

FACULTY OF LIFE SCIENCES

SYLLABUS

FOR

M.Sc. (Zoology) (Credit Based Evaluation & Grading System)

(Semester: I - IV)

Examinations: 2019-20



GURU NANAK DEV UNIVERSITY AMRITSAR

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- (ii) Subject to change in the syllabi at any time.
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M.Sc. Zoology (Semester System)
(Credit Based Evaluation & Grading System)

Scheme of Courses

Programme Code : ZOB2

Semester –I						
Course no.	C/E/I	Course Title	L	T	P	Total Credits
ZOL401	C	Structure and Function of Animals –I	4	0	0	4
ZOL402	C	Biosystematics & Evolution	4	0	0	4
ZOL403	C	Metabolic Regulation of Cell	3	0	0	3
MTL261	C	Biostatistics	4	0	0	4
ZOP421	C	Comparative Anatomy of Animals –I	0	0	3	3
ZOP422	C	Biosystematics & Evolution Practicals	0	0	3	3
HGL405	C	Computer Applications	3	0	0	3
						24

Semester –II						
Course no.	C/E/I	Course Title	L	T	P	Total Credits
ZOL452	C	Structure and Function of Animals –II	4	0	0	4
ZOL454	C	Applied Zoology –I	3	0	0	3
ZOL455	C	Cell Biology	3	0	0	3
ZOL456	C	Animal Ecology & Wild life	4	0	0	4
ZOP471	C	Comparative Anatomy of Animals –II	0	0	3	3
ZOP473	C	Experiments in Cytology	0	0	1.5	1.5
ZOP474	C	Ecological Exercises & Wild life projects	0	0	1.5	1.5
	I	Interdisciplinary course	3	0	0	3
						23

M.Sc. Zoology (Semester System)
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Semester –III						
Course no.	C/E/I	Course Title	L	T	P	Total Credits
ZOL501	C	Applied Zoology –II	3	0	0	3
ZOL502	C	Molecular Cell Biology	4	0	0	4
ZOL504	C	Molecular Genetics	3	0	0	3
ZOL505	C	Animal Behaviour	4	0	0	4
ZOS505	C	Seminar	0	0	2	2
ZOP521	C	Advanced Cytology Practicals	0	0	1.5	1.5
ZOP523	C	Behavioural Zoology Exercises	0	0	3	3
	I	Interdisciplinary course **	3	0	0	3
						23.5

Semester –IV						
Course no.	C/E/I	Course Title	L	T	P	Total Credits
ZOL551	C	Tools and Techniques	4	0	0	4
ZOL553	C	Developmental Biology	4	0	0	4
ZOL554	C	Introduction to Immunology	4	0	0	4
	E	Elective *	4	0	0	4
ZOP572	C	Techniques in Zoology	0	0	3	3
ZOP573	C	Practicals in Specialized field	0	0	1.5	1.5
ZOP574	C	Experimental Developmental Biology	0	0	3	3
Total Credits						23.5

* The students are required to study one of the following Elective papers.

ZOL 581: Introductory Entomology

ZOL 582 :Introduction to Aquatic Biology

ZOL 583 :Introduction to Parasitology

ZOL 584 :Biology of Chromosomes

** Interdisciplinary courses are to be opted from the scheme of courses of other Departments.

ZOL 401: Structure and Function of Animals – I

Credit 4-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section- A

Locomotion:

Evolution of Coelom, Bilateral symmetry and Metamerism, and their significance in locomotion.

Muscles and mechanism of muscle contraction

Skeleton, its role and types: an overview

Hydrostatic skeleton in Cnidarians, Flatworms and Annelids

Exoskeleton in arthropods, molluscs

Locomotory mechanisms in terrestrial, aquatic and aerial animals (including flight in birds and insects).

Vertebrate integument : General features, phylogeny and specializations.

Section–B

Digestion:

Feeding strategies

Symbiotic nutrition

Components of digestive system

Evolution of digestive system

Mechanism and regulation of digestion

Section-C

Circulation :

Circulatory system: Heart, Arteries, Veins, Capillaries and Blood

Open & Closed circulatory systems

Evolution of arterial vessels, venous vessels and hearts

Neurogenics myogenic hearts

Single and double circulation.

Lymphatic system.

Section–D

Respiration:

Respiratory organs

Physiology of breathing

Distribution and brief chemistry of respiratory pigments

Transport of oxygen and carbon dioxide in body fluids.

M.Sc. Zoology (Semester-I)
(Credit Based Evaluation & Grading System)

Suggested Reading Material.

- Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
- Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.
- Bekleimishv, W. M. (1969), Principles of Comparative Anatomy of Invertebrates, Vol. I – Morphology, Vol. II – Organology. Chicago University Press, Chicago.
- Brusca, R. C. and Brusca, G. J. (2003), Invertebrates (2nd Ed). Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
- Cooper, G. M. (2004), The Cell: A Molecular Approach (3rd ed), ASM Press, Washington, D.C.
- Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed.) Macmillan, New York.
- Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
- Goodrich, E. S. (1958), Structure and Development of Vertebrates, Vol. I and II. D. E. Publication, New York.
- Hildebrand, M. and Goslow. Jr. G.E. (2001), Analysis of Vertebrates Structure John Wiley , N. Y.
- Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.
- Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.
- Hyman, L. H. The Invertebrates. Vol I– Protozoa through Ctenophora (1940), Vol. II – Platyhelminthes and Rhynchocoela (1951), Vol. III- Acanthocephala, Aschelminthes and Entoprocta (1951), Mc Graw Hill, New York.
- Jollie, M. (1968), Chordate Morphology, Reinhold, New York.
- Kardong, K. V. (1995), Vertebrates – Comparative Anatomy, Function, Evolution. W.B.C. Pub. , Oxford.
- Karp, G.(2005), Cell and Molecular Biology; concepts and experiments (4th ed.),Hoboken, John Willy and Sons, New York.
- Kent, G. C. and Carr, R. K. (2001), Comparative Anatomy of the Vertebrates (9th ed), McGraw Hill Higher Education, New York.
- Linzey, D. (2001), Vertebrate Biology. McGraw Hill Publishing Company, New York.
- McGowan, C. (1999), A Practical Guide to Vertebrates Mechanics, Cambridge University Press, UK.
- Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate Zoology (3rd Ed). Oxford University Press, New York.
- Pechenik, A. Jan. (2000), Biology of the invertebrates, (4th Ed), McGraw HillBook Co. Singapore.
- Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books seller & Publishers, Agra.
- Pough, F. H., Heiser, J. B. and McFarland, W. N. (1990), Vertebrate Life 3rd ed., Macmillan Pub. Co., New York.
- Purves, W. K., Oriane, G. H., Space, H. C. and Sadava, D. (2001), Life – The Science of Biology (6th ed), Sinauer Assoc. Inc., USA.
- Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
- Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate Zoology (7th ed). Saunders Publ., Philadelphia.
- Saxena, A. (2005). Text book of Mollusca. Discovery Publishing House, New Delhi.
- Willmer, P. Stone, G. and Johnston, I (2000). Environmental Physiology of Animals, Blackwell Science.
- Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, New York.
- Young, J. Z. (1982), The Life of Vertebrates, New York.

ZOL 402: Biosystematics and Evolution**Credit 4-0-0****Time: 3 Hours**

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A**Fundamental concepts**

Definition and basic concepts of Biosystematics and Taxonomy

Importance and applications of Biosystematics in Zoology

Material basis of Biosystematics:

- Evidences
- Character-kinds and character weighing

New aspects of biosystematics

Cytotaxonomy

Chemotaxonomy

Molecular Taxonomy

Section-B**Taxonomic Procedures :**

Taxonomic collections, preservation, curating and process of identification

Taxonomic keys- different kinds, their merits and demerits

Nomenclature :

International code of Zoological Nomenclature (ICZN)

Important rules, formation of scientific names of various taxa

Zoological types

Section-C

Kinds of Publications: Scientific Publications, Systematic Publications

Species – A Taxonomic Category:

Various concepts of species

Sub species

Distribution of species

Section-D

Theories of organic evolution with an emphasis on Darwinism

Unicellular, colonial and multicellular forms

Hardy Weinberg Law

Destabilizing forces: Natural Selection, Mutation, Migration, Genetic Drift, Meiotic Drive

Molecular clocks

Extinctions

M.Sc. Zoology (Semester-I)
(Credit Based Evaluation & Grading System)

Suggested Reading Material:

- Freeman, S. and Herron, Jon C. (2007). Evolutionary Analysis Pearson Prentice Hall, New Jersey.
- Futuyma, D. J. (1998), Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.
- Gote, H.E. (1982), Animal Taxonomy, Edward Arnold.
- Jeffery, C. (1973), Biological Nomenclature, Edward Arnold.
- Kapoor, V. C. (2001), Theory and Practice of Animal Taxonomy, IPH Pub. New Delhi.
- Mayer, E. (1969), Principles of Systematic Zoology, McGraw Hill Book Co. London
- Mayer, E and Ashlock, P.D. (1991). Principles of systematic zoology. McGraw Hill, Inc. Ny.
- Minkoff, E. C. (1983), Evolutionary Biology, Addison Wesley Pub. Co., London.
- Quicke, D.L.J (1993), Principles and Techniques of contemporary Taxonomy. Chapman & Hall, Great Britain.
- Simpson, G.G (2012). Principles of Animal Taxonomy Scientific Publishers, Jodhpur.
- Verma, A. (2015), Principles of Animal taxonomy, Narasa Publishing House Pvt. Ltd, New Delhi.
- Wen-Hsiung Li (1997), Molecular Evolution, Sinauer Associates Inc. Pub. USA.

ZOL 403: Metabolic regulation of Cell**Credit 3-0-0****Time: 3 Hours**

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A**Bioenergetics and metabolism**

Brief introduction to bioenergetics and thermodynamics

Glycolysis

An overview of glycolysis

Fates of pyruvate under aerobic and anaerobic conditions

Section-B

Regulation of glycolysis, gluconeogenesis & glycogenolysis

Regulation of carbohydrate catabolism

Gluconeogenesis

Pentose phosphate pathway of glucose oxidation.

Citric acid cycle

Production of acetate /oxidation of pyruvate

Reactions of citric acid cycle

Regulation of citric acid cycle

Section-C

Glyoxylate cycle

Oxidation of fatty acids

Digestion, mobilization and transport of fats

Oxidation of saturated and unsaturated fatty acids

Formation and oxidation of ketone bodies

Section-D**Amino acid oxidation and production of urea**

Metabolic fates of amino groups

Nitrogen excretion and the urea cycle

Pathways of amino acid degradation

Oxidative phosphorylation

Electron transport reaction in mitochondria

Shuttle system in mitochondria

Regulation of oxidative phosphorylation

M.Sc. Zoology (Semester-I)
(Credit Based Evaluation & Grading System)

Suggested Reading Material

- Abeles, R.H., Fray, P.A. and Jencks, W.P. (1992) Biochemistry, Jones and Bartlett Publishers, London.
- Berg, J. M., Tymoczko, J.L. and Stryer (2002) Biochemistry (5th Ed.) W.H. Freeman and Co., NY.
- Cohn, E.E., Stump, P.K., Bruening, G. and Doi, R.H. (1987) Outlines of Biochemistry (5th Ed) John Wiley & Sons, NY.
- Elliott, W.H. and Elliot, D.C. (2001) Biochemistry & Molecular Biology (Second Edition) Oxford University Press, New York.
- Horton, H.R., Moran, L.A., Ochs, R.S. Rawn, J.D. and Scrimgeour, K.G. (2002) Principles of Biochemistry (3rd Ed.) Prentice Hall Upper Saddle River N.J. 07458.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry (Twenty Sixth Edition) McGraw Hill.
- Nelson, David L. and Cox, Michael M. (2000). Lehninger Principles of Biochemistry (3rd Edition) McGraw Hill Worth Publishers.
- Rawn, J.D. (1983) Biochemistry. Harper and Row Publishers, New York.
- Vasudevan, D. M. and Sree Kumari, S. (2001) Text Book of Biochemistry (3rd Ed.) Jaypee Brothers Medical Publisher (P) Ltd. New Delhi.
- Voet, D. and Voet, J.G. (2015) Biochemistry (4th Ed.) John Wiley and Sons, NY.
- Zubay, G. (1998). Biochemistry (4th Edition) Wm.C. Brown Publishers, USA.

MTL-261-BIOSTATISTICS

Credit hrs.		
L	T	P
4	0	0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note:- The scope of this paper is restricted only to the applications of various statistical techniques. The mathematical derivations of various results are excluded.

Section-A

Statistical Methods — Collection of data, Frequency distribution and, Measures of Central Tendency, Dispersion.

Correlation and Regression — Relationship between variables, Covariance, Karl-Pearson's Correlation Coefficient, Spearman's rank Correlation Coefficient, Least square technique for regression lines (without proof), Regression Coefficients, Relationship between Correlation analysis and Regression Analysis.

Section-B

Probability — Mathematical definition of probability of an event, Use of permutations and combinations in calculations of Probability, Conditional probability, Additive and Multiplication law of Probability, Random Variables and its pmf, pdf, cdf, Mathematical expectation and variances, Theoretical Distributions: Binomial, Poisson and normal, Properties of these distributions (applications only).

Section-C

Hypothesis Testing — Sample, Population, Statistics and Parameters, Null Hypothesis, Level of significance, Definitions of Chi-square, 't' and 'F' variates and their pdfs only, Applications of these distributions in testing of hypothesis.

Section-D

Large sample test- Testing of significance of proportion in single population, Testing of equality of proportions in two populations, Testing of significance of mean in single population, Testing of equality of means in two populations.

Analysis of Variance — Meaning of analysis variance with linear models, Analysis of variance for one-way classified data, Analysis of variance for two-way classified data with one observation for cell.

Text Books

1. Fowler, J., Cohen, L. and Jarvis, P. (1998). Practical Statistics for Field Biology. John Wiley and Sons, 2nd ed. [Chapters: 4,5,6,7,(7.1–7.6), 9 (9.1–9.4), 12 (12.1–12.7), 13 (13.1–13.4, 13.6,13.7), 14 (14.1–14.5, 14.7), 15 (15.3–15.8, 15.10–15.11), 16 (16.9–16.13), 17 (17–.1– 17.3, 17.5,17.6,17.8)].
2. Raghavarao, D. (1983). Statistical Techniques in Agricultural and Biological Research Oxford and IBH Publishing Co. [Chapters: 2,3,4,5,7,8,9 and 10].

Reference Books:

1. Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.
2. Finney, D.J. (1980). Statistics for Biologists. Chapman and Hall Ltd.
3. Hoel, P.G. (1971). Elementary Statistics. John Wiley and Sons, 3rd ed.
4. Ross, S.M. (2005). Introductory Statistics. Academic Press, 2nd ed.
5. Wayne, W, Daniel (1999). Biostatistics: A Foundation for Analysis in Health Sciences. John Wiley and Sons, 7th ed.
6. Woodworth, G. (2004). Biostatistics: A Bayesian Introduction. John Wiley and Sons.

ZOP 421: Comparative Anatomy of Animals –I**Credit 0-0-3**

1. Study the following through permanent slides/charts/models/audio video aids
 - Setae of Earthworm.
 - Jaws and alimentary canal of leech.
 - Mouth parts of Insects (housefly, butterfly, mosquito, bug and cockroach)
 - Radula in *Pila*.
 - Anatomy of gut according to feeding habits (Insect / annelids / fish).
 - Respiratory structures in Crustaceans, Insects, Bivalves, scorpion, cockroach, grasshopper, Chilopods, Elasmobranchs and bony fishes.
 - Heart and circulatory system of fish, frog, lizard, pigeon, mouse.
 - Blood cell types of vertebrate representatives.
 - Skin of vertebrate representatives through permanent slides.
 - Spicules of Herdmania.
 - Locomotory organs of fish.
2. Observation of pseudopodial, ciliary and flagellar movements in Protozoans.
3. Study of appendicular skeleton of vertebrates and invertebrate skeletal forms.

***Some changes in the contents of the practical can be expected depending upon the availability of the material and the required equipment.**

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 422: Biosystematics and Evolution Practicals**Credit 0-0-3**

- Various kinds of equipments used for animal collection and preservation.
- Demonstration through pictures/videos :-
 - Taxidermy.
 - Alizarine preparation.
 - Raisin Embedding.
 - Wet Mounting.
 - Dry Mounting.
- Kinds of keys and their use in taxonomy.
- Construction of phylogenetic tree using some priority weighed characters.
- Calculation of regression, correlation - coefficient, variance of genetic frequencies and genetic equilibrium in natural populations using peapods.
- To calculate gene and genotype frequency in a given population.
- Demonstration of Hardy – Weinberg Law and deviations (role of external forces) from the equilibrium in a population.
- Mapping of geographic distribution of birds, insects, fishes etc.
- Study of fossils.
- Study of various evolutionary phenomena using slides / photographs.
 - Homology, Analogy, Parallel trends, Living fossils, Polyphyletic origin, Anagenesis, Regressive trends, Mimicry, Connecting/Missing links, Types of selection and Bizarre forms.

***Some changes in the contents of the practical can be expected depending upon the availability of the material and the required equipment.**

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOL 452: Structure and Function of Animals –II**Credit 4-0-0****Time: 3 Hours**

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section – A**Excretion :**

Excretory structures and waste disposal
Development and structural organization of chordate kidney and its role in excretion.
Adaptations to different environments / habitats.
Regulation of water salt balance

Section-B**Reproduction:**

Pattern of reproduction in non-chordates and larval forms.
Evolution of the urogenital system in chordates with special reference to separation of the two systems.
Reproductive process and its regulation in chordates

Section-C**Nervous system :**

Cellular organization of neural tissue, propagation of action potential, synapses and synaptic transmission
Chemical coordination of body functions through neuro secretions in non-chordates.
Physiology of nerve net and giant fibre system
Evolution of functional anatomy of chordate brain.

Section-D**Endocrine and neuroendocrine physiology:**

Synthesis, storage and release of hormones
Types of endocrine glands and their function
Endocrine coordination.

Sensory organs :

Common characteristic of receptors
Types of receptors and their function. Chemoreceptors, mechanoreceptors, radiation receptors, Electro receptors

M.Sc. Zoology (Semester-II)
(Credit Based Evaluation & Grading System)

Suggested Reading Material.

- Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
- Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.
- Bekleimishv, W. M. (1969), Principles of Comparative Anatomy of Invertebrates, Vol. I – Morphology, Vol. II – Organology. Chicago University Press, Chicago.
- Brusca, R. C. and Brusca, G. J. (2003), Invertebrates (2nd ed). Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
- Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed.) Macmillan, New York.
- Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
- Goodrich, E. S. (1958), Structure and Development of Vertebrates, Vol. I and II. D. E. Publication , New York.
- Hildebrand, M. & Goslow. Jr. G. E. (2001), Analysis of Vertebrates Structure John Wiley , New York.
- Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.
- Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.
- Hyman, L. H. The Invertebrates. Vol. I-Protozoa through Ctenophora (1940), Vol. II – Platyhelminthes and Rhynchocoela (1951), Vol. III- Acanthocephala, Aschelminthes and Entoprocta (1951), McGraw Hill, New York.
- Jollie, M. (1968), Chordate Morphology, Reinhold, New York.
- Kardong, K. V. (1995), Vertebrates – Comparative Anatomy, Function, Evolution. W.B.C. Pub. , Oxford.
- Kent, G. C. and Carr, R. K. (2001), Comparative Anatomy of the Vertebrates (9th ed), McGraw Hill Higher Education, New York.
- Linzey, D. (2001), Vertebrate Biology. McGraw Hill Publishing Company, New York.
- McGowan, C. (1999), A Practical Guide to Vertebrates Mechanics, Cambridge University Press, UK.
- Meglitsch, P. A. and Schran , F. R. (1991), Invertebrate Zoology (3rd ed), Oxford University Press, New York.
- Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books seller & Publishers, Agra.
- Pough, F. H. , Heiser , J. B. and McFarland, W. N. (1990), Vertebrate Life (3rded), Macmillan Pub. Co. , New York.
- Purves, W. K., Oriane, G. H., Space , H. C. and Salava , D.(2001), Life–The Science of Biology(6th ed), Sinauer Assoc. Inc. , USA.
- Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
- Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate Zoology (7th ed), Saunders Publ. , Philadelphia.
- Saxena, R. K. and Saxena, S. (2008). Comparative anatomy of Vertebrates. Viva Books Pvt. Ltd. New Delhi.
- Willmer, P., Stone, G. and Johnston, I. (2000). Environmental Physiology of Animals, Blackwell Science.
- Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, New York.
- Young, J. Z. (1982), The Life of Vertebrates, New York.

ZOL 454: Applied Zoology -1

Credit 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Apiculture

- Introduction
- Honey bee and kinds
- Life Cycle
- Flora for Apiculture
- Cultivation and Harvesting
- Products of Bee keeping and their importance
- Honey composition, quality and importance
- Enemies of Honey bees

Section-B

Lac culture

- Introduction
- Species for lac culture, Life cycle and Host plants
- Lac composition, properties & importance
- Cultivation and Harvesting of Lac
- Enemies of Lac insect

Sericulture

- Introduction
- Species and their Life Cycle and host plants.
- Silk composition, kinds and uses
- Rearing of silkworm and Silk Production
- Enemies of Silk worm

Section-C

Prawn Culture

- Introduction
- Prawn: species and life cycle
- Fresh water and Marine Prawn farming
- Processing and Preservation
- Enemies of Prawns

M.Sc. Zoology (Semester-II)
(Credit Based Evaluation & Grading System)

Pearl Culture

Introduction
Species and life cycle
Pearl culture – Freshwater and Marine
Pearl composition , kinds and uses
Enemies of Oysters

Section-D

Vermi Culture

Introduction
Species and life cycle
Methods of Vermiculture
Factors affecting vermiculture
Economics of Vermiculture
Enemies of earthworm

Suggested Reading Material

- Bhamrah, H. S. & Juneja, K. (2001), An introduction to Mollusca. Anmol publications Pvt., Ltd. New Delhi.
- Bhatnagar, R. K. and Palta, R. K. (2003), Earthworm; Vermiculture and Vermicomposting , Kalyani Publishers India.
- Carter, G. A. (2004) Beekeeping , Biotech Books, New Delhi.
- Fenemore, P. G. and Prakash, A. (1992), Applied Entomology, Wiley Eastern Ltd. New Delhi.
- Ghorai, N. (1995), Lac Culture in India. International Books and Periodicals, New Delhi.
- Jhingran , V. G. (1991) Fish and Fisheries of India, Hindustan Publishing Company India.
- Kumar, A. and Nigam, P. M. (1989), Economic and Applied Entomology EMKAY Publishing Co. New Delhi.
- Mishra, R. C. (1995), Honey Bees & their Management in India. ICAR, New Delhi.
- Mustafa, S. (1990) Applied and Industrial Zoology. Associated Publishing Company, New Delhi.
- Sarkar, S. Kundu, G. and Chaki, K.K. (2014), Introduction to economic Zoology. New Central Book Agency (P) Ltd. Landon.
- Sathe, T. V. and Jadhav, A. D. (2001) Sericulture and Pest Management, Daya Publishing House, New Delhi.
- Shimizu, M. (1972) Handbook of Silkworm rearing (Agricultural Techniques Manual-1) Fuji Publishing Co. Ltd , Tokyo, Japan.
- Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.
- Singh, S. (1962), Bee Keeping in India, I. C. A. R. Publications, New Delhi.
- Sobti, R. C. (1992), Medical Zoology, Nagin Chand & Co. Jalandhar.
- Srivastava, P. A. (1977), Economic Zoology, Commercial Publication Bureau, Kanpur.
- Ullal, S.R. and Narsimhanna, M. N. (1981), a Handbook of Practical Sericulture, Central Silk Board, Bombay.
- Venkatanarasaiah, P. (1992), Sericulture in India, Ashish Publishing House, New Delhi.

ZOL 455: Cell Biology

Credit 3-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Organisation of a Cell

Cell, Cell size, prokaryotic Cell, eukaryotic Cell

Stem Cells and the maintenance of adult tissues

Embryonic stem cells and Therapeutic cloning

Cytoskeleton: Actin filament, Myosin, Intermediate filament, microtubules

Structure of cell membrane

Membrane functions, history of plasma membrane structure,

Chemical composition of membranes, Glycocalyx

Section-B

Ribosomes

Prokaryotic and Eukaryotic ribosomes

Role of ribosomes in protein synthesis in prokaryotes and eukaryotes

Endoplasmic Reticulum

Structure and chemical composition of membranes

Protein secretion, their targeting and insertion into the ER membrane

Protein folding and processing in the ER

Smooth ER and lipid synthesis

Export of proteins and lipid from the ER

Golgi complex

Organization of the Golgi

Protein glycosylation within Golgi

Lipid and Polysaccharide metabolism in Golgi

Protein sorting and export from the Golgi apparatus

Mechanism of Vesicular fusion

Cargo selection, Coat Proteins and Vesicle Budding, Vesicle Fusion

Section-C

Lysosomes

Lysosomal Acid hydrolases

Endocytosis and lysosome formation

Phagocytosis and Autophagy

Lipofuscin pigments

M.Sc. Zoology (Semester-II)
(Credit Based Evaluation & Grading System)

Mitochondria

Organization and Function of mitochondria
The Genetic system of Mitochondria
Protein import and Mitochondrial Assembly
Electron transport chain, Chemiosmotic coupling
Transport of metabolites across the inner membrane

Section-D

Peroxisomes

Functions of peroxisomes, glyoxylate pathway, Peroxisome Assembly

Nucleus

Structure of Nuclear Envelope, Nuclear Pore Complex
Transport of Nuclear proteins and RNAs
Internal organization of the Nucleus. Nucleolus and rRNA processing

Suggested Reading Material:

- Alberts, B. Bracy, P. Lewis, J. Raff, M. Roberts K and Watson, J. (eds) (2008). Molecular Biology of the Cell(5th Ed.), Garland Publishing, New York.
- Avers, C. J. (1976). Cell Biology, Van Nostrand Reinhold, New York.
- Cooper, G. M. (2015). The cell, A Molecular Approach (7th Ed)ASM press, Washington, D. C.
- Chandra Roy, S and DE Kumar, K. (2001) Cell Biology. New Central Book Agency (P) Ltd. Kolkata.
- Darnell, J. Lodish, H. and Baltimore, D. (2007). Molecular Cell Biology, 6th edition, Freeman, New York.
- Derobertis, E. D. P. and Derobertis, E.M.F. (2011). Essentials of Cell and Molecular Biology(8th Ed) Hold Saunders – Philadelphia.
- Dewitt., W. (1977). Biology of the Cell – An evolutionary approach, Saunders – Philadelphia.
- Holtzman, E. and Novikoff, A. B. (1984). Cells and Organelles. Saunder – Philadelphia.
- Hopkins, C. L. (1978). Structure and Functions of Cells. Saunders – Philadelphia.
- Karp, G. (2013). Cell Biology 7th Edition, McGraw Hill, New York.
- Karp G. (2013). Cell and Molecular Biology. Concepts and Experiments, 7th Editon John Wiley and Sons, Inc. New York, Brisbane, Toronto.
- Loewy, A. G., Siekevitz, P, Menningee, J. R., and Allant, J. A. N. (1999). Cell structure and Functions. An integrated Approach 3rd edition. Saunders College Publishing, Philadelphia, London.
- Pollard. T.D. and Earnshaw, W.C. (2002) Cell Biology. Saunders, Philadelphia London. New York, St. Luis Sydney, Toronto.
- Powar, C. B. (1990). Cell Biology. Himalaya Publishing House, Bombay.
- Sadava, D. E. (1993). Cell Biology – Organelle, Structure and Fucntions. H. Jones and Bartlett- Boston.
- Sheeler, P. and Binachi, D. E. (1983). Cell Biology, John Wiley, New York.
- Smith & Wood (1992). Cell Biology, Chapman & Hall, London, New York.
- Wolfe, S. L. (1995). Introduction of Cell Biology, Woodworth Belmont.

ZOL 456: Animal Ecology & Wild life

Credit 4-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Introduction

Abiotic & Biotic Factors :

Temperature, Moisture, Light, fire, Malentite and Pollution.

Resource, Food, Ecological Niche, Food chains, Food webs, Biomagnifications, Ecological succession.

Adaptations :

Cave, Deep sea, Arboreal, Aerial, and Subterrestrial. Co-adaptations and Adaptive resemblances (mimcry, seasonal polymorphism)

Section-B

Individuals, Populations, Communities

Birth, Death & movement. Population Growth & life tables.

Interactions & Coactions:- Competition, Predation, Parasitism, Commensalisms, Mutualism etc.

Section-C

Wild life

Biodiversity as a resource and causes of its depletion.

Ecological sub regions and distribution of wildlife in India

National & State mammals and birds of India.

Wildlife and its status in Punjab – Important ecological sites and their status

Section-D

Conservation Biology

Red Data Book & Conservation status (endangered , vulnerable, rare, threatened and near threatened species - definitions)

Policies and Laws in Wildlife Management (National)

Important projects for the conservation of Endangered species in India

Conservation of invertebrates with special reference to corals and butterflies

M.Sc. Zoology (Semester-II)
(Credit Based Evaluation & Grading System)

Suggested Reading Material

- Anderwartha, H.G. and Birch, L. C. (1970), The distribution and abundance of animals, University of Chicago Press, Chicago London.
- Beeby, A. (1992), Applying Ecology Chapman and Hall Madras.
- Begon, M., Harper J. L. and Townsend, C. R. (1995), Ecology – Individuals, populations and communities, Blackwell Science, Cambridge UK.
- Brewer, R. (1994), The science of Ecology, Saunders College of Publishing, New York.
- Chapman, J. L. and Resis, M. J. (1995), Ecology- Principles and applications, Cambridge University Press, Cambridge UK.
- Kaeighs, S. C. (1974), Ecology with special references to animal and Man, Prentice Hall Inc.
- Odum, E. P. (1983), Basic Ecology.
- Putmann, R. J. and Wratten, S. D. (1984), Principles of Ecology, Crown Helm, London.
- Salanki, J., Jeffery E. and Hughes G. M. (1994), Biological Monitoring of the Environment (A manual of Methods) CAB International, Wallingford UK.
- Aggarwal, (2000), Wildlife of India.
- Ali, S. (1971), The Books of Indian Birds, Bombay Natural History Society, Bombay.
- Burton, L. D. (2003), Fish and Wildlife: Principles of Zoology and Ecology. Delmar Thompson Learning Pb.
- Dasmann, R. F., (1982), Wildlife Biology, Wiley Eastern, New Delhi.
- Fulbright, Timothy, E. and Hewitt, D. G. (2008). Wildlife Science: Linking Ecological Theory and Management Applications. CRC Press, Taylor and Francis: BocaRaton, F L.
- Giles, R. H. (1984), Wildlife Management Techniques, Natraj Publishers, Dehradun.
- Gopal, R. (1992), Fundamental of Wildlife management Justice Home Allahabad.
- Hosetti, B. B. (1997), Concepts in Wildlife Management, Chawla Press, Delhi.

ZOP 471: Comparative Anatomy of Animals –II**Credit 0-0-3**

- Analysis of normal and abnormal constituents in urine sample.
- RBC, WBC (TLC, DLC), platelet counts.
- Study of osmotic fragility in erythrocytes.
- Determination of ESR and PCV of human blood.
- Estimation of haemoglobin by Sahli's / cyanometgloboin method.
- Study of following with the help of slides/charts/models/audio/video aids:-
- Different forms of excretory structures in invertebrates and vertebrate groups :-
(Nephridium in annelids, green glands in crustacean, malpighian tubules in insects, kidneys of molluscs, fish , frog, lizard, bird and mammal).
- Reproductive system of *Hydra*, flat worm, earthworm, cockroach and *Pila*.
- Nervous system of cockroach, *Pila*, *Sepia*, fish, frog, lizard, pigeon and mouse.
- Histological study of reproductive system of invertebrates and vertebrates from permanent slides.
- Histological study of endocrine glands of vertebrates from permanent slides.

***Some changes in the contents of the practical can be expected depending upon the availability of the material and the required equipment.**

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 473: Experiments in Cytology**Credit 0-0-1.5**

- Various techniques for histological preparations of animal tissue.
- Study of permanent slides of various kinds of tissues.
- Study of electron micrographs of cell and organelles.
- Study of prokaryotic (*Lactobacillus*, *E. coli*) and Eukaryotic Cells (pond water culture) through temporary and permanent preparation.
- Study of different stages of mitosis in root tips of *Allium cepa*.
- Use of ocurometer for estimation of cell size.

***Some changes in the contents of the practical can be expected depending upon the availability of the material and the required equipment.**

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 474: Ecological Exercises & Wild life projects**Credit 0-0-1.5**

- To record temperature and pH of a given water sample.
- To determine the amount of dissolved oxygen (DO) in a water sample.
- To determine the total alkalinity of a water sample.
- To determine the total hardness of a water sample.
- Total count (quantitative estimation) of plankton
- Plotting of survivorship curves from hypothetical life table data.
- Population estimation using Mark and Release method (using beads / pulses etc).
- Wild life projects.
- To mark zoogeographical regions on World map/Biological hot species.

***Some changes in the contents of the practical can be expected depending upon the availability of the material and the required equipment.**

ZOL 501 : Applied Zoology –II

Credit Hours 3-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Pisciculture

Economically important fresh water and marine fishes
Fish culture: aims and evolution
Techniques and factors affecting fish culture
Problems of seed collection from natural resources (in brief)
Induced breeding methods

Poultry

Breeds of poultry birds
Poultry Rearing / Farming
Egg structure and quality, abnormalities in eggs, factors affecting size
Broilers, meat processing and egg processing

Section-B

Fur Industry

Fur producing animals
Fur farming, dressing, Fur processing and dyeing

Leather Industry

Animals of leather industry
Processing of skin, flaying, Curing, salting and tanning
Enemies of skin industry

Section-C

Dairy Farming

Milching animals, Breeds
Housing and raising
Milk composition and dairy products
Improvement of stocks

Wool Industry

Animals of wool industry
Types of wool, structure and their physicochemical properties
Removal of wool
Processing of wool, clearing, drying, bleaching, dyeing, spinning and twisting.

M.Sc. Zoology (Semester-III)
(Credit Based Evaluation & Grading System)

Section-D

Piggery

Characteristics of swine and their products

Breed selection

Housing and raising

Products (Pork, Bristles, Lard, Sausages) and by products

Diseases of Pigs

Other Utilities of animals

Pharmaceuticals from animals (in brief)

Vaccines from animals

Suggested Reading Material:

- Banarjee, G. C. (1982), Poultry. Oxford and IBH Pub. New Delhi
- Banarjee, G. C. (1991), Text book of Animal Husbandry. Oxford and IBH Pub, New Delhi.
- Jawal, P. L. (1977), Handbook of Animal Husbandry, I. C. A. R., Pub. New Delhi.
- Jhingaran, V. G. (1991), Fish and Fisheries of India, Hindustan Pub. Co. India.
- Khanna, S. S. (1986), An introduction to fishes, Central Book Depot, Allahabad.
- Mustafa, S. (1990), Applied and Industrial Zoology, Rastogi publications, Meerut.
- Sarkar, K. T. (1991), Theory and Practice of Leather manufacture. The Author, Madras.
- Sarkar, S. Kundu, G. and Chaki, K.K. (2014), Introduction to economic Zoology. New Central Book Agency (P) Ltd. Landon.
- Shami, Q. J. and Bhatnagar, S. (2002) Applied Fisheries . Agrobios India.
- Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.
- Srivastava, P. A. (1977), Economic Zoology, Commercial Publication Bureau, Kanpur.
- Toor, H. S. and Kaur, K. (1996), Fish Culture manual. PAU, Ludhiana.
- Yadav, M. (2003) Economic Zoology , Discovery Publication House, New Delhi.

ZOL 502 : Molecular Cell Biology

Credit Hours 4-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Biomembranes

Molecular composition, arrangement and functional consequences.

Transport across cell membrane – Diffusion, active transport and pumps, uniports, symports and antiports.

Membrane potential and Nerve Impulses

Trafficking Mechanisms (Endocytosis, Phagocytosis etc.)

Section-B

The Extracellular Matrix and Cell Interactions

Matrix Structural Proteins

Matrix Polysaccharides

Matrix Adhesion Proteins

Cell Matrix Interactions

Cell-Cell Interactions

Adhesion Junctions

Tight Junctions

Gap Junctions

Plasmodesmate

Section-C

Cell signaling

Cell surface receptors

Second messenger system

MAP kinase pathways

Signalling from plasma membrane to nucleus

Biology of Aging

DNA repair enzymes

Pathways of aging (insulin signalling cascade and mTOR pathways)

Section-D

Cell cycle

Various cell cycle check points

Cyclin and cyclin dependent kinases

Regulation of CDK –cyclin activity.

M.Sc. Zoology (Semester-III)
(Credit Based Evaluation & Grading System)

Biology of cancer

Development, causes types and properties of cancer
Tumor Viruses, Oncogenes and Tumor suppressor genes
Molecular approaches for treatment of cancer

Apoptosis

Events of Apoptosis
Caspases the central regulators of apoptosis
Signalling pathways for apoptosis

Suggested Reading Material:-

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, M. & Walter, P. (2002), Molecular Biology of the Cell, 4th Edition Garland Science, New York.
- Becker, W. M., Kleinsmith, L. J. & Hardin, J. (2000), the World of the Cell, B. C. Pub. Co., San Francisco.
- Cooper, G. M. (2004), The Cell: A Molecular Approach IIIrd edition, ASM Press, Washington, D.C.
- Darnell, J. Lodish, H. & Baltimore, D. (1990), Molecular Cell Biology 2nd Edition Freeman, New York.
- DeRobertis, M. D. & DeRobertis, M.D. (Jr.) (1995), Cell and Molecular Biology (8th ed.), B.I. Waverly Pvt. Ltd., New Delhi.
- Karp, G.(2005), Cell and Molecular Biology; concepts and experiments (4th ed.), Hoboken, John Wiley and Sons, New York.
- Lodish, H., Berk, A., Matsudaira, P., Kaiser, C.A., Krieger, M., Scott, M.P., Zipursky, S. L. & Darnell, J., (2004), Molecular Cell Biology 5th Edition W. H. Freeman & Co., New York.
- Pollard, T. D. & Earnshaw, W. C. (2000), Cell Biology, Saunders, U.S.A.
- Ray, S.C. & Kumar, K. (2006), Cell Biology, New Central Book Agency, Kolkata.
- Sadava, D. E. (1993), Cell Biology Organelle Structure and Functions. H. Jones & Bartlett-Boston.

ZOL 504: Molecular Genetics

Credit 3-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

DNA replication and Repair

Replication

Mechanism of Prokaryotic and eukaryotic DNA replication
Enzymes and accessory proteins involved in DNA replication.

Repair

Overview of DNA Repair
DNA Mismatch Repair system
General Excision Repair system
Specialized DNA Repair Mechanisms
SOS Error Prone Repair in Bacteria
Repair in Eukaryotes

Section-B

Transcription

Prokaryotic Transcription
Eukaryotic Transcription
RNA polymerases

Post- transcriptional Modifications in RNA

5' –Cap formation
Transcription termination
3' – end processing and polyadenylation
Splicing , Editing, mRNA stability

Section-C

Translation

Genetic code
Prokaryotic and eukaryotic translation
The translational machinery
Mechanisms of initiation, elongation and termination
Co- and post translational modification of proteins

Section-D

Regulation of gene expression

Regulatory elements and mechanism of transcription regulation
Transcriptional and post transcriptional gene silencing
Regulation of translation

M.Sc. Zoology (Semester-III)
(Credit Based Evaluation & Grading System)

Suggested Reading Material

- Alberts, B., Johanson, A., Lewis, J. Raff, M., Roberts, M. and Walter, P. (2000) Molecular Biology of the cell, 4th Edition, Garland Science, New York.
- Brown, T. A. (2006) Gene cloning and DNA analysis and introduction (5th Edition), Oxford, Blackwell Publishers.
- Christophger Howe (1995) Gene cloning and Manipulation, Cambridge University Press, New York.
- Clark, D.P.(2010), Molecular Biology, Academic Elsevier, USA.
- Cox, M.M. and Nelson, D.L.(2011), Lehninger Principles of Biochemistry (5th ed), W.H Freeman and Company, NewYork.
- Dale, J.W.Shantz MU (2002) From Genes to Genome: Cons, New York.
- DeRoberties, M. D. and DeRobertiees, M.D. (Jr) (1995) . Cell and Molecular Biology (8th ed.) B.I. Waverly, Pvt. Ltd., ND.
- Freifelder. D. (1993). Molecular Biology (2nd ed.) Narosa Publishing House, India
- Freifelder. D. and Malacinski, G. M. (1993). Essentials of Molecular Biology (2nd ed), John and Bartlett Publishing, U.K.
- Lewin B (2001) Genes VII, Oxford University Press, New York.
- Lodish, H., Berk, A., Matsudaira, P., Kiser, C. A., Kriger, M., Scott, M. P., Zipursky, S.L. and Darnell, J. (2004) Molecular Cell Biology, 5th Edition W.H. Freeman and Company, New York.
- Primrose, S.B. , Twyman R.M. and Old R.W. (2001) Principles of Gene manipulation, 6th Ed. Blackwell Scientific Publication, Oxford, U.K.
- Waston J.D., Tooze J. and Kurtz, D.T. (1991) Recombinant DNA. A short course 2nd Ed., W.H. Freeman and Company , New York.
- Weaver, R.F. (2005) Molecular Biology,

ZOL 505 : Animal Behaviour

Credit Hours 4-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Introduction

Ethology as a branch of biology

Animal Psychology –classification of behavior patterns, analysis of behavior (ethogram)

Neural control of behavior

Hormonal control of behavior

Genetic and Environmental components in the development of behavior

Section-B

Communication

Chemical, visual, tactile and audio communication

Functions of Communication

Song specificity of birds

Evolution of language (primates)

Host-parasite relations

Social behavior

Aggregations-schooling in fish, flocking in birds, herding in mammals, advantages and disadvantages of living in groups

Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness

Social organization in insects and primates

Section-C

Reproductive behavior

Evolution of sex

Mating and courtship behavior

Sperm competition

Sexual selection and Parental care

Section-D

Learning and memory

Conditioning, Habituation, Associative learning, Reasoning and Cognitive skills.

Biological Clocks

Rhythmic behaviour

Advantages of biological clocks

Adaptiveness of biological clocks

Molecular basis of clock mechanism

M.Sc. Zoology (Semester-III)
(Credit Based Evaluation & Grading System)

Suggested Reading Material :

- Alcock John. 2005 Animal Behaviour . An Evolutionary Approach (8th Edition)
- Alcock, J. (1998), Animal behaviour, An evolutionary approach Sinauer Assoc., Sunderland, Mass , USA.
- Drickamer, L. C. and Vessey, S. H. (1986), Animal Behaviour - Concepts, Processes and Methods. (2nd ed.), Wordsworth Publ. Co., California.
- Goodenough, J., McGurie and Wallace, R. A. (2001), Perspective on animal behaviour. John Wiley & Sons, Inc. New York.
- Huntingford F. (1984), The study of animal Behaviour, Chapman and Hall, London.
- Manning, A. and Dawkins, M. S. (1992 & 1998), An Introduction to Animal Behaviour , 4th ed.(Cambridge low price editions). Cambridge University Press, Cambridge.
- Manning, A. (1979), An Introduction to Animal Behaviour, 3rd Edition . The English Language Book Society and Edward Arnold Publishers Ltd.
- McFarland, D. (1985 & 1999), Animal Behaviour. Pitman Publishing Ltd. London.

ZOP 521: Advanced Cytology Practicals**Credit Hours 0-0-1.5**

- Separation of WBC from human blood.
- To check the viability of WBC with trypan blue.
- Isolation of DNA from human blood.
- Isolation of DNA from buccal cells.
- Amplification of DNA using PCR.
- To study cellular abnormalities and their frequency.
- To estimate nucleocytoplasmic ratio.
- Comet assay for estimation of DNA damage.
- Double immunodiffusion for antibodies to a specific antigen.
- Gaint chromosomes through permanent slides.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 523: Behavioural Zoology Exercises**Credit Hours 0-0-3**

- Study of behaviour patterns using slides / photographs.
- To investigate locomotive, associative learning and habituation.
- Study of latent and operant learning.
- Study of the phenomenon of thigmotaxis.
- Study of the phenomenon of geotaxis.
- Study of the phenomenon of photo taxis from point source and different colours of light.
- Study of grooming behavior.
- Study of chemosensory responses.
- Study of web spinning habits in spiders.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

M.Sc. Zoology (Semester-IV)
(Credit Based Evaluation & Grading System)

ZOL 551: Tools & Techniques

Credit Hours 4-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Introduction:

pH, Buffers, Homogenisation.

Centrifugation and Ultra centrifugation:

Types, Principles and Instrumentation.

Chromatography:

Principles, Types, Instrumentation and applications.

Section-B

Electrophoresis:

Principles, Types, Instrumentation and applications.

Spectroscopy

Principles, Instrumentation and application of various types of spectroscopy: (UV-Visible spectrophotometry, Spectrofluorometry, X-ray Spectroscopy, Infra-red Spectroscopy and Atomic Spectroscopy)

Section-C

Radio Isotopes

Principles of Radioactivity and its applications.

Auto Radiography

Microscopy

General Principles, Instrumentation and application of Light Microscopy, Phase contrast microscopy, Fluorescent microscopy, SEM, TEM, Confocal, Interference etc.

Section-D

Histological techniques:

Equipment (microtome, cryostat)

Cryopreservation for cells, tissues and organisms.

Animal cell culture techniques:

Design & functioning of tissue culture laboratory

Cell proliferation measurements, Culture media preparation, Cell viability testing, cell separation & harvesting through Flow cytometry.

M.Sc. Zoology (Semester-IV)
(Credit Based Evaluation & Grading System)

Suggested Reading Material:

- Broadway, S. Bracegirdle, B. (1998), Introduction to light microscopy. Bios Scientific Publisher , Oxford. In association with The Royal Microscopical Society, London (Microscopy) Handbook , 42), 123 pp.
- Butler, M. (1996), Animal Cell Culture and Technology. The Basic, IRL Press, Oxford.
- Freiflder, D. (1982), Physical Biochemisrtry : Applications to Biochemistry and Molecular Biology, WH Freeman and Company, San Francisco.
- Freshney , R. I. (1992), Animal cell Culture : A Practical Approach. Second Edition , IRL press, Oxford.
- Freshney, R. I. (2000), Culture of Animal Cells: A manual of Basic Techniques. Fourth Edition. Wiley –Liss, Inc. New York.
- Gupta, M. N. (2002), Methods for Affinity- Based separations of Enzymes and Proteins.
- Hajibangheri, Nasser, M. S. (ed.) (1999), Electron microscopy methods and protocols. (Methods in molecular biology volume 117). Human Press, Totowa, N. J. 296 pp.
- Humasson, G. L. (1967), Animal Tissue Techniques W. H. Freeman and Company, London.
- Jayaram, J. (2001), Laboratory Manual in Biochemsitry, New Age International (P) Ltd. Publishers, New Delhi.
- Mather, J. P. and Barnes, D. (1998), Animal Cell Culture : Methods in Cell Biology Volume 57. Academic Press, New York.
- Osterman, Lev. A. (1984), Methods of Protein and Nucleic Acid Research: Electrophoresis, Isoelectric focusing, Ultracentrifugation, Springer-Verlag, New York.
- Plummer, D. T. (1978), An Introduction to Practical Biochemistry, Tata Mc Graw Hill, Publishing Company Ltd. New Delhi.
- Shah, V. V., Bahtavakar, J. Chinoy, N. J. and Murthy, S. K. (1988), Essential techniques in cell biology, Anand Book Depot, Ahmedabad.
- Sheehan, D. (2000), Physical Biochemistry: Principles and Applications. John Wiley & Sans Ltd, Chichester, England.
- Skoog, D. A. (1985), Principles of Instrumental Analysis, 3rd Edition, Saunders College Publishing, New York.
- Sumner, B.E.H. (1988), Basic Histochemistry. John Wiley and Sons Ltd. Chichester, London.
- Vago, C. (1972), Invertebrate tissue Culture. Volume I and II. Academic Press, New York.
- Wilson, K. and Goulding, K. H. (1992), A Biologist Guide to principles and techniques of practical Biochemistry. 3rd Edition, Foundation Brothers, New Delhi.
- Wilson, K. And Walker, J (1994), Practical Biochemistry : Principles and Techniques. Cambridge University Press, Cambridge.
- Wilson, K. and Walker, J.(2010), Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, New Delhi.

ZOL 553: Developmental Biology

Credit Hours 4-0-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Cell Commitment and Embryonic Development

Fertilization- Beginning of a new organism

Competence and Induction

Section-B

Organogenesis -Ectodermal derivatives, Mesodermal derivatives, Endodermal derivatives

Section-C

Genetic Control of Development

Differential gene expression in development

Cell-Cell communication in development

Axis formation in different animals

Section-D

Metamorphosis and regeneration

Amphibian metamorphosis

Insect metamorphosis

Stem cell mediated regeneration of flatworms,

Eplmorphic regeneration of salamander limb

Morphollaxes in Hydra

Compensatory regeneration of mammalian liver

Suggested Reading Material

- Balinsky, B. I. (1981), An introduction of Embryology, Saunders, Philadelphia.
- Bellairs, R. (1971), Development Processes in Higher Vertebrates, University of Miami Press , Miami.
- Berril, N. J. (1971), Development Biology. McGraw Hill, New Delhi.
- Dawnpart, Development Biology.
- Ebert, J. D. & Sussex , I. M. (1970), Interacting Systems in Development, Holt, Rinehart and Winston, New York.
- Elder, K. and Dale, B.(2001). In vitro fertilization 2nd edition. Cambridge University Press, Cambridge.
- Gilbert, S.F. (2015), Developmental Biology, Sinauer – associates, Inc. USA.
- Goel, S. C (1984), Principles and Animal Developmental Biology, Himalaya, Bombay.

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- Grant, P. (1978). Biology of Developing System.
- Jangir, O.P. (2005). Developmental Biology. A manual. Agrobios (India)
- Karp, G. & Berrill, M. J. (1981), Development McGraw Hill, New Delhi.
- Loomis, W. F. (1986), Developmental Biology Macmillan, New York.
- Miller, W. A. (1986), Developmental Biology Springer Verlag, New York, Inc.
- Oppenheimer, J. M. and Willer, B. H. (1964), Foundation of Experimental Embryology, Prentice – Hall, New Delhi.
- Pritchard, D. J. (1986), Foundation of Development Genetics, Taylor and Francis, London.
- Saunder, J. W. (1982), Developmental Biology, Patterns, Principles, Problems, MacMillan, New York.
- Spratt, N. T. Jn. (1971), Developmental Biology. Macmillan, New York.
- Waddigton, C. H. (1966), Principles of Development and Differentiation. Macmillan, New York.

ZOL 554: INTRODUCTION TO IMMUNOLOGY

Time: 3 Hours

Credit: 4-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Immune Response: Types of immunity

Features of immune response

Immunity to viruses, bacteria and tumors

Transplantation Immunology

Section-B

Cells, organs and microenvironments of the immune system:

Primary lymphoid organs, secondary lymphoid organs

Lymphocyte traffic

MALT, GALT

Receptors and signaling:

Receptor ligand interactions

Classes, structure and interactions of antibodies

Signal transduction

Section-C

Cytokines and Chemokines

The complement system: Major pathways and regulation of complement activation, Complement deficiencies.

The major histocompatibility complex

Structure, function and inheritance of MHC

Pathways of antigen processing and presentation

Section-D

Immunological Disorders: Allergy, Hypersensitivities, Chronic inflammation

Autoimmune disorder: AIDS

Brief introduction to experimental methods:

Antibody generation, Immunoprecipitation based techniques, Agglutination reactions, Antibody assays

Immunofluorescence based techniques. Flow cytometry, Cell sorting

Books Recommended

1. Kindt TJ, Osborne BA and Goldsby RA (2007) Immunology, 6 th Edition, WH Freeman and Company, NY.
2. Male D., Brostoff J., Roitt I and Roth D (2012) Immunology, WB Saunders Co. USA.
3. Owen JA, Punt J and Stranford SA (2013) Kuby Immunology, 7th Edition, WH Freeman and Company, NY.
4. Parham P (2012). The Immune System, 3rd Edition, Garland Sciences, London and New York.
5. Roitt IM, Brostoff J, Male DK (2001) Immunology, Mosby Inc, UK

Elective*

Credit Hours 4-0-0

ZOL 581 : Introductory Entomology

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Introduction :

Salient features of Insects.
Insect abundance and diversity.

Insect Classification:

Classification of class Insecta upto order level with salient features of each group

Section-B

Insect Body
Integument (in brief)

General organisation :

Head, thorax and abdomen.

Modifications and functions of mouthparts, antennae, wings and legs.

Section-C

General account of digestive, respiratory, circulatory, excretory, nervous and reproductive system.

Growth and Development (in brief)

Sensory system:

Photoreceptors
Chemoreceptors
Mechanoreceptors.

Section-D

Definition of Pests

Major pests of cotton, rice, sugar, wheat, vegetables and their biology (in brief).
Major pests of stored grain pests and their biology (in brief)
Different methods of pest management.

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Suggested Reading Material:

- Alford, D. V. (1999), A text book of Agricultural Entomology, Blackwell Science.
- Atwal, A. S. and Dhaliwal, G. S. (1997). Agricultural pest of South Asia and their management. Kalyani Publishers, New Delhi.
- Borrer, D. J., Triplehorn, C. A and Johnson, N.F. (1989). An introduction to the study of insects, Saunders College Publications, Philadelphia (USA).
- Davies, R. G. (1988), Outlines of Entomology, Chapman & Hall.
- Dent, D. (1991), Insect Pest Management, CAB International Wallingford, U.K.
- Dhaliwal, G. S. and Arora, R. (1996). Principles of insect management. Globe offset press, New Delhi.
- Elizinga, R. J. (2004), Fundamentals of Entomology, (6th ed), Prentice Hall, New Jersey.
- Evans, H. E. (1985), Insect Biology: A text book of Entomology, Springer – Verlag.
- Fenmare, P.G. and Parkash, A. (1992), Applied Entomology. Newage International Limited Pb.
- Gullan, P.S. and Crandton, P. S. (2000), The Insects: an Outline of Entomology, Blackwell Science Ltd. Pb.
- Herrick, G. W. (1999). Insect enemies of trees, Logos Press, New Delhi.
- Hill, D. S. (1993), Agricultural insect pests of the Tropics and their Control. (2nd ed), Cambridge University Press, Cambridge, New York.
- Mariau, D. (1999) Integrated pest management of tropical perennial crops. Science Publisher Inc. U.S.A.
- Mani M.S. (1982), General Entomology, Oxford & IBH Pb., N. Delhi.
- Mathur, V. K. and Upadhyay, K. D. (2000), A Text book of Entomology, Aman Publication House.
- Mayer, K. K., Anantha Krishnan, T. N. and David, B.V. (1976), General and Applied Entomology, Tata McGraw.
- Neumann, I. D. (1994), Systematic and Applied Entomology. Melbourne University Press.
- Pedigo, L. R. (2002). Entomology and pest management. (4th ed), Pearson education, Inc. , New Jersey.
- Pradhan, S. (1991) Agricultural entomology and pest control ICAR, New Delhi.
- Romoser, W. S. (1981), The Science of Entomology, Macmillan Pub. Co. Second edition.
- Roses, H. H. , Ross, C.A. and Ross, J. R. (1991), A Text book of Entomology , John Wiley and Sons, 4th edition.
- Roy, D. N. and Brown, A.W.A. (2003), Entomology (Part – I), Published by Biotech Books, Delhi.
- Roy Van Driesche, Mark Huddle and Ted Center (2008). Control of Pests and weeds by National enemies- An Introduction to Biological Control, Blackwell Publishers, U.S.A.
- Saxena, A. B. (1996). Harmful Insects, Anmol publications, New Delhi.
- Srivastava, K. P. (1996), A text book of Applied Entomology, Vol. II Kalyani Publishers.
- Van Ender, H. F. (1989) Pest control, second edition Cambridge University Press U. K.
- Verma, D. K. (1999), Applied Entomology, Mittal Publications.
- Venugopal, Rao, N., Uma Maheswar, T., Rajendraprasad, P., Govardhan Naidu, V. and Savithri, P. (2003) Integrated Insect pest management Dr. Updesh Purohit for Agrobios, Jodhpur.

Elective*

Credit Hours 4-0-0

ZOL 582: Introduction to Aquatic Biology

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Fresh water ecosystems

Introduction

Types of fresh water ecosystems – Distribution ,origin and forms.

Abiotic and biotic factors.

- Light, Heat , Movement .
- Oxygen,carbon,nitrogen and phosphorous.
- Planktons,benthos and nektons.

Section-B

Characteristics of fresh water ecosystem:

Water as a substance: molecular structure and properties, specific heat, density , surface tension

Productivity,Decomposition,

Eutrophication, Saprobian index (water pollution)

Thermal stratification

Section-C

Fish with in Aquatic ecosystem:

Form and locomotion: Bodyshape, scales, fins.

Digestion: Feeding, digestion and absorption of food

Excretion and Osmoregulation: Kidney, excretion and osmoregulation in marine and fresh water

Section-D

Fish with in Aquatic ecosystem:

Respiration: Gills, accessory respiratory organs

Circulation: Heart, Arterial system, Venous system

Reproduction: Gonads, Seasonal changes during reproductive cycle

Suggested Reading Material :

- Wetzel, R. G. (2001). Limnology. Elsevier Academic Press . Sandiago.
- Wetzel R. G. and Likens , G. E. (2004). Limnological analysis . Springer India. Pvt. Ltd.
- Findlay SEG and Sinsabaugh R. L. (2003). Aquatic ecosystems , Academic Press, U.S.A.
- Norman, J. R. and Green Wood , P. H. (1963). A history of fishes. Ernest Benn Ltd., London.
- Chandy, M. (1994). Fishes, National Book trust India.
- Singh, H. R. and Kumar , N. (2006). Ecology and Environmental Science. Vishal Publishing Co. Jalandhar, Sharma P. D.

M.Sc. Zoology (Semester-IV)
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Elective *

Credit Hours 4-0-0

ZOL 583: Introduction to Parasitology

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

General account
Classes of Parasites
Classes of Hosts
Adaptations for Parasitism
Effects of Parasites on hosts and vice versa
General morphology and life cycle of parasites

Section-B

Life cycle, pathogenesis and treatment of
Entamoeba histolytica
Trypanosoma gambiense
Leishmania donovani

Section-C

Life cycle, pathogenesis and treatment of
Plasmodium sp
Giardia intestinalis
Taenia solium

Section-D

Life cycle, pathogenesis and treatment of
Schistosoma haematobium
Trichinella spiralis
Ancylostoma duodenale
Ascaris lumbricoides

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Suggested Reading Material:

- Chatterjee, K.D. (1977). Parasitology , Chatterjee Medical Publishers, Calcutta, India.
- Rej,S.K. and Roy, R. (2013).Simplified course on Parasitology and Immunology, New Central Book Agency(P) Ltd, London.
- Roberts, L. S. and Janovy, J. (2009). Foundation of Parasitology, 8th edition , McGraw Hill Higher Education, Boston.

Elective*

Credit Hours 4-0-0

ZOL 584 : Biology of Chromosomes

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Origin of genetics and chromosome theory of inheritance:

General features of mitotic chromosomes:

Centromeres, Kinetochores, telomeres, NOR and r RNA genes.

Molecular organization of chromosomes and chromatin:

Nucleosome, Packing nucleosomes into solenoids. Other ways to pack DNA.

Section-B

Chromosomes in Interphase:

Interphase nuclei, arrangement of chromosomes, sites of replication transcription and nuclear matrix.

Structure of mitotic and meiotic chromosomes:

Chromosome condensation, biochemistry of condensation, Meiotic and mitotic chromosomes compared.

Constitutive and facultative heterochromatin

Section-C

Sex chromosomes and Sex determination:

Evaluation and mechanisms of sex determination, Dosage Compensation and sex chromosomes in meiosis and gametogenesis.

Lampbrush and Polytene : their structure and role.

Section-D

Chromosomes, karyotype and evolution:

Chromosomes and evolution.

Constraints on chromosome size, shape and number.

Chromosomes changes and speciation. Nucleotypic effects.

Chromosomes engineering and artificial chromosomes :

What is artificial chromosome ?

Future of artificial chromosome.

Suggested reading material :

- Hartl, D. L. and Jones, E. W. (2006). Essential genetics, A Genomic Perspective. Jones and Bartlett Publishers, Sudbury, Boston.
- Sumner, A. T. (2003). Chromosomes organization and function, Blackwell publishing, U.K

ZOP 572: Techniques in Zoology**Credit Hours 0-0-3**

- Working, use and care of various types of microscopes.
- Demonstration of working of weighing balances, autoclaves, incubators, laminar flow, water bath and centrifuge.
- Qualitative and Quantitative estimation of Carbohydrates, Lipids and proteins
- To prepare a buffer solution.
- Study of absorption spectra of coloured solutions.
- Preparation of Titration curve of weak acids and strong base and calculations of pKa value.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 573: Practicals in Specialized field**Credit Hours 0-0-1.5****Parasitology Lab.**

- Different type of Microscopes used in parasitic studies.
- Permanent slides of Parasites.
- Preparation of blood films for the study of protozoans.
 - Wet Blood film
 - Dried and stained film
 - Thin and thick blood film
- Staining blood films for the study of Protozoa.
 - Leishman's stain
 - Romanowsky stain
- Identification of different kinds of blood cells in humans
- Study of life cycles of parasites.
- Extraction of plant –parasitic nematodes
- Extraction of insect-parasitic nematodes

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 573: Practicals in Specialized field

Credit Hours- 0-0-1.5

Entomology Lab.

- Classification of insects upto order level
- Modification of insect mouthparts, antennae, legs and wings through slides/charts.
- Study of different body parts of Grasshopper through slides/charts/videos.
- Study of digestive, circulatory, excretory, nervous and reproductive system of grasshopper / cockroach (chart/videos/models).
- Different types of insect larvae.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 573 : Practicals in Specialized field**Credit Hours 0-0-1.5****Cytogenetics Lab.**

- Study of sex chromatin (Barr body, drumstick).
- Study of mitosis and meiosis through permanent slides/charts.
- Determination of chiasma frequency and terminalization coefficient from meiosis slides.
- Karyological preparation from bone marrow of a rodent.
- Localization of heterochromatin using C-banding technique.
- Localization of active NOR's using Ag-NOR banding technique .
- Study of DNA damage from micronucleated buccal mucosa cells.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 573 : Practicals in Specialized field**Credit Hours 0-0-1.5****Aquatic Biology Lab.**

- To study physico-chemical characteristics of water (pH, temp, DO, alkalinity, electrical conductivity, turbidity , colour).
- To measure solids (dissolved and suspended) in water.
- To study the morphology of fish(diagram/chart/video).
- Familiarity with the identification keys for freshwater fish.
- Determination of age with help of fish scale.
- To study the life cycle of a fish.
- To study the position of mouth with respect to feeding habits of fish.
- Effect of pH and temperature on fish.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in

ZOP 574: Experimental Developmental Biology**Credit Hours 0-0-3**

- Study of growth (multiplicative; accretionary) through permanent slides.
- Study of spermatogenesis and oogenesis through permanent slides.
- Study of various larval and pupal forms across animal kingdom from slides/charts/museum specimens/audio video aids.
- Study of metamorphosis in insects, frog (tadpole larva W.M.) through museum specimens.
- Study of permanent slides of chick and frog embryo (24 hr, 36 hr, 48 hr, 72 hr and 96 hr).
- Study of permanent mount of mammalian embryo (pig, monkey).
- Study of Oestrous cycle of rat.
- Study the direct and indirect development through museum specimens/charts.
- Study different developmental stages of a fresh water fish.
- Study of testis and ovary through permanent slides.

As per the latest UGC guidelines (D.O.No. F. 14-6/2014(CPP-II) dated 01-08-2014) the dissections should not be conducted. The guidelines on this issue are available on the UGC website: www.ugc.ac.in