

KOLHAN UNIVERSITY

CHAIBASA



UNIVERSITY DEPARTMENT OF ZOOLOGY, KOLHAN UNIVERSITY, CHAIBASA

COURSE CURRICULUM FOR POSTGRADUATE COURSES UNDER CHOICE BASED CREDIT SYSTEM

M.Sc. Zoology

WITH EFFECT FROM 2020

Dr. S.B.Lal [HOD]
CHAIRPERSON

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SEMESTER WISE DISTRIBUTION OF COURSES**M.Sc. Programme**

Table – 1 : Course Structure for M. Sc. with Practical Programme

Semesters	Courses	Credit	Total Hrs.
I	Core course-1 (CC-101)	4	60
	Core course-2 (CC-102)	4	60
	Core course-3 (CC-103)	4	60
	Core course-4 (CC-104)	4	60
	Core course-(P) -5 (CC(P)-105)	6	120
II	Core course-6 (CC-201)	4	60
	Core course-7 (CC-202)	4	60
	Core course-8 (CC-203)	4	60
	Core course-9 (CC-204)	4	60
	Core course-(P) -10 (CC(P)-205)	6	120
III	Core course-11 (CC-301)	4	60
	Core course-12 (CC-302)	4	60
	Discipline Specific Elective-1 (DSE-301)	4	60
	Discipline Specific Elective-2 (DSE (P)-302)	6	120
	Project (PR) - 1(PR-301)	6	120
IV	Core course-13 (CC-401)	4	60
	Core course-14 (CC-402)	4	60
	Discipline Specific Elective-3 (DSE-401)	4	60
	Discipline Specific Elective-4 (DSE (P)-402)	6	120
	Project (PR) - 2(PR-401)	6	120
Total Credit		92	

GRADES AND GRADE POINTS

LETTER GRADE	GRADE POINT	MARKS PERCENTAGE
O(Exceptionally Good)	10	95% to 100%
A++(Excellent)	9.0	90% to 94.99%
A+(Excellent)	8.0	80% to 89.99 %
A (VeryGood)	7.5	75% to 79.99 %
B+(Good)	7.0	70% to 74.99 %
B(AboveAverage)	6.0	60% to 69.99 %
C+(Average)	5.5	55% to 59.99 %
C(Satisfactory)	5.0	50% to 54.99%
P(Pass)	4.5	45 % to 49.99 %
F(Fail)	0.0	Less than 45%
Ab(Absent)	-	-

EXAMINATION FRAMEWORK FOR M.Sc

ESUE

- ❖ There will be a uniform pattern of question for all course and of all the programs .
- ❖ A total of **EIGHT** Question will be set in each course for the ESUE in which Question “1” will be Objective Type Question [MCQ /True - False /Fill in the Blanks , etc .] Consisting of “10” Questions of “1” marks each and will be COMPULSORY .
- ❖ Any **FOUR** Question shall have to be answered by the examinees out of the remaining **SEVEN** Question carrying “15” marks each .

SIA

- ❖ Written Examination :- **15 Marks**
- ❖ Co-curricular activities and Regularity :- **05 Marks**
- ❖ Project Work / Seasonal Work / Field Study :- **10 Marks**

[NOTE :- SIA :-Sessional Internal Assessment & ESUE :- End Semester University Examination]

PROPOSED SYLLABUS FOR CHOICE BASED CREDIT SYSTEM
M.Sc. In Zoology
(Four Semester Course)
1ST SEMETER

M.Sc ZOOLOGY

SEMESTER-I, CZOOL - 101 NON- CHORDATES & SYSTEMATICS

UNIT - I :-NON - CHORDATES :-

1. Synopsis of Diversity of Non - chordate group
2. Protozoa :- Locomotion, Reproduction, Colonial protozoans
3. Origin of Metazoa
4. Porifera : Canal system.
5. Coelenterata : polymorphism
6. Helminths :- Parasitic adaptation
7. Annelida :- Nephridial System
8. Arthropoda :- Respiration , Excretion & Larval forms of crustacean.
9. Mollusca :- Respiration,
10. Echinodermata:- Larval forms and their evolutionary significance
10. Characteristics, Evolutionary significance and affinities of Placozoa, Mesozoa, Ctenophora, and Onychophora
11. Diagnostic Characters and Distribution of Rotifera & Brachiopoda

UNIT - II :- SYSTEMATICS AND BIODIVERSITY

1. The universal common ancestor and tree of life, three domain concept of living kingdom; Molecular phylogeny: history, terms, definition and limitations, construction of phylogenetic trees using molecular data, construction of phylogenetic trees by using 16S rRNA gene sequences and concept of speciation in bacteria; complication in inferring phylogenetic trees; origin and diversification of bacteria and archaea
2. Basic concept of taxonomy and systematic - definition and role in biology
3. Biological classification - Type of taxonomy, Linnaean concept and modern Concept of Taxonomy.
4. School of Systematic: - Numerical phonetics, cladistics, Evolutionary systematic.
5. Concept of Biodiversity :- Definition , significance and Ecological role.
6. Biodiversity in bio geographical regions.
7. Diversity clines in relation to area , latitude , altitude and deep sea .
8. Biodiversity indicators, surrogate species.

Books Recommended

1. Barnes: Invertebrate Zoology (4th ed 1980, Holt-Saunders International)
2. Barnes: The Invertebrates - A synthesis (3rd ed 2001, Blackwell)
3. Hunter: Life of Invertebrates (1979, Collier Macmillan)
4. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)
5. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)
6. Harvey et al: The Vertebrate Life (2006)
7. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
8. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
9. Jordan and Verma: Chordate Zoology (1998, S. Chand)
10. Kotpal: The Birds (4th ed 1999, Rastogi Publications)
11. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)
12. Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS)
13. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
14. Sinha, Adhikari and Ganguli: Biology of Animals, Vol. II (1988, New Central Book Agency)
15. Young: The life of vertebrates (3rd ed 2006, ELBS/Oxford)

M.Sc ZOOLOGY

SEMESTER-I, CZOOL - 102

CHORDATES & BIOINFORMATICS

UNIT - I :- CHORDATES

1. Synopsis of Diversity of chordate groups .
2. Characteristic features and affinities of
 - 2.1 Protochordata :-
 - 2.1.1 Hemichordata
 - 2.1.2 Urochordata
 - 2.1.3 Cephalochordata
 - 2.2 Cyclostomata
3. Fishes:- Parental care, Electric organs
4. Amphibia:- General characters and classification, Parental care, Origin and evolution of Amphibia
5. Reptiles:- General characters and classification, Characteristic features and affinities of Sphenodon & Anapsida.
6. Birds :- Flight adaptations, Nest building in birds, Flightless birds
7. Mammals :- Adaptive radiation in mammals: Aquatic, Terrestrial, Aerial, Arboreal and Fossorial
8. Comparative anatomy :-
 - 8.1. Integument and its derivatives.
 - 8.2. Heart and kidney.

UNIT II : Bioinformatics

1. Principles of Bioinformatics and its applications
2. Basic components of computers:- Hardware (CPU, input, output, storage devices), Software (operating systems), Application software; Introduction to MSEXCEL- use of worksheet to enter data, edit data, copy data, move data; Use of in- built statistical functions for computations of mean, S. D., correlation, regression coefficients etc., Use of bar diagram, histogram, scatter plots, etc., Graphical tools in EXCEL for presentation of data; Introduction to MS- WORD word processor- editing, copying, moving, formatting, table insertion, drawing flow charts, Introduction to Power Point, image and data handling and software like Endnote.
3. Era of computerized biological informations:-
 - 3.1 Introduction to computational genomics and proteomics
 - 3.2 Introduction to genomics and proteomics databases-
 - 3.2.1 Nucleic acid sequence databases: Genbank, UCSC, ENSEMBL, EMBL, DDBJ

3.2.2 Protein sequence databases: Swiss-prot, PDB, BLAST, PSI- BLAST (steps involved in use and interpretation of results) and HMMER, BLAST vs FASTA,

3.2.3 Protein structure database

3.3 Databank search- data mining, data management and interpretation

4. Multiple sequence alignment of genes and primer designing. Phylogenetic analysis with the program PHYLIP, DISTANCES, and GROWTREE. Basics of designing a microarray, image analysis and normalization, annotations.

5. Molecular sequence analysis software packages and tools: BLAST, RasMol, Biologist's Workbench-PERL.

Books Recommended

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002, Wiley - Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Jordan and Verma: Chordate Zoology (1998, S. Chand)
5. Kotpal: The Birds (4th ed 1999, Rastogi Publications)
6. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)
7. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)
8. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
9. Sinha, Adhikari and Ganguli: Biology of Animals, Vol. II (1988, New Central Book Agency)
10. Young: The life of vertebrates (3rd ed 2006, ELBS/Oxford)
11. Bioinformatics: Sequence and Genome Analysis, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, New York, USA.
12. Bioinformatics for Dummies, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, US.
13. Lesk: Bioinformatics, Oxford (2003, Indian ed)
14. Westhead et al: Bioinformatics Instant Notes, Viva Books (2003, Indian ed)

SEMESTER-I, CZOOL - 103

EVOLUTION AND ETHOLOGY

UNIT I: - EVOLUTION

1. Origin of life , Origin of cells and first organisms , evolution of eukaryotic cell from prokaryotes – a case of symbiosis .
2. Evidences of Evolution , Theories of evolution :- Lamarckism , Darwinism , Modern theories
3. Populations as a unit of Evolution :- Gene frequencies in Mandelian population, Hardy - Weinberg equilibrium , Genetic drift.
4. Variations: Types, sources and their role in evolution
5. Natural selection :- concept , types .
6. Isolating mechanisms
7. Concept of species, Modes of speciation .
8. Patterns of Evolution :- Micro,Macro and Megaevolution .
9. Evolution of Man :- anatomical , geographical and cultural , Ancestry of Homosapiens .

UNIT II: ANIMALBEHAVIOR

1. Animal Behaviour: - Definition, objectives, significance. Neural and Hormonal control of behaviour.
2. Patterns of behaviour: - Innate and Learned behaviour, concept of FAP, concept of Key or sign stimulus, Innate releasing Mechanism, concept of Learning, Imprinting, concept of evolution of behaviour. Mimicry.
3. Orientation in Animals: - Kinesis, Types of Kinesis, Taxis Types of taxis Echolocation, Language of honey bees .
4. Biological rhythms: - occurrence and significance , circadian , circannual , circatidan , circalunar , circasyzygie Clocks (with examples) .
5. Altruism: reciprocal altruism, group selection, kin selection and inclusive fitness. An over view of Sociality in animal systems. Social organization in honey bees and Termites
6. Parental care in animals

Books Recommended

Evolution

1. Dobzhansky: Genetics and the Origin of Species (1964, Columbia)
2. Dobzhansky: Evolution (1976, Surjeet Publ.
3. Freeman and Herron: Evolutionary Analysis (1998, Prentice Hall)
4. Futuyma: Evolutionary Biology (1998, Sinauer)
5. Hedrick: Genetics of populations (2005, Jones and Bartlett Publ Inc)
6. Hartl and Clark: Principles of Population Genetics (1989 & 1997, Sinauer)
7. Kimura: The Neutral Theory of Molecular Evolution (1984, Cambridge)
8. Li Wen-Hsiung and Dan Graur: Fundamentals of Molecular Evolution (1991, Sinauer)
9. Mayr: Animal Species and Evolution (1966, Belknap Press)
10. Ridley: Evolution (1993, Blackwell)
11. Strickberger: Evolution (2000, Jones and Bartlett)
12. White: Modes of Speciation (1978, Freeman)

Animal Behaviour

11. Slater & Halliday: Behaviour and Evolution (1st ed 1994, Cambridge Univ. Press)
12. Manning A. & Dawkins M.S. – An Introduction to Animal Behaviour. Cambridge 1995
13. Prasad S. – Animal Behaviour. CBS 2004
14. Mathur R. – Animal Behaviour. Rastogi 2002

M.Sc ZOOLOGY

SEMESTER-I, CZOOL - 104

BIOCHEMISTRY AND METABOLISM

UNIT I

1. Energetics and Design of Living Systems: The living state, metabolism as the defining characteristic of living organisms, molecular approach to understanding life forms and living processes, Energetics (second law of thermodynamics, Free Energy and standard free energy change), Reducing power and Redox potential, Nernst equation, synthesis of ATP, structure and function of electron transport chain and synthesis of ATP through Fo-F1 ATP synthase.
2. Protein structure
 - 2.1 Primary structure, peptide bond
 - 2.2 Secondary structure
 - 2.2.1 α helix, β pleated sheet & bends
 - 2.2.2 Prediction of secondary structure, Ramachandran plot
 - 2.3 Tertiary structure
 - 2.3.1 Forces stabilizing tertiary structure
 - 2.3.2 Domains and motifs
 - 2.4 Quaternary structure
3. Nucleic acids: Structure, folding motifs, conformational flexibility and supercoiling
4. Carbohydrates: Types, optical properties, biological significance

UNIT II

1. Enzymes
 - 3.1 Enzyme kinetics
 - 3.1.1 Lowering of activation energy
 - 3.1.2 Derivation of Michaelis-Menten equation, related calculations and MM & LB plots
 - 3.2 Mechanism of action
 - 3.2.1 Active site, substrate binding, transition state analogues and Abzyme
 - 3.2.2 Concepts of regulation of enzyme activity
 - 3.3 Reaction mechanism of chymotrypsin and lysozyme
2. Metabolism: Metabolic Pathways and its Network: A broad outline of metabolic pathways and their linkage, metabolism of primary metabolites – monosaccharaides, lipids, essential amino acids and nucleotides.
 - 2.1 Gluconeogenesis
 - 2.2 Glycogenesis and glycogenolysis
 - 2.3 β -oxidation and synthesis of fatty acid
 - 2.4 Metabolism of Amino Acids

2.5 Metabolism of Nucleotides

3. Metabolic basis of nutrition, metabolic basis of specialized tissue function, metabolic disorders, metabolic basis of diagnostics

Books Recommended

1. Lehningers Principles of Biochemistry, Nelson and Cox, Sixth Edition or recent edition, Macmillan Press.
2. Principles of Biochemistry, Voet, Voet and Pratt, 5th edition (2012) or recent edition, Wiley.
3. Harper's Illustrated Biochemistry, Murray, Granner and Rodwell, (27th Ed.), McGraw Hill, New York, USA.
4. Practical Biochemistry – Principles and Techniques, Wilson and Walker, Cambridge University Press, Cambridge [Latest edition].
5. Berg et al.: Biochemistry (5th Ed.), Freeman, 2001

M.Sc ZOOLOGY

PZOOOL - 105, PRACTICAL

PZOOOL -105, Practical Based on (CZOOOL-101,102,103, &104)

ITEM	MARKS DISTRIBUTION
1. Dissection.	20
2. Spotting (10)	30
• Specimens [04]	
• Whole Mounts [02]	
• Sections [02]	
• Study of bones [02]	
3. Evolution	10
4. Biochemistry	10
5. Biodiversity	10
6. Practical Record	10
7. Viva Voce	10

PZOO - 105, PRACTICAL DETAILS

Dissections :-

General anatomy and nervous system of :- Leech , Prawn, Squilla , , Unio , Pila , Sepia , Earthworm

Specimen :-

Study of Various living invertebrate phyla from Porifera to Echinodermata . .

Whole Mount and Section:-

Euglena , Amoeba , paramecium , Binary Fission , Conjugation in Paramecium .
Earthworm T.S , Larval forms of Fasciola , Mollusca, Crustacea & Echinodermata .
Study of Bones : Frog, Reptiles Birds and Mammals. (Limb and Girdle Bones)

Evolution :-

Study of Living Fossils .

Study of various connecting link [peripatus , amphioxus] .

Biochemistry:-

1. Tests for Carbohydrate, Protein and Fats
2. Estimation of a sugar, an amino acid, a vitamin, a nucleotide/nucleic acid by appropriate chemical and biological methods.

Biodiversity :-

1. To Submit report on any topic of animal Biodiversity and related subject .

**PROPOSED SYLLABUS FOR CHOICE BASED CREDIT SYSTEM
M.Sc. In Zoology
(Four Semester Course)
2nd SEMETER**

M.Sc. ZOOLOGY

SEMESTER-II , CZOOL - 201
MAMMALIAN PHYSIOLOGY

UNIT I

1. Circulation

- 1.1 Blood
 - 1.1.1 Haemopoiesis
 - 1.1.2 Haemostasis
 - 1.1.3 Structure and function of Haemoglobin
- 1.2 Lymph: composition and dynamics
- 1.3 Heart
 - 1.3.1 Origin and conduction of cardiac impulse
 - 1.3.2 ECG and cardiac cycle
 - 1.3.3 Myocardial infarction

2. Respiration

- 2.1 Pulmonary ventilation
 - 2.1.1 Respiratory centers: organization and function
 - 2.1.2 Surfactant
- 2.2 Gaseous exchange
- 2.3 Haemoglobin and gaseous transport
- 2.4 Basal metabolic rate and its measurement
- 2.5 Respiratory adjustments
 - 2.5.1 Hypoxia and oxygen therapy
 - 2.5.2 Dyspnea
 - 2.5.3 Respiratory buffering

3. Excretion

- 3.1 Urine formation and regulation
 - 3.1.1 Structure and types of nephrons, Glomerular filtration
 - 3.1.2 Tubular reabsorption and secretion
 - 3.1.3 Counter current mechanism
 - 3.1.4 Hormonal regulation
- 3.2 Acid-base balance and homeostasis
- 3.3 Renal function tests
- 3.4 Ornithine Cycle

UNIT II

- 1. Nervous system
 - 1.1 Axonal transmission

- 1.1.1 Motor neuron and other types of neurons
- 1.1.2 Genesis of membrane potential and action potential
- 1.1.3 Sodium-potassium pump
- 1.2 Synaptic transmission
 - 1.2.1 Types of synapses and synaptic knobs
 - 1.2.2 Excitatory and inhibitory post-synaptic potential
 - 1.2.3 Chemical transmission, neurotransmitters (acetylcholine, or catecholamines, serotonin and GABA)
- 1.3 Autonomic nervous system (Sympathetic and parasympathetic)
- 2. Vision and hearing
 - 2.1 Eye
 - 2.1.1 Retinal components
 - 2.1.2 Photoreceptors: Ionic basis of potential generation
 - 2.2 Ear
 - 2.2.1 Cochlea, basilar membrane, and organ of Corti
 - 2.2.2 Genesis of action potential in afferent nerve fibers
- 3. Muscle
 - 3.1 Ultrastructure of skeletal muscle fibers
 - 3.2 Muscle proteins
 - 3.3 Sequence of events in contraction and relaxation of skeletal muscle
 - 3.4 Energetics of muscle contraction
 - 3.5 Muscle twitch, summation, tetanus and fatigue
- 4. Nutrition 6
 - 4.1 Overview of digestion and absorption of macronutrients
 - 4.2 Gastrointestinal hormones and regulation
 - 4.3 Obesity and starvation
 - 4.4 Stimulation of hunger and thirst

M.Sc. ZOOLOGY

Books Recommended

1. Ganong: Review of Medical Physiology (22nd ed 2005, Lang Medical Publications)
2. Guyton and Hall: Text Book of Medical Physiology (11th ed 2006, W.B. Saunders)
3. Keel et al: Samson Wright's Applied Physiology (13th ed 1989, Oxford Press)
4. Murray et al: Harper's Illustrated Biochemistry (27th ed 1989, Appleton & Lange)
5. West: Best and Taylor's Physiological Basis of Medical Practice (11th ed 1981, Williams and Wilkins)
6. Longstaff: Neuroscience (2002, Viva Books)
7. Shepherd: Neurobiology (1994, Oxford Univ Press)
8. Squire et al: Fundamental Neuroscience (2003, Academic Press)
9. Eric Kandel: Principles of Neural Science (2000, Mc Graw Hill)

M.Sc ZOOLOGY

SEMESTER-II, CZOOL - 202

ENDOCRINOLOGY

UNIT I

1. Hormone:
 - 1.1 Classification , Mechanism of action of hormones (Receptor types and structure) second messenger
 2. Hypothalamo-hypophysial System
 - 2.1 General organization, Hypothalamic neurosecretory centres, Median eminence: Structure and function, Hypothalamo-hypophyseal portal system
 - 2.2 Hypophysiotropic hormones: Chemistry localization and actions
 - 2.3 Neurohypophysial octapeptides (Oxytocin and Vasopressin)
 - 2.4 Adenohypophysial hormones: Chemistry and physiological roles of
 - 2.4.1 Somatotropin and Prolactin
 - 2.4.2 Glycoprotein hormones (FSH, LH and TSH)
 - 2.4.3 Pro-opiomelanocortin (ACTH, MSH, β -LPH & β -endorphin)
 - 2.5 Neural control of adenohypophysis
 - 2.6 Diseases: dwarfism, gigantism, acromegaly, diabetes insipidus
 - 2.7 Comparative study of Pituitary in vertebrates
3. Thyroid
 - 3.1 General organization and hormones
 - 3.2 thyroid hormone biosynthesis , control of secretion and physiological role.
 - 3.2 Diseases: goiter, myxoedema, cretinism
 - 3.3 Comparative study of Thyroid in vertebrates
4. Parathyroid gland, Role of parathormone: Calcitonin and vitamin D in calcium homeostasis
5. Endocrine Pancreas (Islets of Langerhans)
 - 5.1 General organization and hormones, Biosynthesis and physiological actions of Insulin and Glucagon
 - 5.2 Disease: diabetes mellitus (type I and type II)

UNIT II

6. Adrenal gland
 - 6.1 Adrenal Cortex
 - 6.1.1 Organization
 - 6.1.2 Control of mineralocorticoid and glucocorticoid secretions
 - 6.1.3 Physiological roles of glucocorticoid and mineralocorticoid
 - 6.2 Adrenal Medulla: Catecholamine biosynthesis, release and its physiological roles

- 6.3 Diseases: Addison's disease, Cushing's syndrome
- 6.4 Comparative study of Adrenal in vertebrates

7. Steroid hormone biosynthesis and pathways

8. Testis

- 8.1 General organization and physiological role of hormones
- 8.2 Male infertility
- 8.3 Cryptorchidism

9. Ovary

- 9.1 General organization and physiological role of estrogen, progesterone, relaxin and inhibin hormones
- 9.2 Diseases: polycystic ovarian disease, hirsutism, and hyperandrogenism

10. Hormones and stress

11. Gastrointestinal hormones (Secretin, gastrin and cholecystokinin)

Books Recommended:

1. Bentley: Comparative Vertebrate Endocrinology (1998, Cambridge University Press)
2. Chester-Jones et al: Fundamentals of Comparative Endocrinology (1987, Plenum Press)
3. Gorbman et al: Comparative Endocrinology (1983, John Wiley)
4. Norris: Vertebrate Endocrinology (4th ed 2007, Elsevier)
5. Schreibman & Pang: Vertebrate Endocrinology Vol I-IV, Fundamentals & Biomedical Implications (1985 & onwards, Academic Press)
6. Hadley: Endocrinology, Prentice Hall (2000, International Edition)
7. Brooks and Marshall: Essentials of Endocrinology (1995, Blackwell Science)
8. Turner and Bagnara: General Endocrinology (1984, Saunders)
9. Larson: Williams Textbook of Endocrinology (10th ed 2002, Saunders)
10. Hadley, M.C.: Endocrinology, Prentice Hall, International Edition, 2000
11. Wilson and Foster, Williams Text Book of Endocrinology 10th edition, W.B. Saunders Company Philadelphia, 2005

SEMESTER-II , CZOOL - 203

IMMUNOLOGY AND BIostatISTICS

UNIT - I, IMMUNOLOGY

1. Vertebrate Immune system: Innate and acquired immunity;
 - 1.1 Innate Immune System: Organization and structure of lymphoid organs and their functions; Nature and Biology of antigens and antibody, Inflammation.
 - 1.2 Acquired Immune system: B cell (types and receptors), T cell (Types and receptors), Antigen-Antibody interaction, Epitopes and Haptens; Antibodies (Types, structure and function), Cell-mediated and Humoral immunity.
2. Cells of the Immune system: Hematopoiesis and differentiation, Development of B-cells and T-cells; Lymphocyte trafficking, Macrophages, Dendritic cells; Natural killer and Lymphokine - activated killer cells, Eosinophils, Neutrophils and Mast Cells.
3. Structure and function of MHC complex: Antigen processing cells, antigen processing and presentation, MHC restriction, Self and Non-self recognition.
4. Cytokines and their role in immune regulation: T-cell regulation, MHC restriction; Immunological tolerance; Cell - mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis; antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity; Complement system.
5. Immunity in health and disease: Allergy and Hypersensitivity (Types I, II, III, IV), Autoimmunity, Immunodeficiency diseases, Immunity and Infection, Tumour-immunology, Transplantation, Vaccines.

UNIT :- II, BIostatISTICS

1. INTRODUCTION TO BIostatISTICS :- Population , sample variable , parameter , primary and secondary data , screening and representation of data , frequency distribution , bar diagram , histogram , pie diagram.
2. Mean, Median, Mode, Standard deviation, Variance, Co - efficient of variation ANOVA (One - way and two - way).
3. Probability and Distribution (Normal, Binomial, Poisson's)
4. Correlation Regression and Chi Square test.
5. Hypothesis testing:- Non - parametric and parametric tests, χ^2 - test, t - test, F - test.

Books Recommended:

1. Abbas et al: Cellular and Molecular Immunology (2000, Saunders)
2. Elgert: Immunology understanding the Immune System (1996, Wiley)
3. Kuby: Immunology (6th ed 2007, Freeman)
4. Roitt: Essential Immunology (10th ed 2006, Mosby)
5. Roitt et al: Immunology (7th ed 2006, Mosby)
6. Wayne W. Daniel: Biostatistics, Basic concepts and methodology 10th ed, ISV
7. V. B. Rastogi: Biostatistics
8. Khan and Khanum: Biostatistics
9. Zar: Biostatistical Analysis

M.Sc ZOOLOGY

SEMESTER-II, CZOOL - 204
Molecular biology, Cell structure & function

UNIT: - I:-

1. MOLECULAR ARCHITECTURE AND PROPERTIES OF DNA :

- a) Stability and thermal denaturation
- b) Physical properties
- c) Types of DNA
- d) Denaturation and renaturation of DNA.

2. DNA replication:

- 2.1 Enzymes and accessory proteins involved in replication.
- 2.2 Mechanism of DNA replication in Prokaryotes and Eukaryotes, Proof-reading mechanism

3. Transcription :

- 3.1. RNA polymerases in Prokaryotes and Eukaryotes , Transcription factors.
- 3.2 Initiation, Elongation and Termination in Prokaryotes and Eukaryotes

4. Post-transcriptional RNA processing and nuclear transport – Processing of the 5' and 3' ends of eukaryotic mRNA; Types of introns and their splicing, Catalytic RNA; Alternative splicing and proteome diversity; Processing of rRNA and tRNA precursors; Micro RNA and other noncoding RNAs; Transport across the nuclear envelope, Processes of nuclear import and export and their regulation.

5. Translation

- 5.1 Prokaryotic and Eukaryotic translation : Mechanism of initiation , elongation and termination.
- 5.2 Translational machinery and translational control- Energetics of amino acid polymerization, tRNAs and their modifications; Amino-acyl t-RNAsynthetases

6. Regulation of Gene expression in Prokaryotes & Eukaryotes: Transcriptional control of gene expression positive and negative regulations, RNA polymerases, promoters and regulatory sequences, activators and repressors of transcription. Operon concept , Inducible and repressible system , Tryptophan - Operon , Lac - Operon. Elementary idea of Post-transcriptional control of gene expression.

UNIT : - II CELL STRUCTURE AND FUNCTION

1. Cell membrane

- 1.1. Structure :- Model cell membrane structure , lipid bilayer , Membrane proteins, Membrane lipids, Lipid asymmetry
- 1.2. Transport across cell membrane :- Channels , carriers , pumps , mechanism of diffusion.

2. Sorting and Targetting of Proteins (Endomembrane system)

2.1 Processing through Endoplasmic Reticulum and Golgi complex, targeting to plasma membrane & Lysosome,

2.2 Cell secretion

3. Nucleus :- Structure and Function, Organisation of Chromatin, Nucleolus (Structure and biogenesis of ribosomes)

4. Cell signalling and Intercellular junctions :-

4.1 Intercellular junctions , extracellular matrix , cell-cell adhesion, gap junction. ;

4.2 Receptor classes :- Membrane receptors , Intracellular receptors

6. Cell Cycle :-

6.1 Cell cycle and it's regulation :- role of cyclins and cdks

6.2 Checkpoints in mammalian cell cycle . ;

7. Cytoskeleton: Structure and dynamics of microfilaments; Organization of the cortical cytoskeleton; Actin cytoskeleton in cell shape, intracellular motility and cell locomotion; Microtubule structure, organization and dynamics; Role of microtubules in cell shape and mitosis; Structure and function of intermediate filaments.

8. Apoptosis :- Mechanism and significance

Books Recommended:

1. Alberts et al: Essential Cell Biology (1998, Garland)
2. Alberts et al: Molecular Biology of the Cell (2002, Garland)
3. Bostock & Sumner: Eukaryotic Chromosome (1987, North-Holland)
4. Brooker: Genetics : Analysis and Principles (1999, Addison-Wesley)
5. DeRobertis & DeRobertis: Cell and Molecular Biology (1987, Lee & Febiger)
6. Gardner et al: Principles of Genetics (1991, John Wiley)
7. Griffith et al: Modern Genetic Analysis (2002, Freeman)
8. Hartl & Jones: Essential Genetics: A Genomic Perspective (2002, Jones & Bartlet)
9. Karp: Cell and Molecular Biology (2002, John Wiley & Sons)
10. Lewin, Genes VIII (2004, Wiley)
11. Lodish et al: Molecular Cell Biology (2000, Freeman)
12. Pollard & Earnshaw: Cell Biology (2002, Saunders)
13. Russell: Genetics (2002, Benjamin Cummings)
14. Snustad & Simmons: Principles of Genetics (2003, John Wiley)
15. Malacinski: Freifelder's Essentials of Molecular Biology (4th ed 2005, Narosa)

16. Lewin: Genes IX (2008, Jones and Bartlett)
17. Brown: Genomes (3rd ed 2006, Garland Science)
18. Brown: Gene Cloning and DNA Analysis (2001, Blackwell)
19. Sambrook & Russell: Molecular Cloning (2001, Cold spring Harbor)
20. Primrose: Principles of Gene Manipulation (2001, Blackwell)
21. Asubel et al: Current Protocol in Molecular Biology (1994, Wiley)
22. Lodish et al: Molecular Cell Biology (6th ed 2007, Freeman)
23. Watson et al: Molecular Biology of the Gene

M.Sc ZOOLOGY

PZOOL - 205 , PRACTICAL
PZOOL - 205 , Practical Based on (CZOOL-201 to CZOOL-204)

ITEM	MARKS DISTRIBUTION
1. Staining and preparation of Endocrine slides.	20
2. Spotting (10)	30
• Endocrinology Slides	03
• Histological Slides	03
• Cytological Slides	02
• Vertebrates Specimens	02
3. Hematology	10
4. Cell Biology	10
5. Physiology	10
6. Sessional Work	10
7. Viva - Voce	10

PZOOOL -205 , PRACTICAL DETAILS

1. Staining and preparation of Endocrine slides.

- Staining of paraffin sections using haematoxylin and eosin method.

2. Hematology :-

- Preparation and study of various blood corpuscles of vertebrates .
- Determination of Hb % , ESR , TC DC , haematocrit value , PCV of blood of any vertebrate in normal and experimental condition .
- Determination of blood groups (ABO and Rh)

3. Cell Biology :-

- Study of meiotic stages from temporary Acetocarmine squash preparation of Grass Hopper Testis .
- Study of salivary gland polytene chromosomes from temporary acetocarmine squash preparation of chironomus larva .
- Study of cell division of Onion root tip by squash method.

4. Physiology :-

- Measurement of arterial blood pressure in man with help of of sphygmomanometer by Auscultation method .
- Measurements of Heart Beat and Pulse rate of human Being.
- Studies on frog heart beat in situ and to observe the effects of acetylcholine and noradrenalin.

**PROPOSED SYLLABUS FOR CHOICE BASED CREDIT SYSTEM
M.Sc. In Zoology
(Four Semester Course)
3rd SEMETER**

M.Sc. ZOOLOGY

SEMESTER-III, CZOOL - 301

MICROBIOLOGY & BIOTECHNOLOGY.

UNIT :- I MICROBIOLOGY .

1. Microbial nutrition , growth and control : -
 - 1.1. Microbial growth : Prokaryotic cell cycle, Growth curve, measurement of microbial growth , Influence of Environmental factors on growth, Culture techniques
 - 1.2. Control of microbial growth : Pattern of microbial death, Use of physical methods and chemical agents in control .
 - 1.3 Prokaryotic genome, Reproduction and genetic recombination in prokaryotes
2. Viruses :
 - 2.1. General characteristics of viruses, structure of Viruses , TMV, Bacteriophages
 - 2.2. Virus multiplication, cultivation of virus, virus purification and Assays .
 - 2.3. Viroids , virusoids, Prions
 - 2.4. Viruses and cancer
3. HIV: Structure, mode of infection, AIDS.
4. Common Antibiotics and their mode of action, vaccines
5. Viruses of Family- Coronaviridae with special reference to COVID 19.

UNIT II :- BIOTECHNOLOGY

1. Basic recombinant DNA techniques: Isolation, Purification and Quantification of DNA, cutting and joining DNA molecules, restriction modification systems, various enzymes used in recombinant DNA technology, restriction maps and mapping techniques; nucleic acid probes, Blotting techniques, DNA fingerprinting. Polymerase chain reaction–methods and applications.
2. Basic biology of vectors and cloning strategies: plasmids, phages, single stranded DNA vectors, high capacity vectors, retroviral vectors, expression vectors and other advanced vectors in use.
3. Gene cloning strategies: methods of transforming E. coli and other cells with rDNA; methods of selection and screening of transformed cells; construction of genomic and cDNA

libraries; strategies of expressing cloned genes.

4. Sequencing methods and site directed mutagenesis: Principles of DNA sequencing, automated sequencing methods; synthesis of oligonucleotides, primer design; micro-arrays; protein engineering.

5. Manipulating genes in animals: gene transfer to animal cells, genetic manipulation of animals, transgenic technology, application of recombinant DNA technology; genetically modified organisms: gene knockouts, gene silencing, gene therapy,

Suggested readings:

1. Recombinant DNA: Genes and Genomics – a short course, Watson et al., W. H. Freeman and Company, New York, USA [Latest edition].
2. Principles of Gene Manipulation and Genomics, Primrose, S. B. and Twyman, R.M., (7th Ed. 2006), Blackwell Publishing, West Sussex, UK.
3. Molecular Biotechnology: Principles and application of recombinant DNA, Bernard R. and Jack, ASM Press, Herndon, USA [Latest edition].
4. Gene Cloning, T.A. Brown
5. Microbiology, Prescott
6. Microbiology, Peclzar
7. Microbiology, Tortora *et al*

M.Sc ZOOLOGY

SEMESTER-III, CZOOL - 302

TOOLS & TECHNIQUES

UNIT :- I

1. Centrifugation
 - 1.1 Basic principles
 - 1.2 Types of rotors
 - 1.3 Clinical, high speed & ultracentrifuge
2. Spectroscopy
 - 2.1 Beer-Lambert's law, molar extinction coefficient and calculation
 - 2.2 Absorption spectrum
 - 2.3 NMR, ESR
 - 2.4 Colorimeter and UV- vis Spectroscopy, FT-IR Spectroscopy
 - 2.5 MRI
3. Mass Spectrometry
4. Electrophoresis
 - 3.1 Agarose- and polyacrylamide gel
 - 3.2 Two-dimensional
 - 3.3 Isoelectric focussing
5. Chromatography
 - 4.1 Paper and Thin layer chromatography
 - 4.2 Column chromatography
 - 4.2.1 Gel filtration
 - 4.2.2 Ion-exchange
 - 4.2.3 Affinity
 - 4.3 HPLC

UNIT II

5. Immunotechniques: RIA, ELISA, Immuno-electrophoresis, Immunoprecipitation
6. Flow Cytometry
7. Detection of nucleic acids and proteins
 - 6.1 Southern and Northern blotting
 - 6.2 Western blotting
8. Microscopy : (Working Principle & methods of application)
 - 8.1 Fluorescence microscopy

8.2 SEM

8.3 TEM

9. X-Ray crystallography

Suggested readings:

1. Boyer: Modern Experimental Biochemistry and Molecular biology, Benjamin/Cumin
2. Freifelder: Physical Biochemistry , Freeman
3. Holme and Peck: Analytical Biochemistry, Tata McGraw Hill
4. Plumer: An Introduction to Practical Biochemistry, Tata-McGraw Hill
5. Switzer and Garrity: Experimental Biochemistry, Freeman
6. Wilson and Walker: Practical Biochemistry, Cambridge Univ. Press

M.Sc ZOOLOGY

**SEMESTER-III, Discipline specific Elective Course –
DSE -301
[GROUP - A]
FISH AND FISHERIES**

UNIT :- 1

A- EVOLUTION OF FISHES

- origin evolution and phylogeny of fishes.
- Classification of fishes up to order

B SPECIAL ORGANS

- Acoustic-Lateral line system
- Accessory respiratory organs
- Electric organ of fishes.

C FISH PHYSIOLOGY

- Excretion and Osmoregulation in fishes
- Reproductive System - histology of ovary , ovarian cycle in teleosts
- Osmoregulation in fishes

D FISH ADAPTATION

- Migration - general accounts , migration behavior of some fishes, factor influencing fish migration and advantage of migration
- Deep sea and hill streams fishes
- Air bladder and weberian apparatus

UNIT :- 2

A - FISH CULTURE

- Physico-Chemical and biological factors in fishes
- Fish culture in fresh water fishes.
- Fish culture programming

B- MARINE FISERIES OF INDIA

- Stratification of marine habitat, group of marine fisheries
- Coastal fisheries of India
- Fisheries of Bombay duck ,ribbon fish , pomfrets and Prawn

C- ESTUARINE FISHERIES

- Definition ,origin and classification
- Estuarine fisheries of Chilka Lake
- Prawn culture

D- RIVERINE FISHERY OF INDIA

- Fisheries of Ganga river system
- Dams and their effects on fish migration

Books Recommended:

Fish Biology

1. Brown: Physiology of fishes, Vols 1 and 2 (1957, Academic press)
2. Gupta and Gupta: General and applied Ichthyology (Fish and Fisheries) (2006, S. Chand)
3. Hoar and Randall: Fish Physiology, Volumes I-XV (1969-onwards, Academic Press)
4. Khanna and Singh: A textbook of Fish Biology and Fisheries (2003, Narendra Publishing House)
5. Lagler, Bardach, Miller and May Passino: Ichthyology (2003, Wiley)
6. Mishra: Records of Indian Museum an aid to the identification of the common commercial fishes of India and Pakistan, Vol. 5 (Part I-IV) (1962)
7. Norman and Greenwood: A History of Fishes (3rd ed 1975, Ernest Benn Limited)
8. Pillay: Aquaculture: Principles and Practices Fishing News Books (2005, First Indian reprint)
9. Srivastava: A Textbook of Fishery Science and Indian Fisheries (1985, Kitab Mahal)
10. Srivastava: Fishes of U.P. and Bihar (2002, Vishwavidyalaya Prakashan)
11. Parihar: Fish Biology and Indian fisheries (1999, Central publishing House Allahabad)
12. Singh: Advances in Fish Research, Vol. I, II and III (Fisheries and Fish Biology: Ed Datta Munshi) (1993, 1997 and 2004, Narendra Publishing House Delhi)

**ECZOOOL - 302, PRACTICAL ,
ECZOOOL - 302 , Practical Based on (PAPER - ECZOOOL -301A)
[GROUP - A]**

ITEMS	MARKS
1. Dissection	20
2. Taxonomic Description	10
3. Spotting (10 spots)	30
3 Slides	
2 Bones	
3 Fishes (food fishes ,ornamental ,larvicidal , exotic fishes and Fishes with adaptive features)	
1 Fishing / ecological equipments	
1 Plankton / aquatic weeds or plants	
4. Adaptation / plankton	05
5.Histology and Staning	10
6. Viva - voce	10
7. Records and Sessional Work	15

PZOO - 302A , PRACTICAL DETAILS

1. Dissection :-

- * General anatomy , Cranial nerves, Afferent and efferent blood vessels of fishes.
- * Digestive system of herbivore and carnivore fishes.
 - * Weberian oscicles and Ampulla of Lorenzini of fishes.

2. Taxonomic Description :-

>Taxonomic identification up to species of important fresh water , local and marine fishes

3. Adaptation / plankton :-

> Collection identification of aquatic plants , weeds & planktons .

4. Histology and Staining :

- * **Scales of Fishes.**
- * **Section of Kidney , Corpus of Stanius, Liver, Gonads and Pituitary of fishes**

M.Sc ZOOLOGY

SEMESTER-III, Elective Course - 301B
[GROUP - B] , ECOLOGY AND ENVIRONMENTAL SCIENC
BASIC ECOLOGY & HABITAT ECOLOGY & POPULATION ECOLOGY AND COMMUNITY
ECOLOGY AND ENVIRONMENTAL ACTS AND LEGISLATION

UNIT - I , BASIC ECOLOGY & HABITAT ECOLOGY

1 : Basic Ecology

1.1 Ecosystem- structure , pyramid and function

1.2. Productivity : primary , secondary and tertiary .

1.3. Ecological Niche : Niche overlap and Niche Width, Niche segregation,

1.4 Biogeochemical cycle : Oxygen , Carbon and Nitrogen.

2 : Fresh water Ecology

2.1. Origin and classification of Ponds and lakes .

2.2. Physico - chemical and biological (plankton and Benthos) characteristics of lakes , rivers , ponds

3 : Terrestrial Ecology

3.1. Global Warming Climatic change , Ozone layer depilation.

3.2. Adaptation of desert animals

4 : Environmental Acts and Legislation : 4.1 Standards and certification wild life protection act 1972. , prevention and control of water pollution act 1974, and control of air pollution act 1981

UNIT - II

POPULATION ECOLOGY AND COMMUNITY ECOLOGY

5. Population Growth curve

5.1. Exponential 5.2. Sigmoid 5.3. Stochastic model for growth .

6. Population interaction

6.1. Competition - Types , Intra & Inter specific competition , Competitive ability .

6.2. Lotka - volterra models for competing species .

6.3. Predation - predatory response, co evolution of prey predator system one prey one predator model .

7. Natural regulation of population

7.1. Theories

7.2. Role of density dependent and density independent factors.

7.3. Model for population regulation

8. Community Ecology

8.1. Community structure

8.2. Concept of ecological dominance .

8.3. Concept of species diversity.

8.4. Ecotype and ecotone , concept of climax .

M.Sc ZOOLOGY

**ECZOOOL - 302B, PRACTICAL ,
ECZOOOL - 302B , Practical Based on (PAPER - ECZOOOL -301B)
[GROUP - B]**

ITEMS	MARKS DISTRIBUTION
1. Water Analysis	20
2. Biotic Analysis	15
3. Bio Statistical Analysis	15
4. Adaptation study Spotting [5x4]	20
5. Record and Seasonal Work	20
6. Viva - Voce	10

ECZOO - 302B, PRACTICAL DETAILS

1. WATER ANALYSIS :-

- Estimation of Dissolved O_2 , CO_2 , hardness, silicate, phosphate, chloride, nitrate in sample water
- Estimation of hardness & OMC of Sample water.
- Estimation of Magnesium and calcium in sample water

2. BIOTIC ANALYSIS :-

- Qualitative, Quantitative assessment and working of indices of diversity and dominance of :-Plankton. (Phytoplankton, Zooplankton)
- Macrophyte identification and estimation of biomass.

3. BIOSTATISTICAL ANALYSIS :-

- Analysis of correlation coefficient and sample linear regression in set of data.
- Analysis of similarity index in the species composition by 2×2 contingency table in a forest system.

4. ECOLOGICAL ADAPTATION STUDY :-

- Aquatic insect, Terrestrial insects.
- Higher Vertebrates.
- Ecological Equipments.
- Ecological significances of earthworm and its culture.
- Identification of Aquatic plants and weeds.
- Identification of Benthos, Molluscs and Fishes.

**SEMESTER-III, Discipline specific Elective Course -
DSE -301C
[GROUP - C]**

ENTOMOLOGY

ZOM 102: ENTOMOLOGY

Entomology

Importance and taxonomic richness of insects

2. External anatomy

2.1 Segmentation and tagmosis

2.2 Integument: structure and functions of cuticle, sclerotization and colouration

2.3 Head: types of head and antennae

2.4 Thorax: legs and wings

3. Internal anatomy and physiology

3.1 Nervous system

3.2 Endocrine system and function of hormones

3.3 Circulatory system: heart and haemolymph

3.4 Respiratory system

3.5 Digestive system

3.6 Excretory system and waste disposal

3.6.1 Malpighian tubules

3.6.2 Nitrogen excretion

3.7 Reproduction

3.7.1 Female and male systems

3.7.2 Physiology of reproduction

4. Sensory system

4.1 Tactile mechanoreceptor and position receptor

4.2 Compound eye

5. Applied Entomology

5.1 Insects as friends and foes

5.2 Insect plant-interaction

5.3 General methods of insect pest management

5.4 Medical entomology: insects as vectors of diseases and their control

Books Recommended

Entomology

1. Atwal: Agricultural Pests of India and South East Asia (1986, Kalyani Publishers)
2. Chapman: The Insects: structure and function (4th ed, 1998, ELBS)
3. Gilbert et al: Comprehensive Molecular Insect Science Volume 1- 7 (2005, Elsevier)
4. Hill: Pest of stored foodstuffs and their control (2002, Springer)
5. Imms: A general text book of entomology, 2 vols (1997, Asia Publishing House)
6. Klowden: Physiological Systems in Insects (2002, Academic Press)
7. McGavin: Essential Entomology (2001, Oxford Univ Press)
8. Mullen and Durden: Medical and Veterinary Entomology (2002, Academic Press)
9. Resh and Carde: Encyclopedia of Insects (2003, Academic Press)
10. Srivastava: A text book of applied entomology, Vol I & II (1993, Kalyani Publishers)
11. Wigglesworth: Principles of Insect Physiology (1972, ELBS)

M.Sc ZOOLOGY

**SEMESTER-III, Discipline specific Elective Course - DSE -302C
[GROUP - C]**

ENTOMOLOGY(P)

Entomology

1. Study of external morphology of cockroach
2. Internal anatomy of cockroach
 - 2.1 Alimentary canal
 - 2.2 Salivary apparatus: dissection and in toto stained preparation
 - 2.3 Permanent mounting of heart
3. Dissection of frontal ganglion, brain, corpora cardiaca, corpora allata and recurrent nerve
4. Dissection and mounting of prothoracic gland
5. Dissection of male and female reproductive systems of cockroach
6. Study of external morphology of honey bee and dissection of sting apparatus
7. Study of following using permanent slides/specimens: L. S. of teleotrophic and polytrophic ovarioles, T. S. of testis, and brain showing MNSC, whole mount of head of louse, CC & CA and chironomous larva Fish Biology 1. Classification of the following locally available fis

M.Sc. ZOOLOGY

SEMESTER-III, PROJECT WORK

PZOOOL - 301

Practical hrs :- 30

Project work

The objective of this paper is to inculcate the trait of independent investigation , the student shall work (approximately 60 to 75 study hours) on some topic related to his / her area of specialization or related to his / her broader area of study . He / she shall write a project report preferably independently or in association with faculty members of the Department /Research institutes recognized by Kolhan University.

Two examiners shall evaluate the project. a written test one hour duration relating to the project shall be taken .

MARKS DISTRIBUTION

❖ Project Preparation through Power Point	40
❖ Written Test	40
❖ Viva - Voce	20

**PROPOSED SYLLABUS FOR CHOICE BASED
CREDIT SYSTEM
M.SC. IN ZOOLOGY
(FOUR SEMESTER COURSE)
4TH SEMETER**

M.Sc ZOOLOGY

SEMESTER-IV, CZOOL - 401

CYTOGENETICS & GENETICS.

UNIT I

1. Eukaryotic chromatin structure and chromosome organization
 - 1.1 Classes of DNA
 - 1.2 Chromosomal proteins: histones and their modifications, non-histone proteins, scaffold/matrix proteins
 - 1.3 Levels of chromatin condensation at interphase and metaphase stages
 - 1.4 Nuclear matrix and organization of interphase nucleus
 - 1.5 Centromere, kinetochore and telomere
 - 1.6 Metaphase chromosome bandings
2. Giant chromosomes: models for studies on chromosome organization and gene expression
3. Cell division
 - 3.1. Mitosis
 - 3.1.1 Role of maturation promoting factor
 - 3.1.2 Chromosomal movement
 - 3.1.3 Exit from mitosis
 - 3.2 Cytokinesis
 - 3.3 Meiosis
 - 3.3.1 Overview
 - 3.3.2 Chromosome pairing and recombination
 - 3.3.3 Genetic regulation of meiosis
4. Human cytogenetics
 - 4.1 Karyotype and nomenclature of metaphase chromosome bands
 - 4.2 Chromosome anomalies and disease
 - 4.2.1 Common syndromes caused by aneuploidy, mosaicism, deletion and duplication
 - 4.2.2 Chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma, retinoblastoma and Wilms' tumour)
 - 4.2.3 Fragile site and X-linked mental retardation

UNIT :- II, GENETICS .

1. Mendel's laws and their chromosomal basis, Extension of Mendelism : Incomplete dominance and Co-dominance, Epistasis , Pleiotropy , Multiple allelism , Linkage.
2. Nature of the gene and its functions
 - 2.1 Evolution of the concept of gene

2.2 Fine structure of gene (rII locus)

3. Gene mutation and DNA repair:

- 3.1 Types of gene mutations.
- 3.2 Methods for detection of induced mutations.
- 3.3 P – element insertional mutagenesis in *Drosophila*
- 3.4 DNA damage and repair

4. Methods of gene mapping :

- 4.1 3 – point test cross in *Drosophila*
- 4.2 Gene mapping in human by linkage analysis in pedigrees.
- 4.3 Tetrad analysis in *Neurospora*
- 4.4 Gene mapping in bacteria by conjugation , transformation and transduction.

5. Organization and function of mitochondrial DNA:

Suggested readings:

1. Principles of Genetics, Snustad and Simmons, John Wiley & Sons, USA [Latest edition] .
2. Modern Genetic Analysis: Integrating Genes and Genomes, Griffiths, J.F., Gilbert, M., Lewontin, C. and Miller, W. H. Freeman and Company, New York, USA [Latest edition] .
3. Genetics, J. Russell, Benjamin-Cummings Publishing Company, San Francisco, California, USA [Latest edition]
4. Brooker: Genetics : Analysis and Principles (Addison-Wesley)
5. Gardner et al: Principles of Genetics (John Wiley)
6. Griffith et al: Modern Genetic Analysis (Freeman)
7. Hartl & Jones: Essential Genetics: A Genomic Perspective (Jones & Bartlet)
8. Lewin, Genes [Latest edition] (Wiley)
9. Russell: Genetics (Benjamin Cummings)
10. Alberts et al: Molecular Biology of the Cell (Garland)
11. Bostock & Sunner: Eukaryotic Chromosome (North-Holland)
12. Lodish et al: Molecular Cell Biology (Freeman)
13. Pollard & Earnshaw: Cell Biology (Saunders).

SEMESTER-IV, CZOOL - 402

Reproductive Physiology and Developmental Biology

UNIT :- I , REPRODUCTIVE PHYSIOLOGY.

1. Sperm maturation in Male reproductive tract, role of testicular hormones, Capacitation in female reproductive tract.
2. Bizarre phenomena in mammalian reproduction : Bruce effect , Lee boot effect , Whitten effect.
3. Uterine cycles : - Estrus and menstrual cycle , hormonal regulation of uterine cycles
4. Implantation , Delayed implantation , sterility due to hormonal defects , IVF , Super Ovulation , Variations in IVF.
5. Fertilization in mammals
 - 5.1. Recognition of gametes and acrosomal reaction
 - 5.2. Prevention of polyspermy and gamete fusion
 - 5.3. Activation of egg metabolism

UNIT II: DEVELOPMENTAL BIOLOGY

1. Early Embryonic development :
 - 1.1 cleavage: characteristics of cleavage, physiology of cleavage. Patterns of Cleavage; Blastulation
 - 1.2 Fate maps and cell linkage
 - 1.3 Gastrulation , morphogenetic movements , Neurulation : neurogenesis , notogenesis and mesogenesis, Morphogenesis.
2. Embryonic induction
3. Competence
4. Differentiation: Cell commitment, determination and cyto differentiation, molecular biology of differentiation , control , levels of differentiation , tissue maintenance and replacement.
5. Blastogenesis, Regeneration (Morphallaxis and Epimorphosis), Regeneration of amphibian limb and lens. Epimorphic regeneration of reptile (salamander) limb; Morphallaxis regeneration in hydra

6. Metamorphosis: Harmonal regulation of amphibian metamorphosis.
7. Stem cells and their applications.
8. Body pattern formation
 - 8.1 Origin of anterior-posterior and dorsal-ventral polarity in Drosophila: Involvement of maternal, segmentation and homeotic genes
 - 8.2. Organization of HOX gene in vertebrates
 - 8.3 Axis formation in Amphibians: Nieuwkoop Centre and Primary Organizer
 - 8.4 Axis formation in birds and mammals: Involvement of pattern forming genes
9. Late embryonic development
 - 9.1. Vulva formation in Caenorhabditis
 - 9.2. Formation of neural tube in vertebrates
 - 9.3 Development of limb in vertebrates: Involvement of HOX and other pattern forming genes
 - 9.4 Development of Heart in Chicks

Books Recommended

1. Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)
2. Balinsky: An introduction to Embryology (5th ed 1981, Saunders)
3. Gilbert: Developmental Biology (8th ed 2006, Sinauers)
4. Kalthoff: Analysis of Biological development (1996, McGraw)
5. Wolpert: Principles of Development (3rd ed 2007, Oxford)

SEMESTER-IV, Discipline specific Elective Course - DSE -401A

Elective Course - 401A

[GROUP - A]

FISH AND FISHERIES

UNIT :- 1

A- AQUATIC WEEDS AND AQUATIC POLLUTION

- Introduction and classification of aquatic weeds .
- Common aquatic weeds and control measures

B- FISH PRESERVATION

- Method of fish preservation
- Fish By-Product

C- SEWAGE FEED FISHERIES

- Treatment of sewage, principle cultivation fishes
- Production of sewage fish culture

D- INDUCE BREEDING

- Bundh breeding, types of Bundhs
- Induced Breeding by Hypophysaton
- Factors influencing induced breeding

UNIT 2

FISH PATHOLOGY AND TOXIC IMPACT :-

- Toxic Impact of pesticides
- diseases caused by pathogens and parasites and their treatment

B-SPECIALIZED ORGANS IN FISHES

- Biolumines in Fishes .
- Electric organs in fishes

C-ENDOCRINE GLANDS

- Pituitary gland or hypophysis
- Corpuscles of Stannius
- Ultimobranchial Glands

E- FISHING GEARS

- Local fish catching device
- Conventional inland and marine fishing gears
- Modern fish catching device and techniques

Books Recommended

1. Bentley: Comparative Vertebrate Endocrinology (2000, Cambridge University Press)
2. Bond: Biology of Fishes (1979, Saunders)
3. Brown: The Physiology of Fishes Vol I, II (1953 & 1957, Academic Press)
4. C.I.F.R.I.: Prawn Fisheries (Bulletin No. 10, 1977)
5. Chakroff: Freshwater Fish Pond Culture and Management (1987, Scientific Publishers)
6. Datta-Munshi & Hughes: Air-breathing fishes of India (1992, Oxford and IBH)
7. Davis: Culture and Diseases of Game Fishes (1956, University of California Press)
8. Duijn: Diseases of Fishes (1967, London Iliffe Books)
9. Evans: The Physiology of Fishes (1998, CRC Press)
10. Gopakumar, Singh and Chitranshi: Fifty Years of Fisheries Research in India (2000, Fisheries Division Indian Council of Agricultural Research)
11. Gorbman et al: Comparative Endocrinology (John Wiley)
12. Hadley: Endocrinology Prentice Hall (2000, International Editions)
13. Hall: Ponds and Fish Culture (1994, Agro Botanical Publishers)
14. Hoar & Randall: Fish Physiology, Series Vol. I – XIV (Academic Press)
15. Hora and Pillay: Handbook on Fish Culture in the Indo-Pacific Region (1962, Fisheries Division, Biology Branch, FAO)
16. Howard & Churchill Canning technology (London)
17. Huet: Textbook of Fish Culture, Breeding and Cultivation of Fish, Fishing News (1989, Books)
18. Hughes: Comparative Physiology of Vertebrate Respiration, Heinemann Educational (1967, Books)
19. Jhingran: Fish and Fisheries of India (1985, Hindustan Publishing Corporation)
20. Khanna and Singh: Textbook of Fish Biology and Fisheries (2003, Narendra Publishing House)
21. Kreuzer: Fishery products, FAO, Fishing News (1974, Books)
22. Kurian and Sebastian: Prawns and Prawn Fisheries of India (1976, Hindustan

Publ)

23. Lagler: Studies in fresh water fishery biology (1950)
24. Lagler, Bardach, Miller and May Passino, Ichthyology (2003, John Wiley)
25. Mishra: Records of Indian Museum: an aid to the identification of the common commercial fishes of India and Pakistan Vol 5 (Part I-IV) (1962)
26. Nilsson & Holmgren: Fish Physiology Recent Advances (1986, Croom Helm)
27. Norman and Greenwood: A History of Fishes (3rd ed 1975, Ernest Benn)
28. Norris: Vertebrate Endocrinology (2nd ed 2007, Academic Press)
29. Proceedings of International Symposium on Reproductive Physiology of fishes (1982, 1987, 1991, 1995, 1999, 2003, 2007)
30. Ribelin & Migaki: The Pathology of Fishes (1975, The Univ. of Wisconsin Press)
31. Rounsfell and Everhart: Fishery Science: It's Methods and Applications (1985, John Wiley)
32. Santhanam: Fisheries Science (1990, Daya Publishing House)
33. Singh: Advances in Fish Research, Vol. I and II (1993 and 1997, Narendra Publishing House)
34. Srivastava: A Textbook of Fishery Science and Indian Fisheries (1985, Kitab Mahal)
35. Srivastava, Gopalji: Fishes of U.P. and Bihar (2002, Vishwavidyalaya Prakashan)
36. The Wealth of India, Raw Materials Vol IV Fish and Fisheries (1962, CSIR)
37. Pillay: Aquaculture: Principles and Practices: Fishing News Books: (2005, First Indian reprint)
38. Gupta and Gupta: General and applied Ichthyology (Fish and Fisheries) (2006, Chand)

ECZOOOL - 402A, PRACTICAL
Practical Based on (PAPER - ECZOOOL -401A)
[GROUP - A]

ITEMS	MARKS
1. Microtomy	20
2. Spotting (10 spots)	30
3 Slides from fish Endocrinology. 3 slides from developmental biology. 1 specimen showing animal behaviour. 2 slides from Reproductive system. 1 Microbial slide.	
3. Minor dissection	10
4. Immunology	10
5. Sessional Work	20
6. Viva - voce	10

ECZOO - 402A, PRACTICAL DETAILS

1. Microtomy:-

- Study of the histological and histochemical slides of different organs of Bony fishes..
- Fixative , staining and preparation of histological & endocrinological slides of different organs of fish .

2. Dissection and display of accessory respiratory organs

Of

- Clarias batrachus
- Channa sp
- Heteropneustes fossilis
- Dissection of carp showing interrelationship between the gas (swim or air) bladder and
- Weberian ossicles

3. Immunology :-

- Blood film preparation and identification of cells of fishes.
- Antigen antibody interaction in vitro .
- Histology of lymphoid organs .
- Immunological diagnosis of pregnancy by ELISA .

SEMESTER-IV , Elective Course - 401B
[GROUP - B] ,, ECOLOGY AND ENVIRONMENTAL SCIENCE
POLLUTION ECOLOGY & CONSERVATION AND MANAGEMENT AND
SUSTAINABLE DEVELOPMENT

UNIT - I , POLLUTION ECOLOGY

1. Water Pollution .

- 1.1. Types and source pollutants and their effect. 1.2. Eutrophication .
- 1.3. Biodegradable and non - degradable pollutants. 1.4. Bio - indicators of pollution.

2. Air pollution

- 2.1. Sources and effect of air pollutants 2.2. Aerosol, Smog .
- 2.3. Green house effect 2.4. Acid rain

3. Noise pollution :

- 3.1 source and effect of noise pollution 3.2 control of Noise pollution

4. Eco-toxicology

- 4.1. Effect of agriculture waste, heavy metals , organic wastes and industrial wastes on aquatic organisms.
- 4.2. Biomagnifications and Green chemistry

5. Environmental biotechnology

- 5.1. Concept of bioremediation and its application.
- 5.2. Solid waste management: both organic and inorganic.

UNIT - II , CONSERVATION AND MANAGEMENT

6. Conservation & Biodiversity

- 6.1. Concept of conservation
- 6.2. Conservation of natural resources & their importance .
- 6.3. Concept of biodiversity.
- 6.4. Causes of biodiversity depletion.
- 6.5. Hot spots and mega biodiversity zones .
- 6.6. Priority fixation of biodiversity conservation.

7. Resource management

- 7.1. Concept of natural resources.
- 7.2. Management of air & water resources.

8. Wildlife and forest Management

- 8.1. Concept of endangered, Critically endangered species, endangered species, Vulnerable & Rare Species.
- 8.2. Importance of wild life and causes of Extinction.
- 8.3. Biological basis of wild life management.

9 Environmental Challenges and Sustainable development .

- 9.1 Human impact of natural resource.
- 9.2 Threats challenges to sustainable development.

9.3 world summit on Sustainable development (WSSD)

9.4 Environment and development of Earth summit.

BOOKS

ECOLOGY

1. Mukherjee, B. Fundamentals of Environmental Biology, Silverline Publications, Allahabad 2011
2. Riddle M. – Evolution. 2nd edn. Blackwell 1996
3. Piyanka E.R. - Evolutionary Ecology 5th edn Harper Collins 1994
4. Simmons I.G. - The Ecology of Natural Resources 2nd edn ELBS / Edward Arnolds 1983
5. Dash M.C. & Mishra P.C.- Man and Environment McMillan 2001
6. Stiling P. – Ecology : Theories and Applications 4th edn Prentice Hall India 2002

ENVIRONMENTAL BIOLOGY

1. Cunningham and Saigo: Environmental Science (5th Ed., McGraw Hill, 1999).
2. Odum : Fundamentals of Ecology (Saunders, 1971).
3. Odum and Baret: Fundamentals of Ecology (EWP, 2005).
4. Primark : A Primer of Conservation Biology (2nd Ed., Sinauer, 2004).
5. Raven, Berg, Johnson: Environment (Saunders, 1993).
6. Sharma: Ecology and Environment (7th Ed., Rastogi, 2000).
7. Turk and Turk: Environmental Science (4th Ed., Saunders, 1993).

ECZOOOL - 402B, PRACTICAL
Practical Based on (PAPER - ECZOOOL -401B)

ITEMS	MARKS DISTRIBUTION
1. Soil Analysis	10
2. Analysis of heavy metal with spectrophotometer.	10
3. Calorific value estimation by bomb calorimeter.	10
4. Estimation of Biomass and analysis by quadrat method.	10
5. Adaptation study Spotting [5x4]	20
6. Record and Seasonal Work	20
7. Visit to any lotic and lentic system and study of various ecological parameter.	10
8. Viva - Voce	10

ECZOO - 402B, PRACTICAL DETAIL

1. SOIL ANALYSIS :-

- Estimation of OMC / Total carbon of soil sample.
- Estimation of CaCO_3 in a soil sample.
- Estimation of soil respiration rate in a sample.
- Estimation of N, P, K, in a soil sample.
- Oxy calorific value of leaf of a plant in a chosen system.

2 Analysis of heavy metal with spectrophotometer.

- Analysis of heavy metals such as Fe, Cu, Hg, Pb, Cu, etc. in river water.

3. Calorific value estimation by bomb calorimeter

- Estimation of calorific value of Molluscs, fishes etc..

4. Estimation of Biomass and analysis by quadrat method

- Estimation of biomass of water hyacinth / phytoplankton etc. by quadrat method.

5. ECOLOGICAL ADAPTATION STUDY :-

- Fresh water fish [hill stream fish]
- Marine fish.
- Ecological Equipments (use of pH meter, water bath , centrifuge , colorimeter, thermometer)
- Ecological significances of aquatic plants and animals
- Identification of Bio indicator Species.

SEMESTER-IV ,
Discipline specific Elective Course - DSE -401C
Elective Course - 401C
[GROUP - C]ENTOMOLOGY

Industrial and Medical Entomology

1. Sericulture

1.1 Mulberry sericulture

- Cultivation of food plants
- Rearing of silkworms
- Harvesting and processing of cocoons
- Reeling appliances
- Genetic improvement of silkworms
- Diseases of Bombyx mori
- Predators and parasitoids of silkworm and their management

1.2 Non-mulberry sericulture

- Tasar sericulture
- Cultivation of food plants
- Rearing of tasar silkworms
- Pupation and cocoon formation
- Stifling and reeling of cocoons

1.3 Muga sericulture

- Cultivation of food plants
- Rearing of muga silkworms
- Pupation and cocoon formation
- Grainage technology
- Stifling and reeling of cocoons

1.4 Eri sericulture

- Cultivation of food plants
- Rearing of eri silkworms
- Pupation and cocoon formation
- Stifling and reeling of cocoons

2. Apiculture

2.1 Types of honeybees

2.2 Organization of bee colony

2.3 Life history and behaviour of bees

2.4 Dance language of honeybees

2.5 Diseases of honeybees

2.6 Beekeeping methods

- Equipment and tools
- Apiary management
- Hiving a colony
- Controlling swarming
- Handling of bees
- Extraction of honey and wax

2.7 Bee products

3. Lac culture

Lac insect and its life history

3.2 Host plant management

3.3 Strains of lac insects

3.4 Propagation of lac insects

3.5 Lac crop management

3.6 Natural enemies of lac insects and their management

3.7 Lac extraction

4. Medical entomology

4.1 Pests of public importance and their control: mosquitoes, house flies, lice, bedbugs, fleas

4.2 Insect borne diseases of man: typhus, yellow fever, dengue fever, encephalitis, plague, leishmaniasis, sleeping sickness, malaria, filaria,

4.3 Venoms and allergens

Insect venoms

Blister and urtica-inducing insects

Insect allergenicity

5. Household pests: cockroaches, ants, wasps, carpet beetles, furniture beetles and booklice

6. Pest of farm animals and their control

6.1 Blood-sucking flies

6.2. Myiasis flies

6.3. Lice

6.4. Fleas

7. Forensic entomology

7.1 Arthropods of forensic importance

7.2 Insects succession on corpse and its relationship to determining time of death.

ECZOO - 402C, PRACTICAL DETAIL

Part C: Industrial and Medical Entomology

1. Study of food utilization by silkworm *Bombyx mori*
2. Rearing of silkworm
3. Study of silk glands and their proteins in different larval stages of *B. mori*
4. Study of pre- and post-cocooning characteristics of *B. mori*
5. Study of fecundity of silk moth *B. mori* reared on different varieties of mulberry leaves
6. Study of silkworm diseases using permanent slides/specimen
7. Visit to a local silkworm rearing centre
8. Study of external morphology of different castes of honey bee and preparation of a permanent mount of sting apparatus
9. Visit to a local apiculture centre to study bee keeping and apiary management
10. Study of life cycle of mosquitoes/house flies and their habitats
11. Visit to a local dairy farm to study farm animal pests and their control

M.Sc ZOOLOGY

SEMESTER-IV, PROJECT WORK
PZOOOL - 401

Practical hrs. :- 30

Project work

The objective of this paper is to inculcate the trait of independent investigation , the student shall work (approximately 60 to 75 study hours) on some topic related to his / her area of specialization or related to his / her broader area of study . He / she shall write a project report preferably independently or in association with faculty members of the Department /Research institutes recognized by Kolhan University.

Two examiners shall evaluate the project. a written test one hour duration relating to the project shall be taken .

MARKS DISTRIBUTION

❖ Project Preparation through Power Point	40
❖ Written Test	40
❖ Viva - Voce	20

Overall project dissertation may be evaluated under the following heads:

- Motivation for the choice of topic
- Project dissertation design
- Methodology and Content depth
- Results and Discussion
- Future Scope &References
- Participation in Internship programme with reputed organization
- Application of Research technique in Data collection
- Report Presentation
- Presentation style
- Viva-voce

PROJECT WORK

Each student has to submit two copies of the dissertation work duly forwarded by the HOD of Department concerned. The forwarded copies will be submitted in the Department of Zoology, KOLHAN University, for evaluation (Seven days before the seminar).

The paper will consist of

- (a) Field work/Lab work related to the project.
- (b) Preparation of dissertation based on the work undertaken.
- (c) Presentation of project works in the seminar on the assigned topic in the P.G. Department of Zoology, KOLHAN University, CHAIBASA& open viva thereon.

Topics

Project work related to the following Industrial/socially relevant topics may be given.

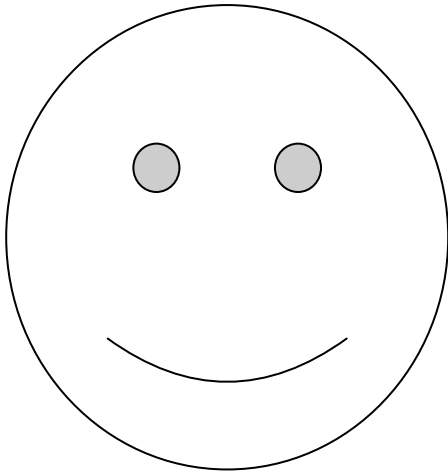
NB:- Students will select topics for the project work in consultation with a teacher of the department.

The Seminar will be held in the Department of Zoology, KOLHAN University, CHAIBASA.

M.Sc ZOOLOGY

END

THANK YOU!!!...



M.Sc ZOOLOGY