Bacterial promoters, RNA processing in Bacteria and Eukaryotes, Ribozymes and reverse transcriptase, RNA foot printing. Regulation of Transcription: Operon model, Positive and Negative control. DNA Sequencing: Maxam and Gilbert, Sanger's and Automated Method.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books:

1. Analysis of Genes and Genomes – Richard Reece
2. Cell – A molecular approach – 2007.
3. Cell Physiology – A. C. Giese
4. Cell and Molecular Biology – De Robertis and De Robertis.
5. Essential Techniques in Cell Biology – Bhatnagar, Murthy, Chinoy, V.C. Shah.
6. Genetis VIII – Lewin.
7. Molecular Biology – Freifeldre.
8. Molecular Biology of Cell – Albert et. al., (Garland)
9. Molecular Cell Biology – Lodish et. al., Scientific American books.
10. Reproduction in Eukaryotic cells – Prescott, D. M., Academic press.
11. Cell – Swanson and Webster.

SEMESTER I

M.Sc. Zoology

Paper No: II

Title of the Paper: Biochemistry

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Proteins: Structure, classification, properties and functions. Amino acids and peptides. Methods for protein purification. Amino acid sequencing for proteins. Protein metabolism: Synthesis and degradation.	12	14 + 6 = 20
Unit 2	Carbohydrates: Structure, classification, properties and functions. Glycoconjugates: Proteoglycans, glycoproteins and glycolipids. Carbohydrate metabolism: Glycolysis, TCA cycle, gluconeogenesis.	12	14 + 6 = 20
Unit 3	Lipids: Structure, classification, properties and functions, biological membranes. Metabolism: Biosynthesis and degradation of lipids. Vitamins: Classification, chemistry and function.	12	14 + 6 = 20
Unit 4	Enzymes: Apoenzyme, coenzyme and prosthetic groups. Properties, classification, functions and mode of action of enzymes and coenzymes.	12	14 + 6 = 20
Unit 5	Hormones: Chemistry, mode of action and function of plants, animals and microbial hormones.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. Biochemistry by Lehninger, Nelson, Cox
2. Biochemistry by N. P. Sharma.
3. Principles and Techniques of Biochemistry and Molecular Biology (6th edition) by Keith Wilson and John Walker.
4. Biochemistry by Stryer.

SEMESTER I

M.Sc. Zoology

Paper No: III

Title of the Paper: Instrumentation in Biological Sciences

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Methods: Measurements of pH, Conductivity, EDTA, Acid Base and Dichromate titrations, Centrifugation, Microscopy.	12	14 + 6 = 20
Unit 2	Microtechniques: Cell culture technique and its potential use, Histological and Histochemical staining.	12	14 + 6 = 20
Unit 3	Techniques: Chromatography: Paper chromatography – Unidimensional and two dimensional, thin layer chromatography (TLC), High pressure liquid chromatography (HPLC), Electrophoretic techniques – paper electrophoresis, gel electrophoresis, its application in biological sciences.	12	14 + 6 = 20
Unit 4	Instrumentation: Colorimetry, Spectrophotometry, Flame photometry and their applications in biological sciences.	12	14 + 6 = 20
Unit 5	Atomic adsorption spectrophotometry (AAS), Mass spectrometric techniques (MS), Nephelometry and Turbidimetry.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books:

1. An Introduction to Practical Biochemistry by Plummer.
2. Environmental science and Biotechnology : Theory and techniques by A. G. Murugesan and C. Rajakumari.
3. Instrumental methods of chemical analysis by B. K. Sharma.
4. Microscopy for students by J. D. Casartelli, McGraw, Hill pub.
5. Principles and techniques of biochemistry and molecular biology (6th edition) by Keith Wilson and John walker, Cambridge Edition.

SEMESTER I

M.Sc. Zoology

Paper No: IV

Title of the Paper: Practicals

Marks: 100

Credits : 15

Practical exercised based on paper I to III

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Zoology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : **II**

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	V	II	Genetics, Evolution and Biostatistics	B.Sc. Botany / Microbiology / Zoology.	
2	VI	II	Environmental Biology and Biotechnology		
3	VII	II	Radiation Biology and Immunology		
4	VIII	II	Practicals		

Name of the Subject: (M.Sc.) Zoology

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	V	II	Genetics, Evolution and Biostatistics	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	VI	II	Environmental Biology and Biotechnology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	VII	II	Radiation Biology and Immunology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	VIII	II	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
Assignment / Study Tour :	05
Attendance :	05
Seminar :	10
Test :	10
Total Marks :	30

SEMESTER II

M.Sc. Zoology

Paper No: V

Title of the Paper: Genetics, Evolution and Biostatistics

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Gene concept and interaction of genes (complementary gene effects, epistasis and its Types) Mendel's work on heredity, Mendel's mono and dihybrid experiments. Neo- Mendelism, Mendel's Laws.	12	14 + 6 = 20
Unit 2	Linkage and crossing over, coupling and repulsion hypothesis, sex linked inheritance. Lethality in animals and humans. Non-chromosomal inheritance.	12	14 + 6 = 20
Unit 3	Principles and theories of organic evolution. Mutation and its types, molecular basis of evolution, speciation. Application of computers in statistics, advantage of using a computer, computer codes, computer programme languages. MS Excel – statistical functions, descriptive statistics, t-test, ANOVA, correlation, regression, Chi-square test.	12	14 + 6 = 20
Unit 4	Definition and scope Biostatistics: Population and sample: Sampling, sample size, sampling distribution, finite and infinite population, necessity of sampling, methods of sampling. Variables: Variables in Biology, Collection, classification and tabulation of data, Diagrams and Graphs. Need, usefulness, guidelines, types of diagram. Frequency distribution: Definition, relative and percent relative frequencies, discrete and continuous frequency distribution, cumulative frequency distribution, frequency graphs.	12	14 + 6 = 20
Unit 5	Descriptive statistics, Average: Definition, objectives, types of averages. Deviation: Mean deviation, standard deviation, interpretation of standard deviation, standard error, coefficient of variation, Probability: Probability scale, definitions, types and rules of probability, applications of probability, Venn diagrams. Hypothesis testing: Hypothesis and null hypothesis, sampling distribution, level of Significance, Student's t-test, ANOVA – one way and two ways, correlation, coefficient of correlation, regression, Chi-square test.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. An introduction to biostatistics, 2nd Revised ed., by Urunmani.
2. Animal cytology and Evolution by White.
3. Biostatistics by P. K. Sen.
4. Cytology, genetics and Evolution by P. K. Gupta.
5. Cell dynamics by Springer and verlang wiin.
6. Evolution by Lull.
7. Evolution by Dobzhanky.
8. Evolution by Savage.
9. Foundation of Genetics by A.C.Pai, McGraw Hill Pub.
10. Genetics by Farnsworth, (Hyper and Row).
11. Genetics by Verma and Agarwal.
12. Genetics by Winchester, Oxford IBH Publication.
13. Genetics: New Frontiers by Chopra, Joshi, Sharma, Bansal.
14. Genetics. The thread of Life by Philippe Kourilsky.
15. Genetics and Origin of species by Dobzhanky, Columbia Univ. Press.
16. Introduction to Evolution (Ind. Edition) by Moody.
17. Principle of Genetics by Gardner, Wiley Eastern Pvt. Ltd.
18. Population, species and Evolution by Major.

SEMESTER II

M.Sc. Zoology

Paper No: VI

Title of the Paper: Environmental Biology and Biotechnology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Man and environment: International efforts to tackle environmental pollution. Pollution of water and treatment of polluted waters	12	14 + 6 = 20
Unit 2	Air pollution: Oxides of carbon, other green house gases, ozone, Sulphur dioxide, oxides of nitrogen, hydrocarbons and particulate air pollution. Central control devices for air pollution.	12	14 + 6 = 20
Unit 3	Soil pollution: Biocides, solid waste pollution. Noise pollution. Bioinformatics: Overview of Bioinformatics, Database types, Genomics and Proteomics, Human Genome Project, DNA microarrays.	12	14 + 6 = 20
Unit 4	Definition and scope of, Recombinant DNA Technology (Genetic Engineering), restriction enzymes, reverse transcriptase, ligation and transformation. Cloning vectors: Plasmids, Cosmids, Phagemids, Phages, Artificial chromosomes, cloning strategies. PCR methods and applications. Production of insulin, human growth hormone and vaccines by RDT. Site-directed mutagenesis, oligonucleotide directed mutagenesis.	12	14 + 6 = 20
Unit 5	Transgenic plants for resistance against insect pests, viruses, herbicides, bacterial and fungal pathogens for higher photosynthesis, nitrogen fixation and better seeds. Biosafety concerns with transgenic plants. Transgenic animals for human proteins. Biotechnological applications of animal cell and tissue culture.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. Air pollution effects on biodiversity by Barker.
2. Air pollution control theory by Crawford.
3. Analysis of Genes and Genomes by Richard Reece.
4. A text book on Biotechnology by H. D. Kumar.
5. Biotechnology by J. Higgins.
6. Biotechnology, 3rd Ed. by John. E. Smith, Cambridge University Press.
7. Biotechnology by P. K. Gupta.
8. Biotechnology. The Biological principles by Trevan, M. D. et al.
9. DNA damage and Repair in Human Tissue by Sutherland and Woodhead.
10. Environmental biology by P. S. Verma.
11. Environmental biotechnology by S. K. Agarwal.
12. Environmental toxicology by Satake.
13. Principals of Gene Manipulation by Primroze.
14. Recombinant DNA techniques by Rodriguez & Tait.
15. Water pollution by Kudesia.

SEMESTER II

M.Sc. Zoology

Paper No: VII

Title of the Paper: Radiation Biology & Immunology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Introduction: Discovery of radiations, radioactive materials and their biological effects. The atom, nuclides, radio nuclides. Characteristics and source of alpha, beta, X and gamma rays and their interaction with matter.	12	14 + 6 = 20
Unit 2	Biological effects: Radiation effects on biomolecules. Chromosomes, microorganisms, plants, mammals, blood and hematopoietic tissues, digestive system, reproductive system, skin and hair, bones.	12	14 + 6 = 20
Unit 3	Radiation detection and uses: Units, measurements of radiation, utility in different fields of biological sciences. Hazards of radiation. Complement system, properties and mode of action.	12	14 + 6 = 20
Unit 4	Antigens: Definition, types and properties. Antibodies: definition, classes, cellular mechanism of production. Antigen –antibody reactions. Monoclonal antibodies: Definitions, productions, uses. Immunity: Definition and types of immunity. Autoimmunity.	12	14 + 6 = 20
Unit 5	Hypersensitivity, types (classes) of hypersensitivity reactions, vaccines. Vaccines: Types, DNA vaccines, malaria vaccines, edible vaccines, Interferon: Types, properties and mode of action.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books:

1. Environmental pollutions- Radiation by Prasad & Chaudhari.
2. Essential Immunology-Ivan. M. Roitt.
3. Fundamentals of Radiobiology by Bacq Alexander, 2nd ed., Pergaman Press, New York.
4. Immunology by Anant Narayan & Paniker.
5. Immunochemistry by Glynn & Steward.
6. Immunology by Gordsby, Kindt, Osborne & Kuby.
7. Immunodiagnosics : Principles and Practice by S. C. Rastogi.
8. Instrumentation Methods of chemical Analysis by B. K. Sharma.
9. Radiation biology by A. P. Casarett, Prentice Hall.
10. R.F. and microwave radiation safety by Ronald Kitchen.

SEMESTER II

M.Sc. Zoology

Paper No: VIII

Title of the Paper: Practicals

Marks: 100

Credits : 15

Practical exercised based on paper V to VII

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Zoology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : **III**

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	IX	III	Comparative Anatomy	Students of M.Sc. Life Sciences Who have cleared SEM - I	
2	X	III	Development Biology and Histology		
3	XI	III	Entomology		
4	XII	III	Practicals		

Name of the Subject: (M.Sc.) Zoology

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	IX	III	Comparative Anatomy	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	X	III	Development Biology and Histology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	XI	III	Entomology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	XII	III	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
Assignment / Study Tour	: 05
Attendance	: 05
Seminar	: 10
Test	: 10
Total Marks	: 30

SEMESTER III

M.Sc. Zoology

Paper No: IX

Title of the Paper: Comparative Anatomy

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Comparative account of digestive organs: Stomach, intestine; liver and pancreas as associate digestive gland. Filter feeding mode of digestion in animals. Nervous system: Types, sympathetic and parasympathetic nervous system, spinal cord, cranial nerves.	12	14 + 6 = 20
Unit 2	Integument: structure of integument in vertebrates, types of skin derivatives in fishes, reptiles, birds and mammals. Endoskeleton: Comparative account of jaw suspensorium, vertebral column in birds and mammals, comparative account of girdles.	12	14 + 6 = 20
Unit 3	Organs of respiration: gills and lungs. Sense Organs: Comparative account of eyes and ear in vertebrates.	12	14 + 6 = 20
Unit 4	Circulatory system: Evolution of heart, aortic arches, portal system Excretory System: Types of nephron in fish, reptiles, birds and mammals.	12	14 + 6 = 20
Unit 5	Reproductive organs: Comparative account of testis and ovary. Minor Phyla: Concept, Significance and general characters.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books :

1. Chordate Zoology by Jordan and Verma.
2. Elements of Chordate anatomy by Wrichert.
3. Invertebrata by Jordan and Verma
4. Life of invertebrate by Russell – Hunter, Macmillan.
5. Life of Vertebrates by Young, Oxford University Press.
6. The chordates by Alexander, Cambridge University Press.

SEMESTER III

M.Sc. Zoology

Paper No: X

Title of the Paper: Development Biology and Histology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Differentiation of gonads in chick and mammals: Gametogenesis, morphological basis of spermatogenesis and oogenesis, semen composition, formation and function. Fertilization: Pre and post fertilization events, biochemistry of fertilization. Early embryogenesis in amphibians, role of germ layer in organogenesis.	12	14 + 6 = 20
Unit 2	Early embryogenesis. In chick, development of foetal membranes, organogenesis and differentiation. Metamorphosis with reference to amphibians.	12	14 + 6 = 20
Unit 3	Regeneration: In Invertebrate and vertebrate groups of animals. Parthenogenesis: With reference to Invertebrates and vertebrates. Histology of tissue: Epithelial, connective, muscles, nervous, integument. Digestive system: Stomach, intestine, liver, pancreas, kidney.	12	14 + 6 = 20
Unit 4	Histology of respiratory organs: Trachea, bronchus and lungs. Reproductive organs: Testis, ovary	12	14 + 6 = 20
Unit 5	Histology of Endocrine gland: Thyroid gland, adrenal gland, pituitary gland, endocrine pancreas, ovary, testis, thymus.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. Development Biology by Arumugam, Saras Publication. 2004
2. Development Biology by Berrill, Taxa McGraw Hill.
3. Histology by Bailey.
4. Histology by Gauba.
5. Histology by Hem.
6. Histology by Inderbeer Singh.
7. Introduction to embryology by Balinsky.
8. Pattern's Book of Embryology.

SEMESTER III

M.Sc. Zoology

Paper No: XI

Title of the Paper: Entomology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Taxonomy: Basic concept, Historical resume of systematics, Importance and application of Taxonomy. Characteristic and classification of insects.	12	14 + 6 = 20
Unit 2	Important Pests: Crops, animals and human beings, chemical and biological control of insect pest.	12	14 + 6 = 20
Unit 3	Insect physiology : Physiology of digestion, blood, excretion, respiration and photoreception.	12	14 + 6 = 20
Unit 4	Reproduction: Fertilization, growth and metamorphosis. Insect embryo development up to germ layers. Insect endocrine organs.	12	14 + 6 = 20
Unit 5	Pheromones, sonification, bioluminescence, Insect preservation and identification, Economic importance of insects, Behavioral study of certain insects.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books:

1. Entomology by Essig.
2. Entomology by Imms.
3. General Entomology by Mani, M.S.
4. Insect Morphology by Snudgrass.
5. Insect physiology by Wigglesworth.
6. A text Book of Applied Entomology by Srivastava, Kalyani publication.

SEMESTER III

M.Sc. Zoology

Paper No: XII

Title of the Paper: Practicals (Zoology)

Marks: 100

Credits : 15

Practical exercised based on paper IX to XI

**DEPARTMENT OF LIFE SCIENCES
BHAVNAGAR UNIVERSITY
BHAVNAGAR**

M.Sc. Zoology

Core

Faculty : Science
PG Department : Department of Life Sciences
Semester : **IV**

Sr. No.	Paper No.	Semester	Course Title	Eligibility	Remarks
1	XIII	IV	Ecology and Animal Biotechnology	Students of M.Sc. Life Sciences Who have cleared SEM - II	
2	XIV	IV	Animal Physiology and Neuroendocrinology		
3	XV	IV	Marine Zoology		
4	XVI	IV	Practicals		

Name of the Subject: (M.Sc.) Zoology

Sr. No.	Paper No.	Semester	Name of the Paper	Total Marks (Ext + Int = Total)	Passing standard (Ext + Int = Total)	Total Teaching Hours	Exam Hours	Credits
1	XIII	IV	Ecology and Animal Biotechnology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
2	XIV	IV	Animal Physiology and Neuroendocrinology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
3	XV	IV	Marine Zoology	70 + 30 = 100	28 + 12 = 40	15 x 4 = 60	03	04
4	XVI	IV	Practicals	100	40	15 x 15 = 225	06	15

Internal	Marks
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Assignment / Study Tour	:	05
Attendance	:	05
Seminar	:	10
Test	:	10
Total Marks	:	30

SEMESTER IV

M.Sc. Zoology

Paper No: XIII

Title of the Paper: Ecology and Animal Biotechnology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation : 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Ecosystem: Definition, types and composition, Biochemical cycles. Inter relationship: Mutualism, Commensalisms, protoco – operation.	12	14 + 6 = 20
Unit 2	Population ecology: population attributes, the role of prey – predators relation in nature, parasitism, competition (inter and intra specific), niche - concept, food chain. Adaptation: aquatic, terrestrial and parasitic.	12	14 + 6 = 20
Unit 3	Wild life: Conservation, sanctuaries and national parks. Animal Biotechnology: An overview, definition, genetic engineering, animal tissue culture, application of animal biotechnology, gene banking and conservation.	12	14 + 6 = 20
Unit 4	Animal tissue culture: Gene controlling differentiation in animals (organ regeneration in animals), transformation of animal cells, characteristics, establishment of cell line, animal tissue culture media, culture procedures.	12	14 + 6 = 20
Unit 5	Transgenic animal, artificial animal breeding, Acquired Immune deficiency syndrome (AIDS), Production of drugs from animals.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks

Attendance : 05 Marks

Seminar : 10 Marks

Test : 10 Marks

Total Marks : 30

Reference Books::

1. Animal Biotechnology by M. M. Ranga, Agrobios, India.
2. Animal Tissue Culture by Cruickshank.
3. Concept of Ecology.
4. Ecology by Odum.
5. Indian Wild Life by B. K. Tikader, ZSI, Calcutta.

SEMESTER IV

M.Sc. Zoology

Paper No: XIV

Title of the Paper: Animal physiology and Neuroendocrinology

Marks: 100

Credits : 04

Marks: Semester End Examination : 70

Continuous Internal Evaluation: 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	<p>Physiology of digestion: Digestive juices, bile and saliva, their regulation of secretion. Digestion and absorption of different food stuffs.</p> <p>Physiology of blood: haemopoiesis, erythropoiesis, coagulation of blood.</p> <p>Physiology of respiration: Respiratory pigments, gaseous exchange, external and internal.</p>	12	14 + 6 = 20
Unit 2	<p>Physiology of heart: cardiac cycle, heart beats.</p> <p>Physiology of Excretion: ultra structure of nephron, urine formation, nitrogenous waste pattern.</p>	12	14 + 6 = 20
Unit 3	<p>Muscle physiology: muscle contraction, conduction of nerve impulses.</p> <p>Hormones: types, neurosecretions and neurohormones, neuroendocrine integration.</p>	12	14 + 6 = 20
Unit 4	<p>Endocrine organs: Adrenal gland, pituitary gland, ovary, testis, pancreas, their hormones and functions. Synthesis, storage and release of thyroid hormones, its function.</p>	12	14 + 6 = 20
Unit 5	<p>Neuroendocrine control: of minerals, reproduction and pigments. Rennin- Angiotensin system.</p>	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour	: 05 Marks
Attendance	: 05 Marks
Seminar	: 10 Marks
Test	: 10 Marks
Total Marks	: 30

Reference Books::

1. Animal physiology by Nielsen Cambridge.
2. Comparative animal physiology by Prosser.
3. Comparative physiology by Hoar, Prentice Hall.
4. Endocrinology, Blackie.
5. Human physiology by Best and Taylor.
6. Human physiology by C.C. Chatterjee.

SEMESTER IV **M.Sc. Zoology**
Title of the Paper: Marine Zoology
Credits : 04

Paper No: XV
Marks: 100

Marks: Semester End Examination : 70
Continuous Internal Evaluation: 30

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
Unit 1	Marine environment: history of oceanography; oceans of the world. Continental drift; sea as a biological environment, main division and zones of marine environment. Physical factors: temperature, light, pressure, sound velocity, sedimentation, dynamic factors, waves, tides, currents, their effects on marine flora, fauna, and microorganisms.	12	14 + 6 = 20
Unit 2	Chemistry of sea water: chemical composition, chlorinity, salinity, pH, dissolved gases, minerals, nutrients and organic matter. Pollution: major pollutant (sewage, agricultural discharges, industrial wastes, dredging, oils, radioactive, elements) and their effects on marine biota, bioremediation.	12	14 + 6 = 20
Unit 3	Marine biodiversity: Zooplankton, marine invertebrates and vertebrates, marine borers and foulers, study of rocky, sandy and muddy habitats. Marine ecosystem: estuaries, marine wetlands, animal communities, interrelationship, food chain and food pyramids.	12	14 + 6 = 20
Unit 4	Marine fisheries: Bombay duck, pomfrets, prawn and molluscan fishery, endangered marine fauna.	12	14 + 6 = 20
Unit 5	Economic importance of marine fishes: exclusive economic zone (EEZ), its significance. Nutritive value, fish by-product, Mariculture.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

Assignment / Study Tour : 05 Marks
Attendance : 05 Marks
Seminar : 10 Marks
Test : 10 Marks
Total Marks : 30

Reference Books::

1. A text book of fish biology and Indian fisheries by R.P Parihar,
2. Biological oceanography by Angle, H.V. Methuen, 1975.
3. Brackish water, aquaculture development in India by Srivastva et al.
4. Chemical oceanography (vol. 1-8) by Riley and Shirrow, Academic press.
5. Fish and Fisheries of India by Jhingran, Hindustan Pub. Co. Delhi.
6. Introduction to Marine Ecology by Bames and Highes, Blackwall, 1982.
7. Marine Ecology by Levingstone, Prentice Hall, 1982.
8. Marine Fisheries by Bal and Virbhadra.
9. Marine Fisheries (IInd ed.) by Bal and Rao, Tata McGraw Hill, New Delhi.
10. Oceanography- an introduction to marine Environment by Weyl, R.R, 1970.

SEMESTER IV **M.Sc. Zoology**
Title of the Paper: Practicals (zoology)
Credits : 15

Paper No: XVI
Marks: 100

Practical exercised based on paper XIII to XV