

3rd, 4th Sem

M. Sc. (Zoology) – 3rd Semester
ZOO – 301 – Molecular Biology (Core Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit – I

Nucleic acid –structure: DNA and RNA as genetic material, Chemical structure and base composition of nucleic acids, Double helical structures, Supercoiled DNA, Forces stabilizing nucleic acid structure, properties of DNA, Renaturation and denaturation of DNA, T_m and Cot curves, Structure of RNA.

DNA Replication: General features of DNA replication, Enzymes and proteins of DNA replication, of replication, Prokaryotic and eukaryotic replication mechanism, Replication in phages, Replication in retroviruses.

Unit –II

Transcription: Mechanism of transcription in prokaryotes and eukaryotes, RNA polymerases and promoters, Post-transcriptional processing of tRNA, rRNA and mRNA (5' capping, 3' polyadenylation and splicing).

Antisense and ribozyme technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, biochemistry of ribozyme, hammerhead, hairpin and other ribozymes, strategies for designing ribozymes, applications for antisense and ribozyme.

Unit –III

Translation: Genetic code, General features, Deciphering of genetic code, Code in mitochondria, Translational mechanism in prokaryotes and eukaryotes, Post translational modification and transport, Protein targeting (in brief), Non ribosomal polypeptide synthesis, Antibiotic inhibitors and translation.

Unit –IV

Regulation of Gene Expression in Prokaryotes and Eukaryotes: Operon concept, Positive and negative control, lac, trp and arb operon, Catabolite repression, attenuation, regulation of gene expression in eukaryotes (a brief account).

Homologous recombination: Holiday junction, FLP/FRT and Cre/Lox combination, RecA and other recombinases

Text/Reference Books:

1. Adams et al. (1992) Biochemistry of Nucleic Acids, 11th ed., Chapman and Hall, NY
2. Lewin B. (2010) Gene X, Pearson Prentice and Hall, New Delhi.
3. Karp G. (2010) Cell and Molecular Biology –Concept and Experiments, 5th Edition, John Wiley, NY.
4. Lodish et al. (2013) Molecular Cell Biology, 7th Edition, W.H. Freeman Publisher
5. Gardener et al. (2001) Principles of Genetics, 8th ed., John Wiley, New York
6. Klug and Cummings (2012) Concept of Genetics, 10th ed., Pearson Education
7. Cooper G.M. and Hausman R.E (2013) The Cell: A molecular approach, Sinauer Associates Inc, Publisher, USA, 6th edition
8. Alberts B, and Johnson A (2016) Molecular Biology of Cell, Garland Science Publisher

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Vineeta Shukla 18/9/18

M. Sc. (Zoology) – 3rd Semester
ZOO – 302 – Developmental Biology (Core Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit-I

Structure, chemistry, dynamics and regulation of sperm activity, capacitation and egg-surface targeting. Molecular biology, cytology and biochemistry of oogenesis: Synthesis and storage of maternal transcripts, proteins and cell organelles. rDNA amplification in amphibian transcription on lampbrush chromosomes, ovulation and its hormonal control in mammals.

Unit -II

Molecular and cellular biology of fertilization: acrosome reaction and signal transduction monospermy and species-specificity. Egg activation, early cleavages and blastocyst formation in mammals and biochemical and cellular changes during the passage down the oviduct to the uterus.

Unit -III

Implantation and formation of the placenta in mammals. Gastrulation in mammals-formation of primitive streak, morphogenetic movements and neural induction. Organogenesis and foetal development. Pattern forming genes and expression in Drosophila and mammalian embryos. Growth Factors and Signal Cascades BMP, Nodal, Wnt, Notch and Retenoid signaling during gastrulation.

Unit -IV

Introduction to stem cells: Molecular basis of embryonic and adult stem cells. Pluripotency and its application. Cell cycles regulators in stem cells. Epigenetic mechanism of cellular memory, Germ line stem cells and its cloning. Programmed morphogenetic histogenetic cell death (apoptosis). Erythropoiesis, myelopoiesis. Ageing.

List of Recommended books:

1. Developmental Biology (2003) - Gilbert S. F. Sinauer Asso.
2. Principles of Development (2002) - Wolpert L et al., Oxford University Press
3. The Art of the Genes (1999) - How Organisms Make Themselves Coen E. Oxford University Press
4. Genetic Analysis of Animal Development (1993) 2nd ed. - Wilkins A. S., Wiley-Liss
5. Biological Physics of the Developing Embryo (2005) - Forgacs G. & Newman S. A., Cambridge University Press.
6. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Two Volume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells, 2012, Academic Press
7. R. Lanza, J. Gearhart et al (Ed), Essential of Stem Cell Biology, Elsevier Academic press

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M. Sc. (Zoology) – 3rd Semester
ZOO – 303 Environmental Biology (Core Course)

Credits: 4
Time: 3 Hrs.

Marks:100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit-I

Environmental policies at global and national level. Remote sensing and geographic information system: Basic concepts, procedure and Applications. Concept of sustainable development: utility and significance

Unit-II

Environment impact assessment: environmental monitoring different phases and significance. Solid waste management: Primary waste products-Solid waste, toxic biological and hospital landfills, incineration, source reduction and recycling.

Unit –III

Bioremediation, its role and significance. Toxicological risk assessment and management. Principles and significance of systematic toxicology. Genotoxicology. Applications of toxicology anthropogenic activities and environment. Human toxicology and medicinal ethics.

Unit-IV

Environmental Toxicology: Food additives, air, water and soil pollutants. Effect of pollutant on ecosystem with case study of important Organo-phosphorous and Organo-chlorine pesticides, Nitrates, Polychlorinated biphenyls. Clenbutarol. Biodegradation

List of Recommended books:

1. Concepts of Ecology by Edward J. Kormondy; Prentice Hall of India (Pvt) Ltd
2. Fundamentals of Ecology by W.B. Odum, E.P. Saunders. Toppan Co. Ltd., Tokyo, Japan.
3. Ecology by Paul Colin Vaux; John Wiley & Sons, Inc.
4. Environmental Pollution by H.M Dix., John Wiley Publications, New York.
5. Handbook of Solid Waste Management by Wilson, Van Nostrand, Reinhold.
6. Environmental Studies by D.B. Botkin, & E.A. Keller, Martill Publishing Co., Columbus, Toronto, London.
7. Ecology of Natural Resources, Francoid remade, John Wiley & Sons, New York, Singapore.
8. Ecology by Paul Colinvaux; John Wiley & Sons, New York, Chichester, Brisbane, Toronto, Singapore.
9. Applied Ecology and Environmental Management by Edward I. Newman
10. Principle of Environmental Science by W.P. Cunningham & M.A. Cunningham.
11. Environmental Impact Assessment Methodologies by Y. Anjaneyulu.
12. Bioremediation Technology by Fulekar, M.H.
13. Biotransformation: Bioremediation Technology for Health & Environmental Protection by R. D. Stapleton Jr. and V.P. Singh (Ed), Elsevier.
14. Casarett & Doull's Toxicology: The Basic Science of Poisons by Curtis Klaassen

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M. Sc. (Zoology) – 3rd Semester
ZOO –304A – Aquaculture (Core Elective Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

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Unit-I

Freshwater habitat: Types of Freshwater habitats – Lotic and Lentic Waters. Zonation in Lentic habitat. Hydrobiological characteristics – Temperature, penetration of light, turbidity, dissolved gases, pH, biogenic salts etc. Water problems in aquatic and amphibious situations
Ecological classifications of freshwater organisms other than fishes : On the basis of trophic status, On the basis of mode of life – Benthos, Periphyton, Plankton, Nekton and Neuston. On the basis of zonation in lentic and lotic habitats.

Unit-II

Classification of lakes: Trophic classification of lakes – Oligotrophic, eutrophic and dystrophic lakes. Thermal classification of lakes – Forel's and Yoshimura's classifications of lakes. Hutchinson's classification of lakes – Amictic, cold monomictic, dimictic, warm monomictic, oligomictic and polymictic lakes.

Productivity: Concepts of productivity – Biomass, biotic potential, standing crop, carrying capacity, yield, productivity, primary and secondary productivity. Estimation of Primary production – Harvest method, oxygen production method, carbon dioxide assimilation method, radioisotope method, chlorophyll method, disappearance of raw materials and pH method.

Unit-III

Eutrophication: Definitions and types - natural and cultural eutrophication. Causes and impact of eutrophication. Control of eutrophication – Mechanical, Chemical and Biological control.

Bioassay – Terminology, methodology, calculation of LC 50 and EC 50 values and threshold concentrations.

Methods in Field Biology: Methods of estimating population density of animals

Unit-IV

Estuarine Habitat: Characteristics of estuarine habitat. Classification of estuaries. Estuarine fauna – Temporary and permanent. Adaptations of estuarine fauna.

Special Aquatic Habitats: Polar and alpine lakes. Salt lakes. Special stream environment

Ecological succession:

Definitions and types of ecological succession. Succession of animal communities through Hydrarch

List of Recommended books:

1. Jhingran, V.G., *Fish and Fisheries of India*, Hindustan Publishing House (India), New Delhi (1991).
2. *Aquaculture Production*, FAO, Fisheries Circular No.815, No.4, Rev.FAO Rome (1998).
3. Mohan Joseph, M, *Aquaculture in Asia*, Asian Fisheries Society, Mangalore (1990)

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4. Talwar, P.K., & Jhingran, A.G., Inland Fishes of India. Vols.I & II. P.K. Talwar & Jhingran, A.G., Oxford & IBH, New Delhi (1991).
5. Lagler Karl F., *Freshwater Fishery Biology*. Wm.C.Brown Company Publ., Dubuque, Iowa (1969).
6. Bangenal, T., *Methods for Assessment of Fish Production in Freshwaters* 3rd Ed., IBH Handbook No.3 Blackwell Scientific Publication, Oxford (1970).
7. Johal, M.S., and Tandon, K.K., *Monograph on the Fishes of reorganized Punjab*, Parts I & II. Punjab Fisheries Bulletin (1979, 1980).
8. Odum, E.P., *Fundamentals of ecology*, W.B. Saunders Co. Philadelphia (1971).
9. Welch, P.S., *Limnology*, Mcgraw Hill Book Co. New York (1952)
10. Wetzel, R.G., *Limnology*, W.B.Saunders Co. Philadelphia (1983).
11. Hynes, H.B.N., *The Biology of Polluted Waters*, Liverpool Univ. Press, Liverpool (1978).
12. Ruttner, F., *Fundamentals of Limnology*, Univ. Press, Toronto (1975).
13. Tandon, K.K. & Johal, M.S., *Age and growth in Indian Freshwater Fishes*, Narendra Publishing House, Delhi (1995).
14. Johal, M.S., Aggarwal, S.C., *Fishery Development*, Narendra Publishing House, Delhi (1997).
15. Peter B. Moyle & Joseph J. Cedh, *Fishes :An Introduction to Ichthyology*, Prentice - Hall, Inc. Jersey, U.S.A. (1986).

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M. Sc. (Zoology) – 3rd Semester
ZOO –304B – Entomology (Core Elective Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit-I

Salient features with suitable examples of the insect orders - Thysanura, Odonata, Isoptera, Orthoptera, Hemiptera, Coleoptera, Lepidoptera, Hymenoptera and Diptera. Structure and function of the following systems in insects: Digestive System, Respiratory System, Nervous System and Reproductive System.

Unit-II

Post embryonic development and types of metamorphosis in insects. Structural modifications in the larvae & pupae. Parthenogenesis in insects. Effect of temperature and photoperiod on the lives of insects, details of onset, termination and significance of diapause.

Unit-III

Systematic position, habits, nature of damage and outlines of the life cycles of following pests of crops, vegetables & fruits. Plant host-insect interaction. Insect-pest management of useful insects : Silkworm, honeybee, Lac insect.

A. CROPS

Cotton :

- (i) *Pectinophora gossypiella* (Pink boll worm)
- (ii) *Bemisia tabaci* (Cotton white fly)
- (iii) *Dysdercus cingulatus* (Red cotton bug)

Sugarcane

- (i) *Pyrrilla perpusilla* (Sugarcane leaf hopper)
- (ii) *Scirpophaga nivella* (Sugarcane top borer)

Paddy

- (i) *Hieroglyphus banian* (Rice grass hopper)
- (ii) *Leptocorisa varicornis* (Ciundhi bug)

Wheat

- (i) *Tanymecus indicus* (Ghujhia weevil)
- (ii) *Sesamia inferens* (Wheat stem borer)

B. VEGETABLES

- (i) *Dacus cucurbitae* (Pumpkin fruit fly)
- (ii) *Raphidopalpa foveicollis* (Red pumpkin beetle)

C. FRUITS

- (i) *Drosicha mangifera* (Mango mealy bug)
- (ii) *Diaphorina citri* (Citrus psylla)

3. Pests of stored food products with particular reference to their systematic position, habits, nature of damage caused by them along with the outlines of their life cycles :

- (i) *Callosobruchus maculatus* (Pulse beetle)
- (ii) *Sitophilus oryzae* (Rice weevil)
- (iii) *Tribolium castaneum* (Rust red floor beetle)
- (iv) *Sitotroga cerealella* (Angoumois grain moth)

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Unit-IV

Insect control: Chemical control: Categories of pesticides, important examples, their application and mode of action; Insect repellents and attractants. Biological Control: Principles. History, use of parasites, predators and pathogens. Integrated Pest Management (IPM). Principle and practices of Apiculture.

List of Books recommended:

1. General Entomology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, Calcutta, Bombay by M.S. Mani, 1990.
2. The Insects, Structure & Function, English Language Book Society Hodder and Sloughton, G. Britain by R.F. Chapman, 1978.
3. Imms Text Book of Entomology Methuen & Co. Ltd. New York: EP. Dutton & Co INC. by Richards & Davies, 10th edition (1997).
4. Honey bees and their management in India. ICAR Publications by R.C. Mishra, 1995.
5. Agricultural Pests of India and South East Asia by A.S. Attwal, Kalyani Publishers, New Delhi, 1991.
6. Insects and Mites of Crops in India by MRGK. Nair, ICAR, N.Delhi, 1975.
7. Economic and Applied Entomology by Kumar and Nigam. Emkay Publications, Delhi, 2000.
8. Destructive and Useful Insects by Metcalf and Metcalf. McGraw Hill Publications, New York, 1951.
9. Integrated Pest Management by David Dent, Chapman & Hall, London, New York, Madras, 1995.
10. Insect Pheromones and their use in Pest Management by House Sevens and Jones, Chapman Hall, London, New York, Madras, 1998.
11. Beekeepy for Profile and Pleasure. Addison Webb. Agrobios, 2004.
12. Textbook of Applied Entomology: P. Srivastava. Vol.1. Kalyani Publishers, 2005

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M. Sc. (Zoology) – 3rd Semester
Laboratory – V
ZOO – 305 – Pertaining to Theory Papers ZOO-301, 302 (Core Course)

Credits: 4

Marks: 100

Duration of exam: (3+3 hour)

1. Isolation of Genomic DNA.
2. Isolation of RNA.
3. Quantitative analysis of DNA.
4. Restriction digestion of DNA.
5. Ligation of DNA fragments.
6. Molecular weight analysis using agarose gel electrophoresis.
7. Isolation of plasmid DNA.
8. Western blotting.
9. Southern blotting.
10. Preparation of competent cell.
11. To study the different stages of development in frog and chick through permanent slides.
12. To study the spermatogenesis of rat and grasshopper through slides.
13. To prepare the permanent stained slides of developing stages from fertilized egg of hen
14. To study different larvae in invertebrates from permanent slides.
15. To study the larvae of invertebrates (Redia, Cercaria, Arthropod larvae, Glochidium larva) through permanent slides.
16. Study of salivary gland chromosomes of larvae of chironomus/Drosophila from permanent slides.
17. Study of metaphase karyotypes from photographs/permanent slides of Drosophila, grasshopper and man/rat.
18. Study of sex-chromatin Bars body from human buccal mucosa.

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

Suggested Reading Material:

1. Sambrook J, EF Fritsch and T. Maniatis (2000) Molecular Cloning: A laboratory Manual, cold spring Harbor laboratory Press, New York.
2. Glover DM and BD Hames (2006), DNA cloning: A practical Approach, IRL Press, Oxford.
3. Priyanks Siwach and Namita Singh (2007) Molecular Biology, Theory and Practices, Laxmi Publication.
4. Lodish et al., Molecular Cell Biology Freeman and Company 2016.
5. Smith and Wood, Cell Biology, Chapman and Halls 1996
6. Watson et al, Molecular Biology of the gene, Pearson Prentice Hall, USA 2003
7. Sambrook J, EF Fritsch and T. Maniatis (2000) Molecular Cloning: A laboratory Manual, cold spring Harbor laboratory Press, New York.
8. Glover DM and BD Hames (2006), DNA cloning: A practical Approach, IRL Press, Oxford.
9. Priyanks Siwach and Namita Singh (2007) Molecular Biology, Theory and Practices, Laxmi Publication.
10. Lodish et al., Molecular Cell Biology Freeman and Company 2016.

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11. Smith and Wood. Cell Biology. Chapman and Halls 1996
12. Watson et al. Molecular Biology of the gene. Pearson Prentice Hall. USA 2003
13. Developmental Biology (2003) - Gilbert S. F. SinauerAsso.
14. Principles of Development (2002) - Wolpert L et al., Oxford University Press
15. The Art of the Genes (1999) - How Organisms Make Themselves Coen E. Oxford University Press
16. Genetic Analysis of Animal Development (1993) 2nd ed. - Wilkins A. S., Wiley-Liss
17. Biological Physics of the Developing Embryo (2005) - Forgacs G. & Newman S. A., Cambridge University Press.
18. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells. Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells. 2012, Academic Press.
19. R. Lanza, J. Gearhart et al (Ed), Essential of Stem Cell Biology. Elsevier Academic press.

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M. Sc. (Zoology) – 3rd Semester
Laboratory – VI
ZOO – 306 A – Pertaining to Theory Papers ZOO-303 (Core Elective Course)

Credits: 4

Marks: 100

Duration of exam: (3+3 hour)

1. Introduction to various instruments and their working principles used in environment biology laboratory.
2. Detection of coliform for determination of purity of potable water.
3. Determination of total dissolved solids of water.
4. Determination of dissolved oxygen concentration of water sample.
5. Determination of biological oxygen demand (BOD) of sewage sample/Pond/Lake.
6. Determination of chemical oxygen demand (COD) of sewage sample/Pond/Lake.
7. Isolation of Xenobiont degrading bacteria by selective enrichment technique
8. Determination of pH/ TDS (Total dissolved solids). TSS (Total suspended solids) of water sample.
9. Determination of organic carbon/Nitrogen/Phosphorous in soil.
10. Test for the degradation of aromatic hydrocarbon by bacteria.
11. Effect of sulphur dioxide on crop plants.
12. Estimation of nitrate in drinking water.

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

Suggested Reading Material:

1. Environmental Microbiology –A laboratory manual, L.L. Gerba, C.P. and Brendeeke, J.W. (1995) Academic Press, New York.
2. Experiments in Microbiology, Plant Pathology and Biotechnology 4th edition Anuja K.R. (2010) New Age International Publisher –New Delhi.
3. Microbiology –A laboratory manual 4th edition, Cappuccino J. and Sheeman N. (2000) Addison Wesley, California.
4. Microbiology-a laboratory manual 4th edition, Cappuccino J. and Sheeman N (2000) Addison Wesley, California
5. Environmental Microbiology – A laboratory manual. Pepper, L.L.; Gerba, C P and Brendeeke, J.W. (1995) Academic Press, New York

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M. Sc. (Zoology) – 3rd Semester
Laboratory – VI
ZOO – 306B – Pertaining to Theory Papers ZOO-304 (Core Elective Course)

Credits: 4

Marks: 100

Duration of exam: (3+3 hour)

1. Qualitative study of biotic components of aquatic ecosystem.
2. Quantitative study of biotic components of aquatic ecosystem.
3. Study of different types of Phytoplankton (Bacillariophyceae Chlorophyceae, Euglenophyceae & Cyanophyceae).
4. Study of different types of Zooplankton (Protozoa, Rotifera, Cladocera, Copepoda).
5. Study of Benthic fauna.
6. Study of Neuston.
7. Study of Nekton.
8. Study of Macrophytes.
9. Estimation of Nitrates in water.
10. Estimation of Phosphates in water.
11. Estimation of dissolved oxygen by modified winklen method in water.
12. Determination of Primary productivity in an aquatic habitat.
13. Study of impact of Heavy metals on productivity.
14. Identification of the following fishes up to species level of Punjab, Haryana and Himachal Pradesh using already prepared field keys. Noting down their important characters, making sketches, and economic importance of each fish species along with ecological notes: *Notopterus notopterus*, *N. chitala*, *Schizothorax richardsonii*, *plagiostomus*, *Hypophthalmichthys molitrix*, *Cyprinus carpio*, *Ctenopharyngodon idella*, *Puntius*, *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Tor putitora*, *Garra gotyla gotyla*, *Noemechilus botia*, *Botia berdi*, *Mystus seenghala*, *Aorichthys* spp., *Wallago attu*, *Heteropneustes fossilis*, *Channa*, *Mastacembelus armatus*.
15. Study of important deep-sea and hills stream fishes with special reference to various adaptations.
16. Study of hard parts e.g., scales, vertebrae, otoliths and opercular bones for age determination, Calculations of back-calculated lengths using Fraser-Lee, equation. On the basis of available growth data calculation of various growth parameters e.g., annual increment, specific rate of linear growth, growth characteristic, growth constant, calculation of harvestable size and maximum size to be attained by the fish.
17. Study of various exotic fishes introduced in India and their characteristic features
18. Study of different bivalves involved in Pearl Culture.
19. Collection and their identification upto family level of atleast three different species from the pterygote orders prescribed in theory.
20. Identification marks and taxonomic status of insect pests of crops vegetables, fruits and stored products.
21. Dissection of suitable insects for the study of following systems:
 - a. Digestive System
 - b. Nervous System
 - c. Reproductive System
22. Systematic position up to family and ecology of the following medical and veterinary pests
 - a. *Anopheles* b. *Culex* c. *Aedes* D. Blow fly e. Bot fly f Horse fly g. Flesh fly.
23. Introduction to apiculture practices and handling of Beehives

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24. Permanent stained preparation of male and female external genitalia.
25. Study of different types of larvae and pupae with the help of preserved material.

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Suggested Reading Material:

1. Jhingran, V.G., *Fish and Fisheries of India*, Hindustan Publishing House (India), New Delhi (1991).
2. *Aquaculture Production*. FAO. Fisheries Circular No.815, No.4. Rev.FAO Rome (1998).
3. Mohan Joseph, M. *Aquaculture in Asia*, Asian Fisheries Society, Manglore (1990).
4. Talwar, P.K., & Jhingran, A.G., *Inland Fishes of India*, Vols.I & II. P.K. Talwar & Jhingran, A.G., Oxford & IBH, New Delhi (1991).
5. Lagler Karl F., *Freshwater Fishery Biology*, Wm.C.Brown Company Publ., Dubuque, Iowa (1969).
6. Bangenat, T., *Methods for Assessment of Fish Production in Freshwaters* 3rd Ed., IBH Handbook No.3 Blackwell Scientific Publication, Oxford (1970).
7. Johal, M.S., and Tandon, K.K., *Monograph on the Fishes of reorganized Punjab*, Parts I & II. Punjab Fisheries Bulletin (1979, 1980).
8. Odum, E.P., *Fundamentals of ecology*, W.B. Saunders Co. Philadelphia (1971).
9. Welch, P.S., *Limnology*, Mcgraw Hill Book Co. New York (1952)
10. Wetzel, R.G., *Limnology*, W.B.Saunders Co. Philadelphia (1983).
11. Hynes, H.B.N., *The Biology of Polluted Waters*, Liverpool Univ. Press, Liverpool (1978).
12. Ruttner, F., *Fundamentals of Limnology*, Univ. Press, Toronto (1975).
13. Tandon, K.K. & Johal, M.S., *Age and growth in Indian Freshwater Fishes*, Narendra Publishing House, Delhi (1995).
14. *General Entomology*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, Calcutta, Bombay by M.S. Mani, 1990.
15. *The Insects, Structure & Function*, English Language Book Society Hodder and Sloughton, G. Britain by R.F. Chapman, 1978.
16. *Imms Text Book of Entomology* Methuen & Co. Ltd. New York: E.P. Dutton & Co. INC. by Richards & Davies, 10th edition (1997).
17. *Honey bees and their management in India*, ICAR Publications by R.C. Mishra, 1995.
18. *Agricultural Pests of India and South East Asia* by A.S. Attwal, Kalyani Publishers, New Delhi, 1991.
19. *Insects and Mites of Crops in India* by MRGK. Nair, ICAR, N Delhi, 1975
20. *Economic and Applied Entomology* by Kumar and Nigam, Emkay Publications, Delhi, 2000.
21. *Destructive and Useful Insects* by Metcalf and Metcalf, McGraw Hill Publications, New York, 1951.
22. *Integrated Pest Management* by David Dent, Chapman & Hall, London, New York, Madras, 1995.
23. *Insect Pheromones and their use in Pest Management* by House Sevens and Jones, Chapman Hall, London, New York, Madras, 1998.
24. *Beekeeping for Profile and Pleasure*, Addison Webb, Agrobios, 2004
25. *Textbook of Applied Entomology*, P. Srivastava, Vol.I, Kalyani Publishers, 2005

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M. Sc. (Zoology) – 4th Semester
ZOO – 401 – Immunology (Core Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit-I

Introduction: Phylogeny of immune System, innate & acquired Immunity, clonal nature of immune system, primary & secondary lymphoid organs

Cells of Immune System: Haematopoiesis & differentiation, B-lymphocytes, T-lymphocytes, Macrophages, Dendritic Cells, Natural Killer & lymphokine activated Killer Cells, Eosinophils, Neutrophils & Mast Cells, lymphocyte trafficking, humoral & cell mediated immune response.

Unit-II

Immune System: Nature & Biology of antigens & superantigens, Immunoglobulins-structure & functions of different classes, Antigenic determinants (Isotype, Allotype & Idiotype), Antigen-antibody interactions, Antibody engineering, MHC, Antigen processing & presentation, structure of MHC I & II, Genomic organization and MHC polymorphism.

Unit-III

Regulation of Immune Response: Genomic organization and generation of diversity of B-Cell and T-Cell receptors, B-Cell and T-cell Regulation, Antibody dependent cell mediated cytotoxicity & macrophage mediated cytotoxicity, cytokines & their role in immune regulation, Complement system

Unit-IV

Immunological Techniques: Immunoprecipitation reactions, Agglutination reactions, Complement tests, ELISA, RIA, Immunofluorescences.

Immune System in Health & Diseases: Hypersensitive Reactions, Auto immunity, AIDS and other immunodeficiencies.

Text/references books:

1. Immunology, 8th Edition., Goldsby, R.A., Kindt T.J., Osborne B.A. (2012) W H Freedom & Comp, NY.
2. Essential of Immunology, 10th Ed. Riott, Ivon, Delves, Peter (2001) Blackwell Scientific Publications, Oxford.
3. Fundamentals of Immunology; Paul W.E. (Eds.) Raven Press, New York.
4. Immunology – A short course – Eli Benjamini, R Coico, G Sunshine (Wiley-Liss).
5. Immunology – An introduction 5th Edition (2013) Tizard I.R. Philadelphia Saunders College Press.
6. Basic Immunology, Sharon J (1998) Williams and Wilkins, Battimore.
7. Janeway et al., Immunobiology, 8th Edition, Current Biology publications, 2012

M. S. K. S.
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W. S. S.
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M. Sc. (Zoology) – 4th Semester
ZOO – 402 – Molecular Endocrinology (Core Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit-I

Basic concept of endocrinology, its scope and role in molecular biology. Chemical nature of hormones: Amino-acid derived hormones. Peptide hormones. Glyco-protein hormones. Steroid hormones and Prostaglandin. Biosynthesis of peptide hormones, transcriptional and post-transcriptional modifications. Network of extra-cellular and intracellular signals. Role of cell structure in intracellular communication. Prostaglandin structure, type, synthesis and biological activities.

Unit-II

Mechanism of action of peptide hormones; Cell Signaling; concept of second messengers. cAMP, cGMP, Ca⁺⁺, Calmoduline, IP₃, DAG, NO. signal transduction mechanisms. Mechanism of action of steroid hormones; Nuclear receptors, orphan genes and receptors and their role in metabolism and development. Cross talk concept, Heat shock proteins (hsp).

Unit-III

Hormonal regulation of Metabolism: Role of Insulin & Glucagon in regulation of Carbohydrate metabolism. Metabolic regulatory hormones in Lipid & Protein metabolism. Role of Parathyroid Hormone in Ca⁺⁺ & PO₄ regulation. Gastrointestinal hormones and their role in regulation of metabolic activity. Regulatory substances – Erythropoietin, growth factors, Thymus gland & Kinins. Diabetes & Obesity management vis-à-vis life style & Endocrine factors.

Unit-IV

Genetic basis of hormonal disorders. Sequence-specific DNA binding proteins, DNA binding receptor proteins and their role in gene transcription, cell differentiation and cell proliferation. Role of hypothalamus in hormonal control. Anterior pituitary hormones, posterior pituitary hormones; thyroid gland and thyroid hormones, pancreas (insulin and glucagon). Endocrine control of food and fluid intake/obesity calcium regulation, adrenal gland. Reproductive organs and their hormonal control in male and females; estrogen and androgen. Reproductive cycle, parturition and pathologies.

List of Recommended books:

1. Benjamin Lewin, Genes VII, Oxford University Press
2. Lodish et al. Molecular Cell Biology
3. Ethan Bier, The Coiled Spring, Cold Spring Harbor Press

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4. L.P. Freedman. *Molecular Biology of Steroid and Nuclear Hormone Receptors*. Birkhauser.
5. G. Litwack. *Biochemical Actions of Hormones*. Academic Press.
6. *General Endocrinology* by Turner. C.D. and Bagnars, W.B. Saunders Company: 1976.
7. *Comparative Endocrinology of Invertebrates* by Highnam, K.C. and Hill, I. Enwaral Arnold Ltd., London; 1981.
8. *Endocrinology* by Golds -Worthy, G.J. Robinson, J. and Mordue, W. John Wiley and Sons, New York; 1981.
9. *An Introduction to Invertebrates Endocrinology* by Tombes, A.S. Academic Press, New York; 1970.
10. *Comparative Vertebrate Endocrinology* by Bentley, P.J. Cambridge Univ. Press: 1998.
11. *Endocrinology* (4th ed) by. Hadley, M. E. Prentice Hall: 1996.

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Vincent Shuteh
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M. Sc. (Zoology) – 4th Semester
ZOO – 403 – Biosafety, Bioethics and IPR (Core Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit – I

Biosafety and risk assessment issues, regulatory framework, National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, cross border movement of germplasm, risk management issues-containment

Unit – II

General principles for the laboratory and environmental biosafety, health aspects, toxicology, allergenicity, antibiotic resistance etc. Impact on environment, gene flow in natural and artificial ecologies, source of gene escape, tolerance of target organisms, creation of superweeds/superviruses, etc.

Unit – III

Ecological aspects of GMOs and impact on biodiversity, monitoring strategies and methods for detecting transgenics, radiation safety and non-radio isotonic procedure, benefits of transgenics to human health, society and the environment.

Unit – IV

The WTO and other international agreements, intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications etc. protection of plant variety and farmers right act, Indian patent act and amendments, patent filing, convention on biological diversity, implications of intellectual property rights on the commercialization of biotechnology products.

List of Recommended books -

1. Singh BD. 2007. *Biotechnology: Expanding Horizon*. Kalyani publishers.
2. <http://patentoffice.nic.in>
3. www.wipo.org
4. www.dbtindia.nic.in
5. www.dbtbiosafety.nic.in

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Anneela Shukla
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M. Sc. (Zoology) – 4th Semester
ZOO –404A – Biodiversity and Wild Life (Core Elective Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit-I

Biodiversity: concept; Types of biodiversity; national & global status; endemism, speciation and extinction; levels of biodiversity; hotspots and hottest hotspots; Major Diversity regions of India with special reference to Himalaya, Western Ghats, Central India and Indo-Gangetic Plains. Significance of biodiversity and its socio-economic importance, causes of biodiversity depletion, rarity of species, threat value, categories of existence, blue/red data categories.

Unit-II

Zoogeography: Zoogeographical regions and their fauna.
Principles of conservation, objectives, implications, action plans and conservation status in India. Conservation for sustainable use-a holistic approach, major approaches to management.

Unit-III

Strategies for conservation: *In-situ* conservation: International efforts and Indian initiatives; potential areas in India – sanctuaries, national park, biosphere reserves, wetlands and Ramsar convention, *Ex-situ* conservation: Principles and practices. *In vitro* repositories, cryobanks in biodiversity conservation.

Unit-IV

Wildlife of India: Different types with references to animals, causes of depletion, significance and conservation of wildlife.

Wildlife Tourism (Red Data Book, IUCN Categories of wildlife species)

Wildlife Projects: Tiger Project, Crocodile Breeding Project, Hangul project, Gir lion Sanctuary project

List of Recommended books:

1. Techniques for wildlife Census in India by W.A. Rogers (A field manual); Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majumuria; Teepress Services, L.P., 487/12-SOI, Wattenslip, Pratunam Bangkok, 10400, Thailand.
3. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay.
4. Wildlife in India by V.B. Saharia, Natraj Publishers, Dehradun.
5. E.P. Gee, The Wildlife of India.
6. Wildlife in India by Saharia, V.B. Natraj Publ. Dehradun (U.P.).

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7. Wildlife Biology by Raymond F Dasmann, Wiley Eastern Ltd., New Delhi, 1982.
8. Rao, R.R. 1994. Biodiversity in India (Floristic Aspects), Bishen Singh & Mohindra Pal Singh, Dehra Dun.
9. Aggarwal, K.C. 1999. Biodiversity, Agro Botanica, Bikaner.
10. Dhar, U. 1993. Himalayan Biodiversity: Conservation, Strategies, G B. Pant Institute of Himalayan Environment and Development, Kosi, Almorha (Himvikas Publication No. 3).
11. Jeffries, M.J. 1997. Biodiversity and Conservation, Routledge, London & New York
12. Kumar, U. & Asija, M.J. 2000. Biodiversity Principles and Conservation. Agrobios (India)
13. Negi, S.S. 1993. Biodiversity and its conservation in India. Indus Publishing. Co., New Delhi

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Vineela Shukla
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M. Sc. (Zoology) – 4th Semester
ZOO –404B – Parasitology (Core Elective Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit-I

Introduction to Parasitology, different types of animal associations: definitions, Parasitism, Mutualism, Hyperparasitism, Hosts: host types, regular hosts, irregular hosts, intermediate hosts. Parasite Host Specificity: Kinds of parasite host specificity, specificity factors related to infection and growth. Host-parasite interaction.

Unit-II

Parasitic (Morphological and physiological) adaptations: Protozoa, Helminths, Nematodes and Arthropods. Immunity to Parasites: Brief account of immunity to malaria, leishmaniasis, trypanosomiasis, schistosomiasis and ascariasis.

Unit-III

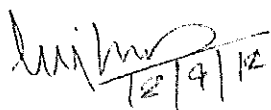
Vectors - Brief account of various insect vectors of human parasitic infections. Parasite Transmission: Introduction, mechanism, circadian rhythm. Zoonosis: viral, rabies, japons encephalitis. Parasitic: Hydatid disease

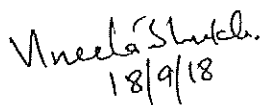
Unit-IV

Ecology of parasites : Ecological niche, host size, and parasite numbus, biological control, evolution of parasitism: Fahrenheit Rule, Szidat Rule, Eichler Rule, origin of parasitism, progressive and retrogressive evolution.

List of Recommended books

1. *Parasitology : The Biology of Animal Parasites*, 5th edition by Noble, E.R. and Noble, G.A., Lea & Febiger, Philadelphia; 1982.
2. *Physiology of Parasites* by Chapell, L.H., Blackie, Glasgow, London; 1979.
3. *Immunology of Infection* by Kaufmann, S., Academic Press; 1999.
4. *An Introduction to Animal Parasitology* by Smyth, J.D., Hodder & Stoughton, London; 1976


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M. Sc. (Zoology) – 4th Semester
ZOO –405A – Biochemistry (Core Elective Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit –I

Biomolecules: An introduction, general structure of biomolecule.

Carbohydrates: Structure, occurrence and biological importance of important monosaccharides, oligosaccharide and polysaccharide. Ring structure and anomeric forms, mutarotation, reactions of monosaccharides, homo and hetero polysaccharides and mucopolysaccharides.

Unit –II

Amino acid and proteins: Structure and properties of amino acids. Essential and nonessential amino acids, peptide bond. Type of proteins and their classification. Forces stabilizing protein structure and shape. Different levels of structural organization of proteins. Structure of hemoglobin and myoglobin.

Unit –III

Lipids: Classification, structure of lipids and their general function. Essential fatty acids. Hydrolysis of fats, saponification value, rancidity of fats iodine number and acid value. Cholesterol-its structure and biological function.

Unit –IV

Nucleic acids: Structure and properties of purine and pyrimidine bases. Nucleosides and nucleotides. Biologically important nucleotides. Double helix model of DNA structure, structural polymorphism of DNA [A, B & Z] and RNA. Biological function of nucleotides.

Vitamins: Structure and biochemical roles of water soluble vitamins and coenzymes.

List of Recommended Books:

1. Lehninger, Principle of Biochemistry, 6th Edition by David L. Nelson and M M Cox [2013] Free and company, New York.
2. Fundamental of Biochemistry, D. Voet and J. G. Voet [2013] John Wiley and Sons New York.
3. Biochemistry 8th Edition by L. Stryer [2015], W.H Freeman and New York
4. Biochemistry 4th edition by G. Zubay [1998] Wm .C Brown Publishers
5. Outline of Biochemistry by Conn E.E, Stumpf P.K, Bruening G and Dav

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M. Sc. (Zoology) – 4th Semester
ZOO –405B – Microbiology (Core Elective Course)

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit –I

History of Microbiology: Discovery of the microbial world. Development of microbiology in the twentieth century. Scope of microbiology.

Microbial Diversity: Prokaryotic and Eukaryotic cells. Morphology and cell structure of major groups of microorganisms e.g. archaea, bacteria, fungi, algae, protozoa and viruses. Classification of viruses, Retroviruses, viroids and prions.

Unit –II

Cultivation and Maintenance of Microorganism: Methods of isolation, purification and preservation of microorganisms. Theory, principles and methods of sterilization.

Concepts of Microbial Nutrition: Culture media, requirement for carbon, nitrogen, phosphorus, sulfur and growth factors. Nutritional categories of microorganisms.

Unit –III

Microbial physiology: Definition of growth. Growth curve and generation time. Mathematical expression of growth. Measurement of microbial growth and factors affecting growth. Synchronous, batch, fed batch and continuous cultures, bacterial endospores.

Bacterial genetics: Transformation, conjugation, transduction, recombination, plasmids and transposons.

Unit –IV

Host-Parasite Relationship: Normal microflora of skin, oral cavity, gastrointestinal tract. Entry of pathogen into the host: colonization and factors predisposing to infections. Types of toxins (exo-, endo- and enterotoxins), their structure and mode of action. Virulence and pathogenesis.

Diseases caused by microbes: Disease reservoirs, Infectious disease transmission. Diseases caused by bacteria and viruses: Tuberculosis, Rabies, Plague, Dengue, Swine flu, Rickettsias, Lyme disease, Malaria, food and water borne human diseases.

List of Recommended Books:

1. Microbiology 9th Revised Ed. Prescott L.M., Harley J.P. (2013) Tata McGraw Hill
2. Microbiology Pelczar Jr., M.J., Chan, E.C.S. (2010) Tata McGraw Hill, New Delhi
3. Brock Biology of Microorganisms 14th Edition, Madigan, M.T., Martinko, J. M. and Parker, J. (2015), Prentice Hall, New Jersey.
4. General Microbiology, Stainer et al. (2003) The MacMillan Press.
5. Tortora, G.J., Funke, B.R., Case, C.L. (2012) Microbiology -An Introduction, 11th Edition, Pearson education Pvt. Ltd. Singapore.

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M. Sc. (Zoology) – 4th Semester
Laboratory – VII
ZOO – 406 – Pertaining to Theory Papers ZOO-401, 402 (Core Course)

Credits: 4

Marks: 100

Duration of exam: (3+3 hour)

1. General Laboratory-safety and Bio-safety measures in immunology laboratory.
2. Introduction to various instruments and their working principles used in immunology laboratory.
3. Blood film preparation and identification of cells
4. Lymphoid organs and their microscopic organization
5. Preparation and administration of antigens.
6. Isolation and purification of Immunoglobulins.
7. Quantification of immunoglobulins.
8. Immunodiagnostics (demonstration using commercial kits)
9. Immunodiffusion techniques:
 - a) Ouchterlony double diffusion
 - b) Radial immunodiffusion.
10. Immuno electrophoresis:
 - a. Counter current Immuno electrophoresis
 - b. Rocket Immuno electrophoresis.
11. Latex agglutination technique.
12. ELISA technique
 - a) Dot ELISA
 - b) Sandwich ELISA
13. To identify the stage of oestrous cycle.
14. To show the endocrine glands in rat through charts/models/video clipping.
15. To study the histology of endocrine glands through permanent stained slides.
16. To study the corrective measures for myopia, hypermetropia, astigmatism, cataract
17. To study the structure of eye, ear and different types of neurons through charts/models

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

Suggested Reading Material:

1. A handbook of Practical Immunology (1983). Edited by G.P. Talwar. Vikas Publishing House Pvt. Ltd. New Delhi-110002.
2. Practical Immunology (1980), Hudson L. and Franks, C.H. Blackwell scientific Publication, Oxford.
3. Fundamental techniques in immunology and serology (2002) Singh A, International Book Distributing Co, Lucknow
4. Current protocols in immunology, (1997). Marjorie, M. John Wiley and sons, Inc USA

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5. Handbook of experimental immunology (1986). Bewesly, P. Blackwell Scientific publications, London.
6. Benjamin Lewin, Genes VII, Oxford University Press.
7. Lodish et al. Molecular Cell Biology.
8. Ethan Bier. The Coiled Spring, Cold Spring Harbor Press.
9. L.P. Freedman. Molecular Biology of Steroid and Nuclear Hormone Receptors. Birkhauser
10. G. Litwack. Biochemical Actions of Hormones, Academic Press.
11. *General Endocrinology* by Turner, C.D. and Bagnars. W.B. Saunders Company; 1976.
12. *Comparative Endocrinology of Invertebrates* by Highnam, K.C. and Hill, L. Enwaral Arnold Ltd., London; 1981.
13. *Endocrinology* by Golds -Worthy, G.J. Robinson, J. and Mordue. W. John Wiley and Sons. New York; 1981.
14. *An Introduction to Invertebrates Endocrinology* by Tombes, A.S. Academic Press. New York; 1970.
15. *Comparative Vertebrate Endocrinology* by Bentley, P.J. Cambridge Univ. Press; 1998.
16. *Endocrinology* (4th ed) by Hadley, M. E. Prentice Hall; 1996.

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M. Sc. (Zoology) – 4th Semester
Laboratory – VIII

ZOO – 407 A – Pertaining to Theory Papers ZOO-404 A, 405 A (Core Elective Course)

Credits: 4

Marks: 100

Duration of exam: (3+3 hour)

1. To study the distribution of animals through zoogeographical maps.
2. A visit to a zoological park to study different wild animals and make a report.
3. To estimate the alkalinity of water.
4. To estimate the chlorides of water.
5. To estimate the nitrates of water.
6. To study the different types of phytoplankton.
7. To study the different types of zooplankton.
8. Introduction to various instruments and their working principles used in biochemistry laboratory.
9. Qualitative estimation of amino acid and protein
10. Qualitative estimation of lipids
11. Qualitative estimation of carbohydrates.
12. Quantitative estimation of protein by Lowry's method.
13. Determination of total soluble sugars by ferricyanide method. (Volumetric procedure)
14. Separation of various components in the different lipid fraction by thin layer chromatography.
15. To measure the activity of enzyme (alpha amylase)/ any other.
16. To study the effect of temperature on enzyme activity.
17. To study the effect of substrate conc. on enzyme activity.

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

Suggested Reading Material:

1. Techniques for wildlife Census in India by W.A. Rogers (A field manual): Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majumuria; Teeprass Services, L.P., 487/42-SOI-Wattenslip, Pratunam Bangkok, 10400, Thailand
3. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay
4. Wildlife in India by V.B. Saharia. Natraj Publishers, Dehradun
5. Wildlife in India by Saharia, V.B. Natraj Publ. Deharadun (U.P.)
6. Wildlife Biology by Raymond F Dasmann, Wiley Eastern Ltd., New Delhi, 1982
7. Experiments in Microbiology, Plant Pathology and Biotechnology -III Edition Aneja, K.R. (2010) New Age International Publishers, New Delhi.
8. Introductory practical biochemistry by S. K. Sawhney and Randhir Singh (2000)- Narosha Publishing House, New Delhi.
9. Principles and techniques of practical biochemistry by K. Wilson and Wolker (1994) Cambridge University Press, Cambridge.
10. An introduction to practical biochemistry by David T. Plummer (1988) Tata McGraw Hill, Book Company, U.K

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M. Sc. (Zoology) – 4th Semester
Laboratory – VIII

ZOO – 407 B – Pertaining to Theory Papers ZOO-404 B, 405 B (Core Elective Course)

Credits: 4

Marks: 100

Duration of exam: (3+3 hour)

1. To study the protozoans and helminth parasites infecting frog, toad and common household insects through slides/charts.
2. To study the helminth parasites infecting gut of the sheep and goat obtained from slaughter house.
3. To study the parasites from stained blood smears - *Leishmania*, *Plasmodium* and *Trypanosoma*.
4. To study the vectors of different parasitic infections (Mosquito, ticks, sand-fly etc).
5. Introduction to various instruments and their working principles used in microbiology laboratory.
6. Microscopy: Care, handling and use of microscopes
7. Micrometry: Calibration, microscopic measurement of microorganisms.
8. Staining methods
9. Preparation of liquid and solid culture media for growth of microorganisms.
10. Pure Culture Techniques: Streak plate, pour plate, spread plate. Preparation of slants and stab cultures. Storage of microorganisms
11. Isolation and enumeration of microorganisms from soil and water.
12. Measurement of microbial growth and study of effect of various factors on growth of microorganisms: temperature, pH, U.V. and carbon and nitrogen sources on growth
13. Biochemical characterization of selected microbes.
14. Milk Microbiology-SPC, testing the quality of milk using MBRT test.

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

Suggested Reading Material:

1. Parasitology : The Biology of Animal Parasites. 5th edition by Noble, E.R. and Noble, G.A., Lea & Febiger, Philadelphia; 1982.
2. Physiology of Parasites by Chapell, L.H., Blackie, Gloggow, London; 1979.
3. Immunology of Infection by Kaufmann, S., Academic Press; 1999.
4. An Introduction to Animal Parasitology by Smyth, J.D., Hodder & Stoughton, London; 1976.
5. Experiments in Microbiology, Plant Pathology and Biotechnology 4th Edition Aneja, K.R. (2010) New Age International Publishers, New Delhi.
6. Microbiology-a laboratory manual 4th edition, Cappuccino J. and Sheeman N. (2000) Addison Wesley, California.
7. Environmental Microbiology A laboratory manual, Pepper, I.L., Gerba, C.P. and Brendecke, J.W. (2015) Academic Press, New York.
8. Introductory practical biochemistry by S. K. Sawhney and Randhir Singh (2000)- Narosha Publishing House, New Delhi.

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