



Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College

of Arts, Science & Commerce

(Empowered Autonomous College)

Affiliated to

UNIVERSITY OF MUMBAI

SYLLABUS FOR M.Sc-II.

SEMESTER : III & IV

PROGRAM : M.SC. ZOOLOGY

PROGRAM CODE : RJSPGZOO

NATIONAL EDUCATION POLICY (NEP 2020)

LEVEL 6.0

(CBCS 2024-2025)

M.Sc - II Zoology Syllabus Semester III & IV

M.Sc. ZOOLOGY SEMESTER III
DISTRIBUTION OF TOPICS AND CREDITS

Course code	Nomenclature	Credits	Topic
RJSPGZOO301	Animal type study, Human Osteology, Entomology & Parasitology	04	1.Type Study: Pila
			2.Human Osteology
			3.Entomology-I
			4.Parasitology-I
RJSPGZOO302	Genetic engineering, Animal tissue culture, Microtechniques & Medical Biotechnology	04	1.Tools and techniques of genetic engineering
			2.Animal Tissue Culture Techniques
			3.Microtechniques in Zoology
			4.Medical Biotechnology
RJSPGZOO303	Molecular biology, Biotechnology, Immunology, IPR and Patenting	04	1. Molecular cell biology
			2. Animal Biotechnology and human Therapies
			3. Advanced Immunology
			4. IPR and Patenting
RJSPGZOOP304	Biostatistics, Separation techniques and Pathology.	04	1. Biostatistics
			2.Separation techniques-I
			3.Separation Techniques-II
			4.General pathology
RJSPGZOOP301	PRACTICAL	02	Practicals based on RJSPGZOO301, 302, 303 & 304

M.Sc - II Zoology Syllabus Semester III & IV

DISTRIBUTION OF TOPICS AND CREDITS
M.Sc. ZOOLOGY SEMESTER IV

Course code	Nomenclature	Credits	Topic
RJSPGZOO401	Animal type study, Human muscular system, Entomology & Parasitology	04	1.Type study: Rat
			2.Human Muscular system
			3.Entomology-II / Insect pests and their control.
			4. Parasitology-II
RJSPGZOO402	Regeneration Biology, Epigenetics, Genome projects, Evolution & population genetics	04	1. Regeneration Biology
			2. Epigenetics
			3. Evolutionary biology and population genetic
			4. Genome Projects
	OJT		

M.Sc - II Zoology Syllabus Semester III & IV

SEMESTER-III (THEORY)		L	Cr
Paper-I : Animal type study, Human Osteology, Entomology & Parasitology Paper Code: RJSPGZOO301		60	4
UNIT I : Type Study: Pila		15	
1	1.1 Introduction to Pila and Systematic Position, Habit and Habitat, External Characters of Pila 1.2 Body cavity and body Wall or Integument 1.3 Digestive System, Respiratory System, Circulatory System, Excretory System, Nervous System, Reproductive System of Pila 1.4 Development of Pila		
UNIT II : Human Osteology		15	
2	2.1: Introduction: General functions of bones. Cartilage: General structure, functions 2.2: Axial skeleton 2.2.1: Skull: General characteristics of skull bones - Cranial and facial bones 2.2.2: Vertebral column: General characteristics of a vertebra, structure of different types of vertebrae 2.2.3: Ribs and sternum: General skeleton of ribs and sternum 2.2.4: Hyoid bone: Structure and function. 2.3: Appendicular skeleton 2.3.1: Pectoral girdle and bones of forelimbs 2.3.2: Pelvic girdle and bones of hind limbs.		
UNIT III: Entomology-I		15	
3	3.1 Introduction and scope of entomology 3.2 Morphology and external characters of insects 3.3 Structure of different systems of insects - digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, endocrine and exocrine glands. moulting; growth, metamorphosis and diapause in insects 3.4 Classification of insects up to order levels.		
Unit IV: Parasitology-I		15	
4	4.1 Introduction to parasites and parasitism 4.2 Origin and types of parasites, Parasitic adaptations. 4.3 Factors influencing parasitic fauna: age, food and mode of life of the host 4.4 Life cycle patterns in different groups of parasites 4.5 Mode of transmission 4.6 Life cycle and pathogenicity of helminth parasites- Cestode (<i>Echinococcus granulosus</i>), Nematodes (<i>Ascaris lumbricoides</i> , <i>Wuchereria bancrofti</i>) 4.7 Plant parasitic nematodes: Biology and disease of Seed gall nematode (<i>Anguina tritici</i> , <i>A. agrostis</i>)		

M.Sc-II	Semester III Theory
RJSPGZOO301 Paper-I Animal type study, Human Osteology, Entomology & Parasitology	Course Objectives: 1. To acquaint learners with some details of Systematics and taxonomy for animal classification and make them familiar with different systems of an invertebrate animal type. 2. To introduce learners with skeletal system of human with main focus on bones. 3. To give insight to the learners about different aspects of insect world. 4. To make learners aware of different parasites and their life cycles. Learning Outcomes: 1. Learners will get an idea of principles of systematics & animal taxonomy along with details of different organ systems of invertebrate animal. 2. Learners will be able to understand the structure and functioning of human skeletal system . 3. Learners will be able to understand interesting aspects of insect biology. 4. Leaners will come to know about different parasitic diseases and life cycles of different parasites.

SEMESTER-III (THEORY)		L	Cr
Paper-II Genetic engineering, Animal tissue culture, Microtechniques & Medical Biotechnology COURSE CODE: RJSPGZOO302		60	4
UNIT I: Tools and techniques of genetic engineering		15	
1	1.1 PCR techniques: Principle of polymerase chain reaction (PCR), Applications of PCR. 1.2 Detection techniques: Blotting techniques and their applications. 1.3 Chemical Synthesis of DNA-Oligonucleotide synthesis by Phosphoramidite method, 1.4 DNA Sequencing -- Maxam-Gilbert method, Sanger's dideoxynucleotide method, By using bacteriophage M13 by Primer walking, Next gen sequencing.		
UNIT II: Animal Tissue Culture Techniques		15	
2	2.1 Introduction to Cell Culture: Historical Background, Types of Tissue Culture, Biology of Cultured Cells 2.2 Cell Culture Lab Design and Equipment: Requirements, Design and layout, Major and Minor equipment essential for Tissue Culture, Safety considerations, Media and Supplements. 2.3 Animal Cell cultures: Primary cell cultures, Cell lines, Subcultures, Cell quantification, Authentication of Cell lines, Cell line immortalization, cell line preservation & characterization, karyotype analysis, cellular markers, commercial cell lines, and insect cell culture. 2.4 Cell Culture Applications: Three-Dimensional Culture, MTT assay, Angiogenic Assay, Wound Healing Assay, Sphenoid Invasion Assay, Matrigel Invasion assay.		
UNIT III: Microtechniques in Zoology		15	
3	3.1 Microtomy: Collection & preservation of animal tissue – Tissue fixation, dehydration, clearing, infiltration, embedding for paraffin method, sectioning, mounting, staining-differential and specific. 3.2 Cryotechniques: History and applications of Cryotechniques, Cryo Ultramicrotomy. 3.3 Histochemical principles: Principles of chemical reactions used in histochemistry and cytochemistry, detection techniques of carbohydrates, lipids and nucleic acids, proteins, hydrolytic and oxidative enzymes, use of inhibitors, detection, localization of calcium.		

M.Sc - II Zoology Syllabus Semester III & IV

	Unit IV : Medical Biotechnology	15	
4	4.1 Vaccines and its types: 4.1.1 *Subunit Vaccine- viruses-Herpes simplex, Bovine foot & mouth disease virus 4.1.2 Peptide vaccines-synthetic drugs (engineered proteins) 4.1.3 Live recombinant vaccines 4.1.4 Attenuated vaccines against Cholera, Salmonella sp. 4.1.5 Vector vaccines-Vaccine directed against viruses-Rabies virus G-protein, Hepatitis B surface antigen 4.2. Monoclonal antibodies (mAbs) & therapeutic applications: 4.2.1 mAbs for prevention of rejection of transplanted organs 4.2.2 Treatment of bacterial blood infection 4.2.3 Human monoclonal antibodies Tumour antibodies		

M.Sc-I	Semester I Theory
RJSPGZOO302 Paper- II Genetic engineering, Animal tissue culture, Microtechniques & Medical Biotechnology	Course Objectives: 1. To acquaint learners with the different tools and techniques of genetic engineering. 2. To introduce the learners to animal tissue culture and culture techniques. 3. To make learners familiar with different microtechniques used in biological sciences. 4. To give learners general idea regarding different types of vaccines and applications of monoclonal antibodies. Learning Outcomes: 1. Learners will get details of different tools and techniques used in genetic engineering. 2. Learners will be able to understand basics of animal tissue culture. 3. Learners will know the applications of different micro techniques in biological sciences. 4. Learners will understand composition of different vaccines and applications of monoclonal antibodies.

M.Sc - II Zoology Syllabus Semester III & IV

SEMESTER-III (THEORY)		L	Cr
Paper- III: Molecular biology, Biotechnology, Immunology, IPR and Patenting COURSE CODE: RJSPGZOO303		60	4
UNIT I : Molecular biology		15	
1	1.1 Induced mutations and causative agents: 1.1.1 Physical agents. 1.1.2 Chemical agents. 1.2.3 Biological mutagenic agents: transposable elements and viruses. 1.2 DNA damage and repair: 1.2.1: Mechanisms that prevent DNA damage - superoxide dismutase and catalase 1.2.2: Mechanisms that repair damaged DNA - direct DNA repair (alkyl transferases, photoreactivation, excision repair) 1.2.3: Post replication repair - recombination repair, mismatch repair, SOS repair.		
UNIT II : Biotechnology		15	
2	2.1 Transgenic animals and their applications: Mice as a model system for human diseases and as a test case model. Cows, pigs, sheep, goats as biopharmaceuticals. 2.2 Recombinant DNA technology to prevent animal diseases, Conservation biology- Embryo transfer 2.3 Tissue engineering: Skin, liver, pancreas, Antibody engineering. 2.4 Xenotransplantation 2.5 Site directed mutagenesis		
UNIT III: Advanced Immunology		15	
3	4.1 Transplant Immunity 4.2 Breaking Tolerance: Autoimmunity & Dysregulation 4.3 Inflammation and autoinflammation 4.4 Mucosal Immunity & Immunopathology 4.5 T.Cell mediated autoimmune diseases 4.6 Antibody mediated autoimmune diseases		
Unit IV: IPR and Patenting		15	
4	3.1 Introduction to Intellectual Property, Economics of Intellectual Property: Innovation and Creativity - Policy Linkages. 3.2 Legal Principles of International Intellectual Property Regime: Introduction to TRIPS, TRIPS and Public Health: Challenges for Access to Medicines, Intellectual Property and Competition Law. 3.3 Concepts of patent, The patent process, The conditions to be satisfied for an invention to be patentable :Novelty, Inventiveness, Usefulness. 3.4 Patenting in different countries, types of inventions that are not patentable in India. 3.5 Pharmaceutical Patents, Biotechnology Patents.		

M.Sc - II Zoology Syllabus Semester III & IV

M.Sc-II	Semester III Theory
RJSPGZOO303 Paper III Molecular biology, Biotechnology, Immunology, IPR and Patenting	Learning objectives: 1. To acquaint the learners with different mutagenic agents and mechanisms of DNA damage and repair. 2. To introduce learners with animal model systems, tissue engineering and transplantation biology. 3. To acquaint learners with different aspects of immunology like immunology of transplantation, autoimmunity and various diseases associated with it. 4. To introduce various intellectual property rights and policies to learners Course outcomes: 1. Learners will be able to comprehend process of mutagenesis and repair mechanisms which operate inside living cells. 2. Learners would get basic ideas about animal model systems and tissue engineering. 3. Learners will understand basic principles of transplantation immunology and autoimmunity . 4. Learners will be able to understand different intellectual property rights and policies which are available nowadays

SEMESTER-III (THEORY)		L	Cr
Paper- IV Biostatistics, Separation techniques and Pathology. COURSE CODE: RJSPGZOO304		60	4
UNIT I: Biostatistics		15	
1	1.1: Central Tendencies and Measures of Variation: Variance, standard deviation, standard error. 1.2: Probability Distributions: p- value, Probability - Addition and multiplication rules and their applications. 1.3: Testing of Hypothesis: Basic concepts, types of hypothesis: Null hypothesis and Alternate hypothesis, Levels of significance and testing of hypothesis 1.4: Parametric and non-parametric test: Parametric tests: two-tailed Z-test and t- test, ANOVA , Non-parametric test: Chi-square test and its applications. 1.5: Correlation: Correlation coefficient and its significance.		
	UNIT II: Separation techniques-I	15	
2	2.1 Principles and application of filtration, distillation and extraction: Ordinary filtration under suction pressure, fractional distillation, steam distillation, technique of extraction with solvents. 2.2 Principles and application of chromatography: Gas chromatography (GC), HPLC, HPTLC 2.3 Principles and applications of centrifugation: Basic principles of centrifugation, Low speed and high-speed centrifuges, ultracentrifuge, application of centrifugation-preparative techniques, analytical measurements, care of centrifuges and rotors.		
	UNIT III: Separation Techniques-II	15	
3	3.1 Introduction to Electrophoresis: Principles and basic concepts of electrophoresis. Electrophoretic mobility and factors affecting it. Types of Gel Electrophoresis (Agarose gel electrophoresis. Polyacrylamide gel electrophoresis (PAGE). Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). Native-PAGE) 3.2 DNA Electrophoresis: DNA gel electrophoresis for separation and analysis of DNA fragments. DNA size markers and ladder. Applications of DNA electrophoresis. 3.3 Protein Electrophoresis: Protein separation using electrophoresis. Protein staining and visualization techniques. Applications of protein electrophoresis. 3.4 Isoelectric focusing of proteins, Capillary Electrophoresis and Pulse field gel electrophoresis.		
	Unit IV: Pathology	15	
4	4.1: Introduction and scope 4.2: Cell injury: Mechanisms: ischemic, hypoxic, free radical mediated and chemical. 4.3: Retrogressive changes: Definition, types of degeneration (causes and effects): cellular swelling, fatty, mucoid and amyloid. 4.4: Necrosis: Definition and causes; nuclear and cytoplasmic changes; types: coagulative, liquefactive, caseous, fat and fibroid. 4.5: Gangrene: Definition and types - dry, moist and gas gangrene.		

M.Sc - II Zoology Syllabus Semester III & IV

M.Sc-I	Semester III Theory
RJSPGZOO304 Paper- IV Biostatistics, Separation techniques and Pathology.	Course Objectives: 1. To familiarize learner with biostatistics as tool for analysis and application. 2. To acquaint students with different modern methods of separation, along with their working principles. 3. To provide learners with a comprehensive understanding of different types of cell injury, cellular degenerations, and gangrene. Learning Outcomes: 1. Learner will be able to develop critical thinking and apply the knowledge in formulating hypothesis and research problems. 2. Learners will Learn about the different methods of separation. 3. Learners will be able to understand the pathological changes at the cellular level.

PRACTICALS BASED ON THEORY: CODE: RJSPGZOO301

1. Study of various mouthparts 2. Demonstration of Southern blotting technique/ Western blotting technique. 3. Differential centrifugation 4. Identification: necrosis types. 5. Problems based on t-test, z-test, chi square test, regression analysis and ANOVA 6. Use of Microsoft excel for data analysis 7. Helminth parasites from the digestive tract of fish gut. 8. Fixation and staining techniques of collected helminths to prepare a permanent whole of helminths. 9. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans and helminths. 10. Isolation of cells for culture and checking their viability. 11. Separation of proteins using SDS-PAGE. 12. Restriction digestion of DNA and separation of DNA fragments by agarose gel electrophoresis. 13. Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation. 14. Identification: Skull, Axial(vertebra) and appendicular skeleton. 15. To estimate the number of bacteria in the given culture by nephelometry.	Cr 02
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M.Sc II	Semester-III Practical
RJSPGZOO301 Practicals Based on Theory papers	Course Objectives: 1. To familiarize the learner to understand various characteristic features of non chordates. 2. To make the learner understand different types of non-chordate larval forms. 3. To enhance the learner's skill on analysis of different biochemical parameters. 4. To equip the learner with hands-on training of different methods of biochemical analysis. Learning Outcomes: 1. The learner will be able to apply the knowledge of taxonomy to identify various animals 2. The learner can understand larval forms and metamorphosis process during development 3. Learner will understand the analysis of biochemical parameters. 4. Learner will be able to use the different methods and techniques for biochemical analysis

SEMESTER -IV

SEMESTER-IV (THEORY)		L	Cr
Paper- I Animal type study, Human muscular system, Entomology & Parasitology Paper Code: RJSPGZOO401		60	4
UNIT I: Type study: Rat		15	
1	1.1 Morphology, 1.2 Digestive system 1.3 Circulatory system (arterial and venous) 1.4 Brain and cranial nerves 1.5 Urinogenital system (male and female)		
UNIT II: Human Muscular system		15	
2	2.1: Muscles of forelimbs 2.1.1. Muscles that move the arm (Humerus)-Triceps Brachii,Biceps Brachii, Brachialis, Brachioradialis, 2.1.2. Muscles that move the forearm (Radius-ulna) - Flexor carpi radialis, Flexor carpiulnaris, Extensor carpi ulnaris 2.1.3. Muscles that move the wrist, hand and fingers - Flexor digitoriumsuperficialis, Extensor carpi radialis, Extensor digitorum 2.2: Muscles of hindlimbs 2.2.1. Muscles that move the thigh (Femur) - Sartorius, Adductor group, Quadriceps groupRectus femoris, Vastus lateralis, Vastusmedialis, Hamstring group - Biceps femoris, Semimembranosus, Semitendinosus. 2.2.2. Muscles that move the lower leg (tibia-fibula)- Fibularis longus, Gastrocnemius, Tibialis anterior, Soleus, Extensor digitorum longus, Fibularistertius 2.2.3 Muscles that move the ankle, foot and toes - Tibialis anterior, Extensor digitorum longus, Fibularis muscles Case Study:Shin splint syndrome, Plantar fasciitis and Stress fractures.		
UNIT III: Entomology-II		15	
3	3.1 Classification of insecticides based on mode of entry, mode of action and chemical nature. 3.2 Mechanism of action of organochlorines/ organophosphates/ carbamates/ pyrethroids 3.3 Factors affecting toxicity of insecticides; insecticide compatibility. 3.4 Pest resistance to insecticides 3.5 Integrated pest management Case study:Bhopal gas tragedy, Endosalphan : Kerala		

M.Sc - II Zoology Syllabus Semester III & IV

	Unit IV: Parasitology-II	15	
4	4.1 Introduction to the Physiological basis of parasitism. 4.2 Physico-chemical nature of different parasitic habitats. 4.3 Metabolism of carbohydrate-PEP/PEPCK ratio, CO ₂ fixation, volatile acid production. 4.4 Life cycle and pathogenicity of Protozoan parasites: Trypanosoma spp., Plasmodium spp, Babesia		

M.Sc-II	Semester IV Theory
RJSPGZOO401 PAPER-I Animal type study, Human muscular system, Entomology & Parasitology	Learning objectives: 1. To acquaint learner with the muscular system of the fore and hindlimbs, normal function and common musculoskeletal disorders. 2. To provide learners with a comprehensive understanding of insecticide classification, mechanisms, toxicity, pest resistance, and integrated pest management. 3. The course aims to explore the physiological basis of parasitism. Learning Outcomes: 1. Learners will be able to understand the structure, function, and clinical relevance of muscles in the forelimbs and hindlimbs. 2. Learners will understand insecticide classification, mechanisms, toxicity factors, pest resistance, and integrated pest management. 3. Learners will understand physiology of parasitism & pathogenicity of Protozoan parasites.

M.Sc - II Zoology Syllabus Semester III & IV

SEMESTER-IV (THEORY)		L	Cr
Paper- II Regeneration Biology, Epigenetics, Genome projects, Evolution & population genetics COURSE CODE: RJSPGZOO402		60	4
UNIT I: Regeneration Biology		15	
1	1.1 Cellular basis of regeneration: sources of new cells in animal regeneration(unipotent cells: salamander lens, pluripotent cells: planaria) role of stem cells 1.2 Epimorphic regeneration in salamander and zebrafish : 1.3 Morpholactac regeneration in hydra and planaria 1.4 Cellular and Molecular basis of regeneration in liver Case Study : 3D bioprinting of human organs		
UNIT II: Epigenetics		15	
2	2.1 Overview and concept of epigenetics 2.2 Epigenetic regulation of gene expression :at transcriptional and translational levels: DNA methylation, acetylation, histone modification, chromatin remodelling, RNA silencing, 2.3 Epigenetics in human health: cancer, autoimmune diseases and neurodegenerative diseases. 2.4 Epigenetics and environment		
UNIT III: Evolutionary biology and population genetics.		15	
3	3.1 Geological time scale. 3.2 Origin of life: Theories and experiment. 3.3 Evolution of life: Theories 3.4 Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift.		
Unit IV: Genome Projects		15	
4	4.1 Human Genome Project: Scopes and Goals of the project. 4.2 Techniques used in human genome project: Genetic linkage maps, sequencing of DNA- chromosome walking, Restriction mapping, Physical Maps and sequence tagged sites 4.3 Impact of HGP on human medical field. 4.4 Extensions to human Genome- HapMap Project and 1000 genome project Case Study: International Human Genome Project v/s Celera Human Genome Project		

M.Sc - II Zoology Syllabus Semester III & IV

M.Sc-II	Semester IV Theory
RJSPGZOO402 PAPER II Regeneration Biology, Epigenetics, Genome projects, Evolution & population genetics	Learning objectives: 1. To introduce the learners to the process of regeneration at molecular, cellular and organ levels. 2. To introduce concept of epigenetics and epigenetic gene regulation. 3. To acquaint learners with concepts of evolutionary biology and population genetics. 4. To introduce the topic of genome projects and their impact. Course outcome: 1. Learners will be able to understand intricate mechanism of regeneration. 2. Learners will understand the concept of epigenetics and epigenetic gene regulation. 3. Learners will be able to comprehend the process of evolution and some basic concepts of population genetics. 4. Learners will come to know about different genome projects and techniques used in them.

SEMESTER IV PRACTICALS: NO PRACTICALS: INSTEAD, RESEARCH PROJECT TO BE CARRIED OUT.

REFERENCES:

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- General Parasitology by Cheng
- Clinical Parasitology by Belding
- Principles of Parasitology by Smyth
- General parasitology by Dogiel
- Parasitology (Protozoology and Helminthology) in relation to clinical medicine by K.D. Chatterjee
- A general textbook of entomology, Imms , A. D., Chapman & Hall, UK
- Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
- Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
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- Atlas of human anatomy -Vol I; R.D. Sinelnikov; Mr. Publishers Moscow
- A Guide Of Osteology (for medical students); Prakash kendra, Lucknow
- Text Book Of Comparative Anatomy And Physiology; Tortora
- Human osteology; Tim D.White
- Text Book of Human osteology; Singh Inderbir
- Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978
- Integumentary system and derivatives Comparative Anatomy of the Vertebrates; Ninth Edition; Kent, G.C. and Carr R.K.; The McGraw-Hill Companies; 2000
- Text book of chordates; Saras publication Modern text of zoology; Prof. R.L. Kotpal Integumentary system and its derivatives; Samuel D. Hodge Human Osteology Atlas of human anatomy -Vol I; R.D. Sinelnikov; Mr. Publishers Moscow
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- Muscles of Long Bones of Human Limbs Human anatomy by John. W. Hole, Jr., Karen A. Koos, Publisher: Wm.C. Brown Publisher, USA.

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- Principles of anatomy and physiology by Gerard T. Tortora and Sandra Reynolds Grabowski. Publisher: Harpers Collins College Publishers (7th Edition).
- Principles of Gene Manipulation: An Introduction to Genetic Engineering. by Sandy B. Primrose
- Genetic engineering - Principles and Practice; SandhyaMitra; Macmillan India Ltd., New Delhi.
- Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005.
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- Genetics and evolutionary biology by Manideep Raj, Guwahati Ashok book publishers.
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- Biochemistry and Physiology of endoparasites by Von Brand
- Biochemistry of Parasites by Barrett
- General Parasitology by Cheng
- Principles of Parasitology by Smyth
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- Introduction to Parasitology with special reference to parasites of man by Asa C.Chandler
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- R. E. Speir, J. B. Griffiths, W. Berthold (Ed), Animal Cell Technology – Products of today, prospects of tomorrow, Butterworth –Heinman Publishers
- Martin Fransman, Gerd Junne, Annemieke Roobeek (Ed), The Biotechnology revolution?, Blackwell Scientific Publishers
- Terence Cartwright, Animal Cells as Bioreactors, Cambridge Univ. Press
- Patent Facility Centre (PTC) Technology information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology, New Delhi
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- Cellular and Molecular immunology; Abbas A. K., Lichtman A. H. & Pillai S.; Elsevier Health Sciences; 2014.
- The Elements of Immunology; Khan F.H.; Pearson Education, India; 2009.

EVALUATION SCHEME AND SKELETON PAPERS

EVALUATION Total marks :100

Internal component : 40M (Seminar/assignment/mini project)

Semester End Examination : 60M (Question paper based on theory units)

M.Sc. ZOOLOGY

Semester III/Semester IV(Major & Elective) THEORY EXAMINATION

Maximum Marks: 60

Duration: 2 Hours

Instructions:

- i. All questions are compulsory.
- ii. All questions carry equal marks.
- iii. Draw neat and labelled diagrams wherever necessary.

1A. Answer any two questions from the following (Based on Unit I)

- i. 06
- ii.06
- iii.06
- iv.06

1B. Answer any one question from the following.

- I.03
- ii.03

2A. Answer any two questions from the following (Based on Unit II)

- i. 06
- ii. 06
- iii.06
- iv.06

2B. Answer any one question from the following.

- I.03
- ii.03

3A. Answer any two questions from the following (Based on Unit III)

- i. 06
- ii. 06
- iii.06
- iv.06

3B. Answer any one question from the following.

- I.03
- ii.03

4A. Answer any two questions from the following (Based on Unit IV)

- i. 06
- ii. 06
- iii.06
- iv.06

4B. Answer any one question from the following.

- i.03
- ii.03

* Pattern Subject to change as per exam committee requirements.

**M.Sc. II ZOOLOGY GENERAL PAPER
SEMESTER III NEP**

PRACTICAL EXAMINATION

Total Marks: 50

Q.1. Restriction digestion of DNA and separation of DNA fragments by agarose gel electrophoresis. 15M
OR

Separate the given sample using differential centrifugation technique.

Q.2. To estimate the number of bacteria in the given culture by nephelometry. 10M

OR

Demonstration of Southern blotting technique/ Western blotting technique.

OR

Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation.

Q.3. Identification 09M

a) Mouthparts of insect (Any one)

b) Helminth parasite (Any one)

c) Protozoan parasite (Any one)

Q.4 Biostatistics Problems. 06M

Q5. Viva 05M

Q6. Journal 05M

• Candidates are required to present certified journal on the day of practical examination.