M.Sc. (Two Year Course) Syllabus

SCHEME OF EXAMINATION

&

DETAILED SYLLABUS

For

Masters of Science

(Zoology)

2024-2025

Department of Zoology

School of Applied Sciences

K. K. University

BERAUTI, NEPURA, BIHARSHRIF, NALANDA

Pro Vice Chancellor
KK University
Berauti, Nepura, Bihar Sharif
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M.Sc. (Two Year Course) Syllabus

Year	Semester	Course Code	Course Title	L	T	P	C
1	I	MSZG 1101	Invertebrate & Vertebrate Diversity and Comparative Anatomy	4	1	0	5
		MSZG 1102	Animal Physiology & Biochemistry	4	1	0	5
		MSZG 1103	Population Genetics, Animal systematics & Evolution	4	1	0	5
		MSZG 1104	Practical I (Based on MSZG 1101, 1102 & 1103)	0	0	2	5
			Total	**12**	**3**	**2**	**20**
	II	MSZG 1201	Developmental Biology and Endocrinology	4	1	0	5
		MSZG 1202	Environmental Biology and Ethology	4	1	0	5
		MSZG 1203	Histology, Histochemistry, Tool and Techniques	4	1	0	5
		MSZG 1204	Practical II (Based on MSZG 1201, 1202 & 1203)	0	0	2	5
			Total	**12**	**3**	**2**	**20**
2	III	MSZG 2101	Biostatistics and Bioinformatics	4	1	0	5
		MSZG 2102	Microbiology & Immunology	4	1	0	5
		MSZG 2103	Genetics & Cell Biology	4	1	0	5
		MSZG 2104	Practical III (Based on MSZG 2101, 2102 & 2103)	0	0	2	5
			Total	**12**	**3**	**2**	**20**
	IV	MSZG 2201	Elective Theory I: Molecular Biology	4	1	0	5
		MSZG 2202	Elective Theory II: Biotechnology	4	1	0	5
		MSZG 2203	Project /Dissertation	4	1	2	5
		MSZG 2204	Elective Practical	0	0	24	5
			Total	**8**	**2**	**26**	**20**

Abbreviations: L- Lectures, T-Tutorial, P-Practical

M.Sc. (Two Year Course) Syllabus

SEMESTER I

Invertebrate & Vertebrate Diversity and Comparative Anatomy (MSZH – 1101)

Program Outcome:

1. Recall basic understanding of taxonomy, animal biology.
2. Identify and classify major animal phyla, with a focus on distinguishing characteristics of non-chordates and chordates.
3. Explore the evolutionary relationships and adaptations of different animal groups.
4. Organize the anatomy, physiology, and life cycles of representative species from each phylum.
5. Evaluate the ecological roles and significance of various animal groups.

Course Outcome

1. Understand origin metazoans and classification based on development of coelom and larval stages.
2. Identify the invertebrates and vertebrates and classify them up to the class level.
3. Compare anatomy, physiology, and life cycles of representative species from each phylum.
4. Evaluate evolutionary relationship with help of comparative anatomy study among chordates.

Course Objective:
This course provides an extensive overview of animal diversity, focusing on the classification, structure, function, and evolutionary relationships of both non-chordates and chordates. It explores the vast array of animal life, examining their adaptations to various environments and their roles in ecosystems.

Syllabus

UNIT	Content	No. of Hours	No. of Week
I	**Non-chordates (Acoelomate and Pseudo-coelomate)** Colonial Protozoa and theories of origin of Metazoans. Origin of coelom-Acoela, Pseudocoelom, Schizocoelom and Enterocoel. Protozoan diseases in man. Canal system in Sponges. Coral reef formation and significance. Polymorphism in Coelenterates. Helminthes parasites (*Taenia, Ancylostoma*). Concept of Host specificity and Host parasite relationship.	10	2.5
II	**Non-chordates (Coelomate)** Metamerism and segmentation in annelids. Vision in insects. Torsion in Gastropoda. Nervous system in Cephalopods. Water vascular system in Echinoderms. Reproduction and development in Echinoderms with evolutionary significance.	10	5

III	**Protochordates and Lower Vertebrates** General characters and interrelationship of Proto-chordates. Retrogressive metamorphosis. General characters and affinities of Cyclostomata. Accessory Respiratory organs in fishes. Luminous organ in fishes. Origin and ancestry of Amphibia.	8	7
IV	**Higher Vertebrates** Adaptive radiation in reptiles. Classification of reptiles based on skull pattern. Flight adaptation in Birds. General characters of Prototheria and Metatheria. Adaptive radiation in mammals. Dentition in mammals.	8	9
V	**Comparative Anatomy** Development, general structure, functions of skin and its derivatives, General plans of circulation in various groups of Vertebrates. Evolution of heart. Evolution of aortic arches. Evolution of Urogenital system in Vertebrates series. Comparative anatomy of the brain in relation to its function. Autonomic nervous systems.	12	12

Reference:

Barnes, R. D. (1987). Invertebrate Zoology (5th ed.). Saunders College Publishing.

Kotpal, R. L. (2010). Minor Phyla (11th ed.). Rastogi Publications.

Jordan, E. L., & Verma, P. S. (2001). Invertebrate Zoology (13th ed.). S. Chand and Co. Ltd.

Waterman, A. J. (1971). Chordate Structure and Function. The Macmillan Company.

Romer, A. S., & Parsons, T. S. (1986). The Vertebrate Body (6th ed.). Saunders College Publishing.

Kardong, K. V. (2019). Vertebrates: Comparative Anatomy, Function, Evolution (8th ed.). McGraw-Hill Education.

Animal Physiology and Biochemistry (MSZH – 1102)

Program Outcome

1. Recognize the fundamental concepts relating to broad range of topics in animal physiology and biochemistry.
2. Explain physiology and mechanism of thermoregulation among vertebrates.
3. Illustrate the respiratory, excretory and reproductive system anatomically and functionally in humans.
4. Analyze different types of biomolecules. Compare structure and function of carbohydrates, proteins, lipids and vitamins.

5. Evaluate the process of cellular respiration and describe the steps and process involved in the metabolism of carbohydrates and protein.

Course Outcome

1. Comprehend the concepts of physiological and thermoregulation in vertebrates.
2. Discuss the detailed anatomy, function and concepts related to respiratory, excretory system and circulatory system in humans.
3. Demonstrate the mammalian reproductive system and concepts related to hormone, reproduction, pregnancy and parturition.
4. Develop an understanding of biomolecules and functions of the biomolecules.
5. Assess the process and steps involved in cellular respiration along with biochemical pathways and regulation of biomolecules.

Course Objective:

This course offers an in-depth study of the physiological processes and biochemical pathways in animals. It covers the mechanisms by which animals maintain homeostasis, process energy, and adapt to their environments. The course integrates principles of biochemistry with animal physiology to provide a comprehensive understanding of how molecular and cellular processes underlie animal function.

Syllabus

UNIT	Content	No. of Hours	No. of Week
I	**Introduction to Physiology** Elementary idea of stress and strain. Physiology of exposure to cold, heat, altitude, Thermoregulation: Mechanism of thermoregulation in vertebrates, Ectotherms and Endotherms.	8	2
II	**Excretion and Respiration** Excretion: Patterns of excretion, organs of excretion, Physiology of Urine formation. Respiration: Respiratory pigment in animals, transport of gases, dissociation curve, Bohr's effect, Root effect. CO transport, Haldane effect, Chloride shift. Blood Circulation: Hb and associated diseases: sickle cell anaemia & thalassemia	10	4.5
III	**Reproduction** Histology of mammalian reproductive system - Testis, Ovary. Structure and function of Sertoli cell, Leydig cell, Corpus luteum. Histophysiology of Mammary gland. Semen composition and information, Pheromones and reproduction. Hormone and Reproduction, Hormonal regulation of implantation pregnancy, Parturition, Placental hormones.	10	7
IV	**Biochemistry** Amino acids: Structure classification, properties due to different	12	10

	functional group, Protein: Peptides and peptide bond, primary protein, secondary protein, tertiary protein, Ramachandran plot, conjugated protein, Protein folding. Structure and properties of Simple sugars polysaccharide.		
V	**Biochemical Pathways** Biochemical pathways and their regulation - Krebs cycle (Anaplerotic reaction). Key junction molecules - Glucose 6-phosphate, pyruvate, Acetyl Co-A, Enzyme - Kinetics and mechanism of action.	12	13

Reference

Prosser, C. L. (1991). Comparative Animal Physiology (4th ed.). Wiley-Liss.
Wood, D. W. (2014). Principles of Animal Physiology (2nd ed.). Benjamin-Cummings Publishing Company.
Bentley, P. J. (2002). Endocrines and Osmoregulation: A Comparative Account in Vertebrates (2nd ed.). Springer.
Cooper, T. G. (1977). The Tools of Biochemistry. Wiley.
Smith, E., & Marks, A. D. (2017). Marks' Basic Medical Biochemistry: A Clinical Approach (5th ed.). Lippincott Williams & Wilkins.
Nelson, D. L., Cox, M. M., & Hoskins, A. (2021). Lehninger Principles of Biochemistry (8th ed.). W.H. Freeman and Company.

Population Genetics, Animal systematics & Evolution (MSZG 1103)

Program Outcome

1. Understand genetic variation, analyze allele frequencies, and evaluate evolutionary forces, population structure.
2. Illustrate the principles and methods of classifying and naming organisms, including binomial nomenclature and hierarchical classification.
3. Analyze the core principles of evolutionary theory, including natural selection, genetic drift, and gene flow.
4. Evaluate the processes and patterns of speciation and the factors that contribute to the formation of new species.

Course Outcome:

1. Identify the roles of mutation, selection, genetic drift, and gene flow in shaping genetic diversity.
2. Explain and describe the mechanisms driving evolutionary change at the molecular, organismal, and population levels.
3. Calculate and interpret allele and genotype frequencies using the Hardy-Weinberg principle and other population genetic models.
4. Construct phylogenetic trees using morphological,

genetic, and molecular data.

Course Objective:

Population genetics is the study of the genetic composition of populations and how it changes over time due to various evolutionary processes. Animal systematics, also known as taxonomy, is the scientific study of the diversity and classification of animals. It involves identifying, naming, and classifying species based on their evolutionary relationships. Evolution is the process by which different kinds of living organisms are thought to have developed and diversified from earlier forms during the history of the earth. These three areas are deeply interconnected, with population genetics providing insights into the genetic basis of evolution, and systematics helping to classify and understand the evolutionary relationships among species.

Syllabus

UNIT	Content	No. of Hours	No. of Week
I	**Population Genetics** Population, Gene frequency, Hardy Weinberg's law in genetic stability, Variation in evolution - Sources of variability, Mutation, Genetic Recombination, Chromosome aberration, Natural Selection, Migration, Genetic Drift, Isolation Founder's principle	12	3
II	**Animal Systematics** Importance and application of biosystematics in Zoology, International code of Zoological Nomenclature (ICZN): interpretation and application, important rules.	8	5
III	**Speciation** Species and species concept, Speciation and types of speciation, Models of speciation (allopatric, sympatric, parapatric), Reproductive isolation - biological mechanism of genetic incompatibility.	8	7
IV	**Theory of Natural Selection** Theories of organic evolution with emphasis on Darwinism and its shortcomings, Synthetic theory of Evolution, Selection in evolution: Types of Natural selection, Artificial and Sexual Selection.	8	9
V	**Evolution** Concept of Evolution, Patterns of evolution: Micro, Macro and Mega evolution, Evolutionary trends. Pattern of nucleotide and amino acid sequence changes, Ecological significance of nucleotide and amino acid sequences changes.	12	12

Reference

Falconer, D. S., & Mackay, T. F. C. (1996). Introduction to quantitative genetics (4th ed.). Longman.

Hartl, D. L., & Clark, A. G. (2007). Principles of population genetics (4th ed.). Sinauer Associates.

Hedrick, P. W. (2011). Genetics of populations (4th ed.). Jones & Bartlett Learning.

Mayr, E., & Ashlock, P. D. (1991). Principles of systematic zoology (2nd ed.). McGraw-Hill.

Hillis, D. M., Moritz, C., & Mable, B. K. (Eds.). (1996). Molecular systematics (2nd ed.). Sinauer Associates.

Lemey, P., Salemi, M., & Vandamme, A.-M. (Eds.). (2009). The phylogenetic handbook: A practical approach to phylogenetic analysis and hypothesis testing (2nd ed.). Cambridge University Press.

Futuyma, D. J., & Kirkpatrick, M. (2017). Evolutionary biology (4th ed.). Sinauer Associates.

Hall, B. K. (2014). Strickberger's Evolution (5th ed.). Jones & Bartlett Learning. ISBN: 9781449614843.

Rastogi, V. B. (2018). A Textbook of Vertebrate Zoology (Revised edition). MedTech. ISBN: 9789386478057.

SEMESTER II

Developmental Biology and Endocrinology (MSZG-1201)

Program Outcome

- Introduction to developmental biology and describe the key principles and mechanisms of developmental biology.
- Explain early developmental processes and explain the stages of development from fertilization to organogenesis and the molecular control of these processes.
- Analyze the principles of endocrinology, endocrine glands and hormones, further, illustrate hormone classification.
- Evaluate the hormone biosynthesis, mechanisms of hormone action and control.

Course Outcome

1. Recognize and recall concepts of gametogenesis, fertilization, zygote formation, cleavage.
2. Explain concept of morphogenesis, body axes and symmetry, limb development and organogenesis.
3. Demonstrate types of hormones, biosynthesis, and secretion.
4. Illustrate structure, secretion, and regulatory roles of hypothalamus, pituitary and other endocrine gland.
5. Assess how endocrine signals regulate developmental processes and maintain homeostasis.

Course Objective:

This course explores the

fundamental concepts and mechanisms in developmental biology and endocrinology, focusing on the embryology, growth, differentiation, and hormonal regulation of organisms. Students will learn about the genetic, molecular, and cellular processes that drive development from fertilization through to adulthood, as well as the role of endocrine systems in regulating physiology and development.

Syllabus

UNIT	Content	No. of Hours	No. of Week
I	Fertilization: Specialization of the egg, structural specialization of sperm, Species-specific binding of gametes sperm-egg fusion, Capacitation. Acrosomal reaction. Prevention of polyspermy, Early development Nucleocytoplasmic interactions in early development, Nuclear transplantation experiments in Amphibia, Morphogenetic substance and their role in development, Chemical changes during cleavage Segregation and localization of morpho metric determinants, Segregation of germ cell determinants.	16	4
II	Cell differentiation Myogenesis (Skeletal muscle - formation regeneration and hypertrophy). Differentiation of erythrocytes (stem cells and their diversification control of haemoglobin synthesis, erythrocyte membrane), Genetic control of development: Genes controlling embryogenesis, determination of the embryonic axes (Drosophila), segmentation of larval body. Homeotic genes, Complex gene interaction in development Sequential gene action, Homeobox, Post-embryonic Development: Metamorphosis in insect	16	8
III	Abnormal Development: Neoplasia, Pineal in vertebrates, its hormones and their function, Comparative anatomy of endocrine glands and their hormones: Adenohypophysis, Neurohypophysis, Thyroid, Adrenal Parathyroid**.**	12	11
IV	Functions of the hormones secreted from - Hypothalamus (mammals only), Endocrinology of calcium regulation, Endocrinology of osmoregulation.	12	14

Reference

Gilbert, S. F., & Barresi, M. J. F. (2016). Developmental Biology (11th ed.). Sinauer Associates.

Wolpert, L., Tickle, C., & Arias, A. M. (2015). Principles of Development (5th ed.). Oxford University Press.

Slack, J. M. W. (2013). Essential Developmental Biology (3rd ed.). Wiley-Blackwell.

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th ed.). Garland Science.

Melmed, S., Polonsky, K. S., Larsen, P. R., & Kronenberg, H. M. (2015). Williams Textbook of Endocrinology (13th ed.). Elsevier.

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Gardner, D. G., & Shoback, D. (2017). Greenspan's Basic & Clinical Endocrinology (10th ed.). McGraw-Hill Education.
Hadley, M. E., & Levine, J. E. (2007). Endocrinology (6th ed.). Pearson/Benjamin Cummings.
Goodman, H. M. (2009). Basic Medical Endocrinology (4th ed.). Academic Press.

Environmental Biology and Ethology (MSZH – 1202)

Program Outcome

1. Understand ecological principles and comprehend the fundamental concepts and processes that govern ecosystems and biodiversity.
2. Explain the interactions between organisms and their environments, including energy flow, nutrient cycling, and population dynamics.
3. Analyze environmental issues and evaluate the impact of human activities on the environment and explore solutions for sustainable development.
4. Illustrate animal behavior and investigate the adaptive behaviors of animals in their natural environments and understand the mechanisms driving these behaviors.
5. Evaluate the principles and mechanisms of animal behavior, including communication, foraging, mating, and social interactions

Course Outcome

1. Introduction to ecological concepts of biomes, biodiversity: and conservation of biodiversity.
2. Identify and describe ecosystem dynamics, trophic levels, food webs, and biogeochemical cycles.
3. Discuss human impact on the environment including pollution, climate change, habitat destruction, and mitigation strategies.
4. Analyze principles of ethology that includes evolutionary and ecological basis of animal behavior.
5. Evaluate mechanisms of animal communication together with strategies and adaptations for feeding and avoiding predators.

Course Objective:
This course examines the interactions between organisms and their environments, focusing on ecological principles, environmental issues, and the behavior of animals in their natural habitats. Students will explore the dynamics of ecosystems, the impact of human activities on the environment, and the adaptive behaviors of animals. The course integrates concepts from ecology, environmental science, and ethology.

Syllabus

UNIT	Content	No. of Hours	No. of Week
I	Lindeman Trophic Dynamic concept, Energy Flow in Ecosystem, Food chain. Food web, Food Pyramid, Concept of Limiting factor, Shelford's Law of tolerance, Liebig's Law of Minimum, Pollution Ecology, Water, Bioremediation, Biosensors, Bio-accumulation, Bio-magnification, food additive.	12	3

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II	Community Ecology: Component, Analytical and synthetic characters, Biodiversity: Status, monitoring and documentation. Major factors for biodiversity changes, Concept of Productivity Primary, Secondary and Tertiary factors and Methods of measurement	12	6
III	Environmental pollution - Definition, global scenario consequences and significance climate change, ozone layer, Greenhouse effect, Global warming, Population Characteristics and Interaction Competition and Niche theory - Intraspecific and interspecific competition Characteristics of community, Environmental economics, basic concept and its application	8	8
IV	Wildlife-their illegal trade and control, Wild life conservation techniques, Red Data Book. Categories of Endangered species, National projects: Project Tiger: Project Elephant, Wildlife (Protection) Act 1972, General concept of Ethology, Motivation, Fixed Action Pattern, Sign or key stimulus of releasers, Innate Releasing Mechanism Action specific energy, Learning of Experience, Imprinting, Physiological Basis of Behavioural, Evolution of Behaviour	12	11
V	Behaviour and its types, Individual and social interaction, Social organization - in insects and Primates, Innate and learned behavior, Anti-predator behavior, Wildlife behavior, Reproductive behavior, Perception of environment: Mechanical, Electrical, Chemical, Olfactory, Visual Orientation in animals - its nature and types, Biological rhythms - occurrence and significance.	12	14

Reference

Begon, M., Townsend, C. R., & Harper, J. L. (2006). Ecology: From Individuals to Ecosystems (4th ed.). Wiley-Blackwell.

Molles, M. C. (2016). Ecology: Concepts and Applications (7th ed.). McGraw-Hill Education.

Odum, E. P., & Barrett, G. W. (2005). Fundamentals of Ecology (5th ed.). Brooks/Cole.

Cunningham, W. P., & Cunningham, M. A. (2018). Environmental Science: A Global Concern (14th ed.). McGraw-Hill Education.

Raven, P. H., Berg, L. R., & Hassenzahl, D. M. (2014). Environment (9th ed.). Wiley.

Wright, R. T., & Boorse, D. F. (2017). Environmental Science: Toward a Sustainable Future (13th ed.). Pearson.

Alcock, J. (2013). Animal Behavior: An Evolutionary Approach (10th ed.). Sinauer Associates.

Goodenough, J., McGuire, B., & Jakob, E. (2009). Perspectives on Animal Behavior (3rd ed.). Wiley.

Dugatkin, L. A. (2013). Principles of Animal Behavior (3rd ed.). W. W. Norton & Company.

Krebs, J. R., & Davies, N. B. (1997). Behavioural Ecology: An Evolutionary Approach (4th ed.). Blackwell Science.

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Histology, Histochemistry, Tool and Techniques (MSZG-1203)

Program Outcome:

1. Introduction to histology and histochemistry, to understand tissue structure followed by microscopic organization of different tissues and organs.
2. Gain proficiency in different types of microscope imaging techniques and analyze and interpret histological and histochemical data.
3. Understand working principle of modern biological tool and technology for separation and amplification biomolecules.
4. Apply standard histological techniques to prepare, stain and identify cellular and tissue components. Further develop histochemical methods to detect and visualize specific cellular components.

Course Outcome

1. Recognize and describe the structure and function of different types of tissues (Epithelial, connective, muscle, and nervous tissues)
2. Understand working principle of various types of microscopes, including light, electron, and fluorescence microscopes. Further, discuss MRI (Magnetic Resonance Imagining), electrophoresis, PCR (Polymerase Chain Reaction) and Western bloating.
3. Understand enzyme histochemistry (detection of specific enzymes within tissues), immune-histochemistry (use of antibodies to detect specific antigens) and in situ hybridization (detection of nucleic acids within tissues).
4. Perform histological techniques through tissue fixation, embedding in paraffin, and sectioning, followed by staining in hematoxylin and eosin (H&E), special stains (e.g., PAS, Masson's trichrome).

Course Objective:

This course covers the study of the microscopic structure of tissues (histology), the chemical components of cells and tissues (histochemistry), and the tools and techniques used in these fields. Students will learn about tissue preparation, staining methods, microscopy, and other advance techniques used to analyze and understand tissue structure and function. Emphasis is placed on practical skills and the application of various histological and histochemical techniques in biomedical research and diagnostics.

Syllabus

UNIT	Content	No. of Hours	No. of Week
I	Fixation and tissue processing i. Types of fixatives ii. Chemistry of fixation and selection of fixatives Sectioning of paraffin block staining of paraffin section: Principle and methods of staining	8	2

II	Histological stains, Histochemical identification and localization of the following a. Glycogen and glycoprotein b. Protein end groups c. Lipid moieties d. Nucleic acids.	12	5
III	Principles and uses of analytical instruments: Spectrophotometer, Spectroscopy - Atomic Absorption Spectroscopy Microscopy and cryotechnique: Principles and working, Scanning and Transmission electron Microscope. Cryopreservation of cells, tissues and organism.	12	8
IV	Separation techniques, Separation by different types of chromatography, Electrophoresis (Agarose and SDS Page) Centrifugation: Basic principles of sedimentation	8	10
V	Magnetic resonance imaging (MRI), ELISA, Mammalian Histology of Liver, kidney, Stomach, Bones and Cartilage.	8	12

Reference

Kiernan, J. A. (2015). Histological and Histochemical Methods: Theory and Practice (5th ed.). Scion Publishing.

Bancroft, J. D., & Gamble, M. (2008). Theory and Practice of Histological Techniques (6th ed.). Churchill Livingstone.

Ross, M. H., Pawlina, W., & Barnash, T. (2020). Histology: A Text and Atlas (8th ed.). Wolters Kluwer.

Carson, F. L., & Hladik, C. (2009). Histotechnology: A Self-Instructional Text (3rd ed.). American Society for Clinical Pathology Press.

Kumar, G. L., & Kiernan, J. A. (2010). Education Guide: Special Stains and H & E (2nd ed.). Dako North America, Inc.

Biostatistics and Bioinformatics (MSZG-2101)

Program Outcome

1. Introduction to fundamental statistical concepts and bioinformatics tools and databases.
2. Gain proficiency in probability, random variables, hypothesis testing, confidence intervals and p-values.
3. Explore the relationships between variables using linear regression and correlation techniques.
4. Calculate for sequence alignment, motif finding, and phylogenetic analysis.
5. Evaluate the principles of protein structure prediction and analyze genomic data, including gene expression and variant analysis.

Course Outcome

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1. Understand and apply statistical concepts to demonstrate a solid understanding of fundamental statistical principles and methods.
2. Develop the ability to interpret the results of statistical analyses and present findings clearly.
3. Analyze data using statistical software like origin pro, R, SPSS to perform statistical analyses.
4. Utilize bioinformatics databases to efficiently navigate and extract data from bioinformatics resources.
5. Conduct sequence alignments, identify motifs, and construct phylogenetic trees. Further, predict and analyze the structure and function of proteins.

Course Objective:

This course provides an introduction to biostatistics and bioinformatics, focusing on the principle and application of statistical and bioinformatics methods to biological sciences data. It covers fundamental statistical concepts, techniques for data analysis, and the interpretation of results. Students will learn to use statistical software to perform analyses and gain practical experience through exercises and projects. Further, this course also introduces the fundamental concepts and methods in bioinformatics, with a focus on the application of computational tools and techniques to biological data. It covers the analysis of DNA, RNA, and protein sequences, structural bioinformatics, genomics, and systems biology.

Syllabus

UNIT	Content	No. of Hours	No. of Week
I	Statistics and its applications, Primary and secondary data source, Frequency distribution, Diagrammatic and graphic presentation of data, Range, Interquartile range, Mean deviation and standard deviation.	8	2
II	Correlation: Definition types of correlation, Methods of studding correlation, Karl Pearson coefficient of correlation and rank correlation methods. Regression analysis: Regression lines and regression equations, Concept of sampling and sampling methods.	12	5
III	Test of significance for large samples, small samples. Chi-square analysis. Probability distribution and their properties: normal Binomial Poisson distribution. Evaluation of Biodiversity indices: Shannon-Weiner index of dominance.	12	8
IV	Principles of bioinformatics and its application, concept of digital laboratory. Introduction to computer operating systems (Window), internet protocol and information technology. Basics of home-pages, web-pages and uniform resource locater (URL), Biological database: Nucleic acid sequence databases, Genomic database, Protein sequence, structural and interacting proteins databases, Gene expression databases, Literature databases, Biodiversity and ecosystem-based databases.	12	11
V	Data retrival systems, Search engine, Sequence retrieval systems (SRS) and protein identification resources (PIR), Molecular sequence analysis software packages and tools: Biological information on the web: Motif, folds and domains, BLAST,	12	14

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	CLUSTALX, PHYLIP, Rasmol, Primer designing, Applications and prospects of Bioinformatics Primer designing.		

Reference

Books:

Batschelet, E. (1979). Introduction to mathematics for life scientists (3rd ed.). Springer-Verlag.

Berger, J. O. (1985). Statistical decision theory and Bayesian analysis (2nd ed.). Springer.

Ewens, W. J., & Grant, G. R. (2005). Statistical methods in bioinformatics: An introduction (2nd ed.). Springer.

Pagano, M., & Gauvreau, K. (2018). Principles of biostatistics (2nd ed.). CRC Press.

Ramakrishnan, N. (2006). Bioinformatics: A practical guide to the analysis of genes and proteins (3rd ed.). Wiley-Interscience.

Software:

Excel, Origin Pro, SPSS: A software package used for statistical analysis

BLAST: Basic Local Alignment Search Tool for sequence alignment.

Clustal Omega: A tool for multiple sequence alignment.

Bioconductor: An R-based platform for bioinformatics analysis.

Online Resources:

NCBI (National Center for Biotechnology Information)

EMBL-EBI (European Bioinformatics Institute)

UCSC Genome Browser

Microbiology & Immunology (MSZG-2102)

Course Overview: This course provides an in-depth exploration of microbiology and immunology, covering the biology of microorganisms and the principles of the immune system. Students will study the structure, function, and genetics of bacteria, viruses, fungi, and parasites, along with the mechanisms of the immune response. The course emphasizes the interaction between pathogens and the host immune system, with applications in disease prevention, diagnosis, and treatment.

Prerequisite: Basic understanding of classification of microorganisms along with cellular and molecular biology.

Course Objective:

- Learn about the classification, structure, function, and genetics of microorganisms.
- Explore microbial

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physiology and metabolism to study the growth, reproduction, and metabolic pathways of microbes.
- Understand the components and functions of the innate and adaptive immune systems.
- Examine host-pathogen interactions to investigate how pathogens cause disease and how the immune system responds.
- Learn about the role of microbiology and immunology in diagnostics, vaccines, and therapeutics.

Course Outcome

After completion of the course, the student will be able to:

CO1: Identify and classify the characteristics and taxonomy of bacteria, viruses, fungi, and parasites.

CO2: Understand and explain microbial genetics and metabolic processes, along with terminologies associated with diseases.

CO3: Explain components of immune system and describe the mechanisms and function of innate and adaptive immunity.

CO4: Analyze host-pathogen interactions to understand the molecular and cellular interactions between pathogens and the immune system.

CO5: Apply knowledge of microbiology and immunology to real-world and public health issues like food technology, novel drug discovery and pharmaceutical industry.