

SARDAR PATEL UNIVERSITY



FACULTY OF SCIENCE COURSE OF STUDY

RULES OF DEGREE OF THE MASTER OF SCIENCE (M.Sc.) ZOOLOGY

R.PG.Sc.1: A candidate who has obtained the degree of Bachelor of Science of this University or of any other University recognized as equivalent thereto may, after successful completion of the course work etc. prescribed for the M.Sc. degree examination, be admitted to the examination for the degree of M.Sc. in the respective subject as per the regulation prescribed in that behalf.

A candidate possessing a bachelors degree in science with atleast 40% marks in theory papers in external examinations will be held eligible for admission to the Master degree course in Zoology offered by him / her at the Bachelors degree examination. However, the number of eligible applications as in above is less than available seats a candidate possessing bachelors degree in science with three subjects (optional-equal weightage) with atleast 40% marks in theory papers in external examinations will be held eligible for admission to the Masters degree course in Zoology.

The degree of Master of Science will be taken by papers and Practicals only.

R.PG.Sc.2: The examination for the various theory papers and laboratory work will be conducted under semester system. For this purpose each academic year will be divided into two semesters.

R.PG.Sc. 3: Candidates will be examined in each theory paper for 100 marks and practicals for 50 marks wherever prescribed at the end of each semester. There shall be a viva-voce examination of 50 marks at the end of the each semester to be held by the university.

- (i) For deciding result of M.Sc. examination at each semester the ratio between the internal assessment and external assessment will be 30:70.

For the purpose of internal assessment, the Department concerned will conduct at least one test in each semester. The Department will also arrange Quiz, Seminar etc. for internal assessment in theory course work and the Practicals. The distribution of marks will be as under: -

1.	Structure for each theory paper:				
	a)	Quiz	..	..	5 marks
	b)	Seminar		..	5 marks
	c)	Test	..	..	20 marks

				Total	30 marks
2.	Structure for each practical				
	a)	Regularity, records and results	...	...	5 marks
	b)	Test	...	...	10 marks

				Total	15 marks

R.PG.Sc. 4: Candidate shall be required to attend at least 75% of total theory, lectures, practical and project work organized under each of the courses during the semesters.

R.PG.Sc.5: (i) The Head of the department in consultation with other teachers of the department will prepare in the beginning of the year a detailed scheme of seminars, home work, quizzes, etc, and the Programme for the test examinations and the same will be announced to the candidates.

(ii) The records of the test examinations as well as seminars, home work, quizzes etc. will be maintained by the department concerned.

(iii) Every candidate shall maintain a regular record of his / her practical work that shall be duly certified by his / her teacher(s) from time to time.

R.PG.Sc.6: Candidates will be required to obtain at least 33% marks in the internal evaluation separately in each head of passing. A candidate who fails to obtain 33% marks in not more than two heads of passing, may be allowed to appear at the University examination by the head of the department concerned on the recommendation of the committee appointed by him to assess the candidate's overall performance.

(Note: A Head of passing will mean a course in theory or practicals).

R.PG.Sc.7: A candidate desirous of appearing at each semester examination my forward his / her application in the prescribed form to the Registrar through the Head of the University Post-graduate Department concerned on or before the date prescribed for the purpose under the relevant ordinances.

R.PG.Sc.8: The final result for the award of the degree will be declared on the basis of the grand total of all the Theory papers, Practicals, Project work and viva-voce prescribed for all semester examinations prescribed for the examination.

R.PG.Sc.9: Only those students who fail in not more than two heads of passing at each semester examination be allowed to keep terms at the semester. No candidate will be allowed to reappear in course in which he/she has already passed.

R.PGSc.10: Standard of passing:

The standard of passing at the M.Sc. degree examination will be as under:

(a) To pass any semester for the M.Sc. degree, a candidate must obtain at least 40% marks at the University Examination and 40% marks in the aggregate of University and Internal examination in each course of Theory and Practicals and 40% marks in Viva-Voce Examination.

(b) Award of Classes:

(i) The successful candidates will be placed in Second Class if they obtain at least 50% or more but less than 60% marks in the aggregate of all semesters examination taken together.

(ii) The successful candidates will be placed in First Class if they obtain at least 60% or more but less than 70% of the marks in the aggregate of the all the semesters examination taken together.

(iii) The successful candidates in First Class who obtain at least 70% or more marks in the aggregate of all the semesters examinations taken together will be declared to have passed the examination in First Class with Distinction.

R.PG.SC.11: (i) A candidate who fails in more than two courses (any two of the total heads of passing) in a particular semester will not be admitted for further study at a subsequent semester and will be required to repeat the courses in which he / she has failed by joining the department as a regular student the semester in which these courses are again offered.

(ii) A candidate failing in not more than two courses at any semester examination will be allowed to continue to the subsequent semester. Such candidate of the First Semester will be permitted to continue his/her study upto Third Semester but will not be permitted to go to the Fourth Semester until he / she has cleared all the courses of the First Semester, even though he / she may have passed in Second and / or Third Semester.

R.PG.Sc. 12: The following will be the scheme of the examination for the M.Sc. Zoology.

M.Sc., ZOOLOGY- PREVIOUS

SEMESTER- I

Z- 401: Evolutionary Biology and Phylogeny
Z-402: Instrumentation in Biological Sciences
Z-403: Molecular Cell Biology
Z-404: Molecular and Clinical Genetics

Laboratory Courses:

Z-405: Lab I- Practicals based on Z-401 and Z-402
Z-406: Lab II- Practicals based on Z-403 and Z-404

SEMESTER- II

Z-501: Environmental Biology and Biodiversity
Z-502: Environmental Toxicology
Z-503: Development and Differentiation
Z-504: Biological Chemistry

Laboratory Courses:

Z-505: Lab I- Practicals based on Z-501 and Z-502
Z-506: Lab II- Practicals based on Z-503 and Z-504

SEMESTER- III

Z-601: Applied Physiology
Z-602: Biology of Animal Behavior
Z-603: Aquacultural Biotechnology
Z-604: Immunology

Laboratory Courses:

Z-605: Lab I- Practicals based on Z-601 and Z-602
Z-606: Lab II- Practicals based on Z-603 and Z-604

SEMESTER- IV

Z-701: Animal Biotechnology
Z-702: Molecular and Applied Endocrinology
Z-703: Bioinformatics
Z-704: Parasitology and Histopathology

Laboratory Courses:

Z-705: Lab I- Practicals based on Z-701 and Z-702
Z-706: Lab II- Practicals based on Z-703 and Z-704

SEMESTER- I

Z- 401: Evolutionary Biology and Phylogeny

1. Introduction to Evolutionary Biology: meaning and importance of evolution in biology. A brief history of life.
2. The development of evolutionary theory- Lamarckism, Darwinism, Natural selection, Neo-Darwinism and Mutation theory.
3. Variations- nature and types. Mechanisms that decrease and increase variations (natural selection, genetic drift, mutation, recombination and gene flow).
4. Speciation: Modes of speciation, isolating mechanisms, speciation in time.
5. Macro and micro-evolution: definitions, mechanisms and importance.
6. Evidences, patterns of evolution and extinctions over the geological period.
7. Phylogeny: introduction and concepts of phylogeny. Phylogenetic trees, cladistics and phylogenetic reconstructions, hierarchy of species, transitional forms and molecular phylogeny.

Recommended References:

- Population, Species and Evolution- Ernst Mayr
- The theory of Evolution- J. Maynard Smith
- Molecular Evolution and Origin of Life- Widney W. Fox and Klous Dose
- Animal species and their evolution- A.J. Cain
- 29+ Evidences for Macroevolution- Douglas Theobald (<http://www.talkorigins.org/faqs/comdesc/>)

Z-402: Instrumentation in Biological Sciences

1. Electrochemistry: pH and buffers, potentiometric and conductometric titration.
2. Principle and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, confocal microscopy, cytophotometry and flow cytometry. Preparation of microbial, animal and plant samples for microscopy.
3. Principles, methodology and applications of gel – filtration, ion –exchange and affinity chromatography; thin layer and gas chromatography; high performance liquid chromatography, FPLC.

4. Centrifugation: Basic principle and application. Differential, density and ultracentrifugation.
5. Principle and method of biophysical analysis of biopolymer structure; X ray diffraction, fluorescence, UV, ORD/CD, visible, IR, NMR and ESR spectroscopy.
6. Atomic absorption and plasma emission spectroscopy; MS and MALDI-TOF.
7. Electrophoresis: Principle and applications of Native, SDS, Agarose and 2D gel electrophoresis.
8. Principle and applications of tracer technique in biology: Radioactive Isotopes and half life of isotopes; Effect of radiation on biological system; autoradiography; Cerenkov radiation; radiation dosimetry; scintillation counting.
9. Biosensors: Principle and application.

Recommended References:

- Instrumental method of chemical analysis -Shrama BK
- Instrumental methods of analysis- DA Skoog
- An introduction to practical Biochemistry -Plummer
- Instrumentation -Chatwal and Anand
- Modern experimental Biology- Boyer

Z-403: Molecular Cell Biology

1. Introduction, Biomembranes, Molecular composition, arrangement and functional consequences, Membrane transport and its excitability
2. Cytoskeleton, Microfilaments, intermediate filaments and microtubules – structure and dynamics. Microtubules and mitosis; Cell movements. Intracellular transport and the role of kinesin and dynein.
3. Cell signaling: Cell surface receptors; Second messenger system; MAP kinase pathways. Signaling from plasma membrane to nucleus
4. Cell – Cell adhesion and communication: Ca^{++} dependent cell-cell adhesion; Ca^{++} independent cell-cell adhesion. Cell junctions and adhesion molecules
5. Cell matrix adhesion : Integrins ; Collagen ; Non-Collagen components.
Movement of leukocytes into tissues

6. Cell Cycle: Cyclins and cyclin dependent kinases. Regulation of CDK – cycline activity
7. Intracellular protein traffic: Protein synthesis on free and bound polysomes, Uptake into ER, Membrane proteins, Golgi sorting, post- translational modifications.
8. Biology of cancer and Apoptosis

Reference Books:

- Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc. USA
- Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson. Garland Publishing Inc. New York.
- Cell and Molecular Biology. Concepts and Experiments, Gerald Karp. John Wiley and Sons, Inc. New York.
- Essentials of Cell and Molecular Biology. De Robertis E. D. P. and De Robertis E. M. F.
- Basic Histopathology. A Colour Atlas and Text. Paul Wheater, George Burkitt, Alan Stevens and James Lowe. ELBS with Churchill Livingstone.

Z-404: Molecular and Clinical Genetics

1. Fundamentals of genes and chromosomes: structure, function and inheritance
DNA structure, Genome replication and regulation.
Transcription: DNA methylation and gene expression; synthesis and processing of RNA; regulation of genome activity. Mutation and mutagenesis, DNA repair.
Chromosome organization, numerical as well as structural chromosome abnormalities.
Pedigree analysis, Mendelian and non-Mendelian pedigrees, mosaicism, chimerism and multifactorial inheritance.
2. Recombinant DNA technology: Introduction, principles, methods and applications.
Possible biological hazards of recombinant DNA technology.
3. Human genetic diseases and diagnostics: Disorders associated with metabolism; congenital abnormalities. Single gene disorders, prenatal diagnosis of genetic diseases. Oncogenes and cancer.
4. Features of human genome: Mapping of human genome and human genome project.

5. Manipulation of human genes. Gene therapy and other molecular genetic based therapeutic approaches.

Reference Books:

- Karp, G.: Cell and molecular biology – concepts and experiments. John Wiley & sons, New York.
- Brown, T.A.: Genomes. John Wiley & Sons. NY.
- Hartl, D.M. and Clark, A.G: Principles of population genetics. Sinauer, Sunderland, MA.
- Watson, J.D., and Gilman M., Witkowski, J and Zoller M.: Recombinant DNA. Scientific American Books.
- Emery, A.E.H.: Elements of medical genetics. Churchill Livingstone, Edinburgh.
- Weatherall, D. J.: The new genetics and clinical practice. Oxford University,UK.

SEMESTER- II

Z-501: Environmental Biology and Biodiversity

1. The multidisciplinary nature of Environmental studies: definition, scope, importance, need for Public awareness- institutions and people in environmental studies. Renewable and non-renewable resources: forest, water, mineral, food and land resources. Conservation of natural resources, use of alternate energy sources and case studies.
2. Ecosystems: concept, structure, components and functions. Energy flow in the ecosystem- Water, Carbon, Oxygen and Nitrogen cycles and integration of energy cycles in nature. Ecological succession: Food chains, webs and ecological pyramids. Types, characteristics, structure and functions of ecosystems: Forset, Grassland, Desert and Aquatic ecosystems.
3. Population and Community Ecology: Basic concepts, characteristics, dynamics and regulation of population density. Characteristics, composition, structure, development and classification of communities.
4. Biodiversity: Genetic, species and ecosystem diversity. Biodiversity at global, national levels. Biogeographic classification of India, India as a mega diversity nation.
5. National Parks, Wild life Sanctuaries and Biosphere Reserves, Hotspots of Biodiversity. Threats to biodiversity- habitat loss, poaching and man-wildlife conflicts. Endangered and Endemic species of India: Common plant and animal species.

6. Conservation of Biodiversity, *insitu* and *exsitu* conservation, Keystone species, measurement of biodiversity. Environmental Priorities, strategies and Environmental Legislation (Acts) in India, Environmental Impact Assessment.
Bioremediation: Concept need and scope, environmental applications.

References:

- Textbook for Environmental Studies- Erach Bharucha, UGC, New Delhi (2004)
- Environmental Biology- K.C. Agrawal
- Ecology & Environment- P.D. Sharma
- Biodiversity- E.O. Wilson
- The Biology of Diversity- M. Kato
- The Diversity of Life- E.O. Wilson

Z-502: Environmental Toxicology

1. General Principles of Toxicology: Ecotoxicology and its environmental significance, Branches of Toxicology, factors influencing environmental concentration of toxicants and toxicity, synergism and antagonism, Dose-Response relationships, Determination of ED₅₀ and LD₅₀, Acute and Chronic exposures.
2. Toxicological Testing Methods: Acute, Subacute, Chronic and Special tests (Metabolic, neurotoxicity and reproductive toxicity, Carcinogenicity and Mutagenicity), Statistical concept of toxicity-concentration, Response relationships, Margin of safety, Toxicity curves, cumulative toxicity and toxicity of chemical mixtures.
3. Xenobiotic Metabolism: Xenobiotics – Transfer across Membrane barriers, Absorption, Distribution. Biotransformation – Phase I (Oxidation, reduction and hydrolysis) and phase – II (Glucuronidation, Sulfation, Glutathione Conjugation, Acetylation, amino acid conjugation and Methylation) reactions. Excretion of xenobiotics.
4. Pesticide Toxicity: Pesticides and Types: Insecticides, Herbicides, fungicide, Rodenticides, Nematicides, Fumigants Properties and effects of pesticides: Mechanism of action, Pharmacokinetics, Acute & chronic effects, treatment, Biological monitoring and regulation.
5. Toxicology of Food Additives and Metals: Types and functions of food additives, hazards of food additives. Pharmacokinetics of Metals (Absorption, distribution, inhalation, oral ingestion, dermal exposure), metabolism, storage and excretion.
6. Toxicology of metals – Arsenic, cadmium, chromium, lead, mercury, zinc, Beryllium and Nickel
7. Environmental Pollution: Air, water, soil and land pollution. Impact of pollutants on general fauna, flora and ecosystems. Environmental monitoring of pollutants, Environmental policy in control of pollution.

Reference Books:

- Principles of Toxicology (eds.) Phillip L. Williams, Robert C. James and Stephen M. Roberts, John Wiley & Sons Inc. New York.
- Environmental Biology: P. D. Sharma, Rastogi Publications, Marut.

- Toxicology : P. D. Sharma, Rastogi & co. Marut
- An Introduction to Toxicology: S. N. Prasad & Vasantika Kashyap, S. Chand & Co., New Delhi.
- Environmental Pollution : M. Manivasakam, National Book Trust, New Delhi
- Modern Toxicology – Vol. I, II, III: Gupta, P. K. and Salunkhe. D. K. Metropolitan Book Co. Pvt. Ltd. New Delhi.
- Environmental Biology: K. C. Agrawal, Agro Botanica, Bikaner.
- A text Book of Environmental Chemistry and Pollution Control. S. S. Dara S. Chand & Co. Ltd. New Delhi.

Z-503: Development and Differentiation

1. Introduction to animal development. Developmental patterns in metazoans. Development in unicellular eukaryotes.
2. Creating multicellularity and early vertebrate development. Cleavage types. Comparative account of gastrulation and Neurulation. Ectoderm, mesoderm and endoderm.
3. Differential gene expression during development. Differential gene transcription. Selective nuclear RNA processing. Selective messenger RNA translation. Differential protein modification. Progressive cell-cell interaction and cell specification fate.
4. Body Axes: Establishment of body axes in mammals and birds. Genetics of axis specification in *Drosophila*
5. Homeobox concept in different phylogenetic groups.
6. Tetrapod limb development.
7. Hormones as mediators of development: Amphibian and Insect metamorphosis.
8. Medical implications of developmental biology. Genetic errors of human development: Infertility, Teratogenesis
9. Environmental regulation of animal development.
10. Stem cells: Totipotency and Pluripotency. Embryonic stem cells.

Reference Books:

- S.F. Gilbert, Developmental Biology, Sinauer Associates Inc. Massachusetts
- Ethan Bier, 'The Cold Spring' Cold Spring Harbor Laboratory Press New York
- Karp G, and Berrill N.J., Development
- B.I. Balinsky, An introduction to Embryology, Saunders College Publishing
- Lewis Wolpert, Principles of Development, Current Biology Ltd., London, New York

Z-504: Biological Chemistry

1. Matter and energy, Atomic structure, ions, electrolytes, free radicals, solutions, colloids, suspensions, chemical reactions, acids, bases, pH. Principles of Bioenergetics: Bioenergetics and Thermodynamics, ATP, Biological oxidation-reduction reactions.
2. Enzymes: Nature, function, classification and nomenclature. Enzyme kinetics, mechanism of action, active sites, substrate binding, Regulation of enzyme activity. Chemistry and functions of Co-enzymes.
3. Carbohydrate Metabolism: Glycolysis pathway and regulation. Gluconeogenesis, glycogenolysis and glycogenesis. Pentose phosphate pathway, Synthesis of complex polysaccharides- glycoproteins and proteoglycans.
4. Lipid Metabolism: Chemical nature of fatty acids, synthesis of fatty acids. Storage of fatty acids and utilization. Regulation of lipid metabolism. Biochemistry of phospholipids, cholesterol, sphingolipids, prostaglandins, thromboxanes and oxyeicosatetraenoic acids.
5. Protein Metabolism: Proteins- structure, classification, properties, functions, synthesis and degradation. Types and properties of amino acids. Nitrogen incorporation and excretion (Urea Cycle).
6. Vitamins: Water and Fat-soluble vitamins, chemistry, occurrence and physiological role.

Recommended References:

- Principles of Biochemistry- Lehninger, A.L., Nelson D.L. and Cox, M.M. LBS Publishers & distributors, New Delhi.
- Fundamentals of biochemistry- Voet, D., Voet, J. G. and Pratt, C. W. John Wiley & Sons. Inc. New York.
- Biochemistry. Vol.1-3 - Zubey, G. W C Brown Publishers, Oxford.