

## Proceedings of the online/offline meeting of Post-Graduate Board of Study

Siddharth University, Kapilvastu, Siddharth Nagar, U.P.

Subject: Zoology

Date: 18/06/2022

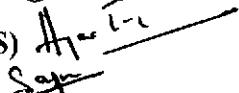
An online/Offline meeting of Board of Studies of Zoology subject was held on 18/06/2022 at 02: 00 PM under the chairmanship of Dr. Susmita Srivastav, Convenor BoS to Design the Pre Ph.D syllabus (according to new education policy-2020). Following members of the BoS were present in this meeting:

### Offline Attendee

1. Dr. Susmita Srivastav (Convenor, BoS) 

2. Prof. Vijay Bahadur Upadhyay (External Subject Expert, BoS) 

3. Prof. Rajendra Singh (External Subject Expert, BoS) 

4. Prof. Aja Kumar Srivastav (Special Invitee Member, BoS) 

5. Dr. Sapna Rani (Member, BoS) 

7. Dr. Vineeta Rawat (Special Invitee Member, BoS) 

### Online Attendee

1. Prof. Madhu Tripathi (External Subject Expert, BoS)


2. Dr. Rajendra Singh (Special Invitee Member of BoS)

3. Mr. Dharmendra Singh (Member, BoS)

4. Dr. Ashish Srivastava (Special Invitee Member, BoS)

The BOS meeting comprehensively discussed the Pre Ph.D Course (CBCS) Syllabus and recommended. The BOS submitted it to university for further necessary action.

Enclosure: The final Syllabus of Zoology

  
(Dr. Susmita Srivastav)  
Convenor

Board of Studies (Post -Graduate Zoology)  
Siddharth University, Kapilvastu,  
Siddharth Nagar, U.P.

# SIDDHARTH UNIVERSITY, KAPILVASTU SIDDHARTH NAGAR



## DEPARTMENT OF ZOOLOGY

### Pre-Ph.D. Course work in Zoology

#### Syllabus Developed and desgined by

Sr.No.	Name of Expert/BOS Member	Designation	Department	College/ University
1	Dr. Susmita Srivastav	Convener	Department of Zoology	Shiv Harsh Kisan P.G. College, Basti
2	Dr. Sapna Ram	Member	Department of Zoology	Shiv Harsh Kisan P.G. College, Basti
3	Mr. Dharmendra Singh	Member	Department of Zoology	Shiv Harsh Kisan P.G. College, Basti

#### Invited Members

1	Dr. Ashish Srivastava	Invited Member	Department of Zoology	Siddharth University, Kapilvastu , Siddharthnagar
2	Dr. Vineeta Rawat	Invited Member	Department of Zoology	Siddharth University, Kapilvastu, Siddharthnagar

#### External Subject Expert

1	Prof. V. B. Upadhyay	Rtd. Prof. & Expert	Department of Zoology	DDU University Gorakhpur
2	Prof. Rajendra Singh	Rtd. Prof & Expert	Department of Zoology	DDU University Gorakhpur
3	Prof. Madhu Tripathi	Rtd. Prof & Expert	Department of Zoology	Lucknow University Lucknow

#### Special Invitee Subject Expert

1	Prof. Ajai K. Srivastav	Rtd. Prof & Expert	Department of Zoology	DDU University Gorakhpur
2	Dr. Rajendra Singh	Subject Expert	Department of Zoology	Bareilly College, Bareilly

**DEPARTMENT OF ZOOLOGY  
FACULTY OF SCIENCE**

**Course Work for Ph. D. Zoology Students**

Every student admitted in Ph. D. Zoology programme, will be required to pass a course work of 16 credits. The course work has been divided into three papers. Paper-I (4 credits) is *compulsory* for all Ph. D. students. Paper-II (6-credits) is *discipline-specific course* is also compulsory for all Ph.D. students and Paper-III (6 credits) is *research theme-elective course*.

Course Nature	Course Code	Core Courses	Credit
<b>General Compulsory Course</b>			
Compulsory Course	ZTHC 601	Research Methodology	04
			<b>Credits</b> 04
<b>Discipline-specific Compulsory course</b>			
Discipline Specific Compulsory Course	ZTHC 602	Biostatistics, Bioinstrumentation and Bioinformatics	06
			<b>Credits</b> 06
<b>Open Elective Course (Any one of the following)</b>			
Research Theme-Elective Courses	ZTHE 603A	Fish Morphology and Physiology	06
	ZTHE 603B	Fish Reproduction, Breeding and Biotechnology	06
	ZTHE 603C	Molecular Genetics	06
	ZTHE 603D	Genomics	06
	ZTHE 603E	Endocrinology	06
	ZTHE 603F	Entomology	06
	ZTHE 603G	Agricultural Entomology	06
	ZTHE 603H	Recent trends in Biochemistry I	06
	ZTHE 603I	Recent trends in Biochemistry II	06
	ZTHE 603J	Techniques in Animal Sciences	06
	ZTHE 603K	Advances in Toxicology	06
	ZTHE 603L	Biodiversity and its Conservation	06
	ZTHE 603M	Molecular Basis of Human Diseases	06
	ZTHE 603N	Drug and Gene Delivery Systems	06
	ZTHE 603O	Parasitology	06
			<b>Credits</b> 06
		<b>Total Credits</b>	16

**PAPER I**  
**GENERAL COMPULSORY PAPER**  
**RESEARCH METHODOLOGY**

**Course Code: ZTHC 601**

**Credits: 04**

**Unit-I**

Research in biological science; problem, identification, objective and significance, scope and limitations; problem and challenges in the biological research; Synopsis: Preparation, introduction of problem, importance of literature survey, importance and designing of the problem to be undertaken, use of journals, books, internet for literature survey, referencing.

**Unit-II**

Sampling design, data collection and analysis, creativity, innovations, originality, advancement and application to the society, Research ethics: Ethical issues in research; IPR; biosafety and bioethics.

**Unit-III**

Preparation of proper research proposal, progress report and the writing of research paper; layout, chapter writing, plagiarism, communication skills, review of published research; Report writing, Presentation: organizing conferences, symposia, workshops, seminars, exhibitions, etc.

**Unit-IV**

Fundamentals of computer and its application for research, word and excel, data and graphical processing, use of web tools for research, use of graphical software and multimedia tools; Legal, social and scientific issues in biological research; A brief idea about the funding agencies such as DST, DBT, ICAR, ICMR, CSIR and UGC.

**Suggested readings:**

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International, 418p.
3. Day, R.A., 1992. How to write and publish a scientific paper, Cambridge University Press.
4. Fink, A., 2009. Conducting Research Literature Reviews: From the internet to paper. Sage Publications.
5. Satarkar, S.V., 2000. Intellectual property rights and copyright. EssEss Publications.
6. Saxena, V.P., 2013. Lecture Notes on Research Methodology. Indra Publishing House.
7. Introduction to Computer Science, ITL Education Solutions, Pearson Education.
8. P. K. Sinha and Priti Sinha, Computer Fundamentals, BPB Publications.

21

**PAPER II**  
**DISCIPLINE SPECIFIC COMPULSORY COURSE**  
**BIostatISTICS, BIOINSTRUMENTATION AND BIOINFORMATICS**

Course Code: ZTHC 602

Credits: 06

**Unit I**

Collection and classification of data, Graphical presentation of qualitative and quantitative data (Bar diagram, Pie diagram, Histogram, Frequency polygon, frequency curve and ogive and box plot) Measures of central tendencies (mean, median and mode), measures of dispersion (variance and standard deviation), concept of coefficient of variation, skewness and kurtosis Correlation and regression (linear and curvilinear), concept of coefficient of determination.

**Unit II**

Concept of probability Hypothesis Testing and estimation: Fundamentals of hypothesis testing- Standard error point and interval estimates-Important non-parametric tests, Definitions and applications of Chisquare test, 't' and 'f' test Analysis of variance: one way and multiple comparison.

**Unit III**

Microscopy: Basic principle and types: Fluorescence microscopy, Confocal microscopy and Electron microscopy Homogenization, Centrifugation - Principles, Types and Methods (RIA, ELISA) Chromatography - Principle and applications, Gel filtration and affinity chromatography, GLC, HPLC Electrophoresis - Principle and applications, PAGE (native, denaturing and 2D), Agarose gel electrophoresis.

**Unit IV**

Visible and UV spectroscopy, Autoradiography and X-ray diffraction Imaging techniques PET, CAT, MRI, fMRI Basic concepts of Genetic Engineering and Biotechnology - PCR & BLOT Techniques.

**Unit V**

Cell culture techniques: Primary and secondary culture, Cell lines and their maintenance, Cryopreservation Detection of gene expression at cellular level, Hybridization based: In situ hybridization, Antibody based: Immunocytochemical detections Pre-requisites of a model system; in vitro systems Prokaryotic model organisms; Bacteria and Phages Eukaryotic model organisms; Yeast, C. elegans, Drosophila, Xenopus, Echinus, Zebra fish Animal handling.

**Unit VI**

Introduction to data archiving systems: FASTA format, Accession, and GI-Number Databases, search and retrieval: NCBI, Swiss-prot, PIR, PDB, KEGG, PubMed Concept of homology: BLAST, Clustal-X and their applications, Genbank Protein structure bioinformatics: Protein visualization, structure comparison, homology modeling.

**Suggested Readings:**

1. Bruning & Kintz, 1977, Computational Handbook of Statistics, Scott
2. Sadasivam and A. Manickam, 2005. Biochemical Methods. New Age International Private Ltd., New Delhi.
3. Pears (1993) Histochemistry: Theoretical & Applied (Vol I, II, III). Churchill-Livingstone
4. Wilson & Walker (2006). Principles of Biochemical and Molecular Biological Techniques. Cambridge Univ.
5. Sambrook et al (2001) Molecular Cloning: A Laboratory Manual (Vol I, II, III) CSHL
6. Barnes & Gray, 2003, Bioinformatics for Geneticists. Wiley
7. Campbel, 2006, Discovering Genomics, Proteomics and Bioinformatics. LPE
8. Hunt & Livesey, 2006, Functional Genomics. Oxford
9. Lesk, 2006, Bioinformatics 2/e. Oxford
10. Mount, 2006, Bioinformatics 2/e. CBS
11. Westhead et al, 2003, Bioinformatics Instant Notes. Viva Books (Indian ed)
12. Daniel, 2000, Biostatistics: A Foundation for Analysis in Health Sciences, John Wiley.
13. Milton & Tsokos, 1983, Statistical Methods in the Biological and Health Sciences, McGraw Hill
14. Quinn & Keough, 2002, Experimental Design and Data Analysis for Biologists, Cambridge Univ

15. Rastogi, 2008, Fundamentals of Biostatistics, ANE Books
16. Sharma, 2008, Text Book of Biostatistics-I&II, Discovery Publishing
17. Snedecor & Cochran, 1968, Statistical Methods, Oxford & IBH
18. Sokal & Rohlf, 2000, Biometry, Freeman.
19. Steel & Torrie, 1980, Principles and Procedure of Statistics: A Biometrical Approach, McGraw Hill Book Co.
20. Zar, 2003, Biostatistical Analysis, Pearson 20. Boyer, 2005, Modern Experimental Biochemistry and Molecular Biology, Benjamin

**PAPER III**  
**RESEARCH THEME-ELECTIVE COURSES**

**Course Code: ZTHE 603 A**

**Credits: 06**

**Fish Morphology and Physiology**

**Unit I**

Integument: Epidermis: Mucogenic, Keratinized

**Unit II**

Dermis: General organization, Scales, Chromatophores

**Unit III**

Respiration Aquatic respiration: Gills, Mechanisms of respiration, Counter current principle, Water flow across the gills, Respiratory pump, Pump musculature and skeleton, Gas exchange Air-breathing: Accessory respiratory organs and respiratory epithelium, Physiological adaptation in airbreathing fishes, Transport of respiratory gases

**Unit IV**

Digestion: Alimentary canal and its modifications in relation to food and feeding habits, Digestive fluids and enzymes, Digestion and absorption of lipids, proteins and carbohydrates, Gastrointestinal motility control.

**Unit V**

Swim bladder: General organization and circulation, Composition of swim bladder gas, its secretion and maintenance, Removal of gas from swim bladder, Functions of swim bladder

**Unit VI**

Circulation, Heart and aortic arches, Regulation of cardiac activity, Hemodynamics, Cardiac output, Circulation time, Blood pressure, Fish hemoglobin.

**Suggested Readings:**

1. Bond, C.E., Biology of Fishes, Saunders College Publishing Philadelphia, 1979
2. Brown, M.E., The Physiology of Fishes Vol. I & II. Academic Press, 1953 & 1957.
3. C.I.F.R.I., Prawn Fisheries Bulletin No. 10, 1977.
4. Datta-Munshi, J.S. & Hughes G. M., Air-breathing fishes of India, Oxford and IBH Publ. Co. New Delhi, 1992.
5. Evans, D.H., The Physiology of Fishes, CRC Press, 2006
6. Hoar W.S. & Randall, D. J., Fish Physiology, Series Vol. I - XIV, Academic Press.
7. Hughes, G. M. (1967) Comparative Physiology of Vertebrate Respiration, Heinemann Educational Books Ltd.
8. Khanna S. S. and H. R. Singh. 2003 A textbook of Fish Biology and Fisheries, Narendra Publishing House.
9. Lagler, K. F., Bardach J.E., Miller R.R. and May Passino, D.R. Ichthyology, John Wiley, 2003.
10. Nilsson, S. & Holmgren, S., Fish Physiology Recent Advances, Croom Helm, London, 1986.
11. Singh, B. R. Advances in Fish Research, Vol. I, II and III (Ed. Munshi J.S.D.) Narendra Publishing House, Delhi 1993 and 1997.
12. Gupta S.K. and Gupta, P.C. General and Applied Ichthyology (Fish and Fisheries), S. Chand & Co., New Delhi



## Fish Reproduction, Breeding and Biotechnology

### Unit I

Functional morphology of gonads: General organization of gonad, Oogenesis and spermatogenesis, Vitellogenesis and its hormonal regulation.

### Unit II

Final oocyte maturation, Role of environmental factors on gonad maturation, Gonadal steroidogenesis and its control.

### Unit III

Role of hypothalamo-hypophyseal hormones in reproduction, Reproductive behaviour and pheromones, Types and mode of reproduction, Secondary sexual characters, Bisexuality and hermaphroditism.

### Unit IV

Induced breeding, Factors responsible for induced breeding, Use of different synthetic and natural hormones, their formulation and mechanism of action, Bundh Breeding, Hapa Breeding, Hatchery Breeding.

### Unit V

Multiple breeding of carps, In vitro fertilization and incubation, Fish seed collection, transport of brood fish and fish seed, Fundamentals of fish genetics.

### Unit VI

Fish Biotechnology, Gynogenesis, Androgenesis, Polyploidy & sterile fish, Production of monosex population, Hybridization, Cryo-preservation of gametes and embryo, Transgenic fish, sex reversal.

### Suggested Readings

1. Brown, M.E., The Physiology of Fishes Vol. I, II. Academic Press, 1953 & 1957
2. Evans, D.H., The Physiology of Fishes, CRC Press, 2006
3. Hoar W.S. & Randall, D. J., Fish Physiology, Series Vol. I - XIV, Academic Press.
4. Gupta S.K. and Gupta, P.C. General and Applied Ichthyology (Fish and Fisheries)
5. S. Chand & Co., New Delhi Lakra, Abidi Mukherjee and Ayyappan (2004) Fishery Biotechnology, Narendra Pub. House, Delhi

*SN*



## Molecular Genetics

### Unit I

Eukaryotic chromatin structure and chromosome organization, classes of DNA, chromosomal proteins: histones and their modifications, non-histone proteins, scaffold/matrix proteins, Levels of chromatin condensation at interphase and metaphase stages.

### Unit II

Nuclear matrix and organization of interphase nucleus, centromere, kinetochore and telomere. human cytogenetics and genetics, karyotype and nomenclature of metaphase chromosome bands.

### Unit III

Types of chromosome anomalies, chromosome anomalies and disease, pedigree construction, inheritance patterns and risk assessment.

### Unit IV

Mendel's laws and their chromosomal basis, methods of gene mapping, three-point test cross in *Drosophila*, gene mapping in bacteria by conjugation, transformation and transduction.

### Unit V

Gene mutation: types of gene mutations, methods for detection of induced mutations, Pelement insertional mutagenesis in *Drosophila*, nature of the gene and its functions.

### Unit VI

Evolution of the concept of gene, fine structure of gene (rII locus), introduction to gene regulation in eukaryotes.

### Suggested Readings

1. Alberts et al, 2008, *Molecular Biology of the Cell*, Garland.
2. Becker et al, 2009, *The world of Cell*, Pearson.
3. Brooker, 1999, *Genetics: Analysis and Principles*, Addison-Wesley.
4. Futuyma, 2005, *Evolution*, Sinauer.
5. Gardner et al, 2006, *Principles of Genetics*, John Wiley.
6. Gilbert, 2006, *Developmental Biology*, Sinauer.
7. Griffith et al, 2005, *Modern Genetic Analysis*, Freeman.
8. Hall & Hallgrímsson, 2008, *Strickberger's Evolution*, Jones & Bartlett.
9. Hartl & Jones, 2009, *Essential Genetics: A Genomic Perspective*, Jones & Bartlett.
10. Hartl & Clark, 2007, *Principles of Population Genetics*, Sinauer.
11. Hedrick, 2005, *Genetics of Populations*, Jones & Bartlett.
12. Karp, 2007, *Cell and Molecular Biology*, John Wiley & Sons.
13. Klug et al, 2009, *Concepts of Genetics*, Pearson.
14. Lewin, 2011, *Genes X*, Jones & Bartlett.
15. Lewis, 2007, *Human Genetics*, WCB McGraw.
16. Lodish et al, 2008, *Molecular Cell Biology*, Freeman.
17. Mange and Mange, 1999, *Basic Human Genetics*, Sinauer.
18. Pollard & Earnshaw, 2002, *Cell Biology*, Saunders.
19. Rooney, 1987, *Human Cytogenetics*, Oxford.
20. Russell, 2002, *Genetics*, Benjamin Cummings.
21. Snustad & Simmons, 2010, *Principles of Genetics*, John Wiley.
22. Strachan & Read, 2011, *Human Molecular Genetics*, Wiley.
23. Wolpert, 2002, *Principles of Development*, Oxford.

BL

## Genomics

### Unit I

Diversity of genomes: overview of pro- and eukaryotic genomes, modes of genomic innovations

### Unit II

Mutations, gene duplication: gene families, pseudogenes, transposable elements, horizontal transfer of genomes, genomic expression analysis

### Unit III

Concepts and methods of transcriptome and proteome analysis, applications in human disease, Epigenetic memory and imprinting

### Unit IV

Genetic basis of sex determination, regulation of gene expression: Transcriptional regulation: nuclear architecture, chromatin remodelling, non-coding RNA, micro-RNA network

### Unit V

Post transcriptional regulation: splicing, alternative splicing, trans-splicing, RNA editing, mRNA stability

### Unit VI

Post translational processing: Protein folding and molecular chaperons, protein processing, and protein degradation

## Suggested Readings

1. Brown, 2007, Genomes, Bios.
2. Connors & Smith, 1994, Essentials of Medical Genetics, Blackwell.
3. Glick & Pasternak, 1994, Molecular Biotechnology, ASM Press
4. Gregory, 2006, The Evolution of the Genome, Elsevier.
5. Hartl, 2006, Essential Genetics: A Genomic Perspective, Jones Blackett.
6. Howley & Mori, 1999, The Human Genome, Academic.
7. Jorde et al., 2003, Medical Genetics, Elsevier.
8. Lewin, 2011, Genes X, Jones & Barlett
9. Primrose & Twyman, 2006 Principles of Gene manipulation and Genomics, Blackwell.
10. Sambrook et al., 2001, Molecular Cloning, vols 1-3, CSHL Press.
11. Strachan & Read, 2011, Human Molecular Genetics, Wiley.
12. Watson et al., 2004, Molecular Biology of the Gene, Pearson Education.

ON

## Endocrinology

### Unit I

Synthesis of mechanism of hormone action: protein hormones, membrane receptors, Gproteins, Cyclic AMP signalling cascade, PKC signalling pathway, tyronine kinase pathway, nitric oxide signalling pathway steroid hormones (genomic and nongenomic pathways).

### Unit II

Hypothalamo-hypophysial system: general organization, neurohypophysial octapeptides (oxytocin and vasopressin), adenohypophysial hormones: chemistry and physiological roles of: somatotropin and prolactin, glycoprotein hormones (FSH, LH and TSH), proopiomelanocortin (ACTH, MSH, LPH and endorphin) neural control of adenohypophysis

### Unit III

Thyroid hormones: biosynthesis, control of secretion and physiological roles, steroid hormones: biosynthetic pathways

### Unit IV

Role of parathyroid hormone, calcitonin and vitamin D in calcium homeostasis, Endocrine pancreas: biosynthesis and physiological actions of insulin and glucagon pineal gland: pineal, biological clock and calendar, melatonin and photoperiodic measurement

### Unit V

Adrenal: organization, control of mineralocorticoid and glucocorticoid hormones, physiological role of glucocorticoids and mineralocorticoids, catecholamine: biosynthesis, release and physiological role

### Unit VI

Testis: organization and physiological roles of androgens, Ovary: organization and physiological roles of estrogen, progesterone, relaxin and inhibin.

### Suggested Readings

1. Bentley, 1998, Comparative Vertebrate Endocrinology, Cambridge University Press.
2. Chester-Jones et al, 1987, Fundamentals of Comparative Endocrinology, Plenum Press.
3. Gorbman et al, 1983, Comparative Endocrinology, John Wiley.
4. Norris, 2007, Vertebrate Endocrinology. 4th Edition, Elsevier.
5. Schreibman & Pang, 1985, Vertebrate Endocrinology, Vol I-IV, Fundamentals & Biomedical Implications, Academic Press.
6. Hadley, 2000, Endocrinology, International Edition, Prentice Hall.
7. Brooks and Marshall, 1995, Essentials of Endocrinology, Blackwell Science.
8. Turner and Bagnara, 1984, General Endocrinology, Saunders.
9. Larson, 2002, Williams Textbook of Endocrinology, 10th Edition, Saunders.

BL

## Entomology

### Unit I

Introduction, origin and evolution of insects. Outline classification of class Insecta.

### Unit II

Integumentary system: structure, function and formation, growth, moulting and metamorphic development, hormonal influence, sclerotization.

### Unit III

Digestive and excretory system: alimentary tract, digestive and excretory physiology Nervous and endocrine system: insect hormones- with reference to metamorphosis & reproduction, components of the nervous system, sensory receptors, vision & acoustics.

### Unit IV

Circulatory and respiratory system: circulatory system, haemolymph, haemocytes, immunity and thermoregulation; tracheal system and mechanism of gas exchange Reproductive system: female & male reproductive systems; usual and unusual modes of reproduction.

### Unit V

Insect pests of crops, major pests of the following crops, their life cycles, nature of damage caused and pest management: paddy, pulses, cotton crops, vegetables, fruits and stored grain, polyphagous insect pest: locusts, termites, gram pod borer, aphids.

### Unit VI

Environmental impact of insecticides, insect resistance to insecticides and resurgence, effect on non-target animals.

### Suggested Readings

1. Advances in Insect Physiology, 1986-2001, Vols. 1-28, Academic Press.
2. Chapman, 1998, The Insects: Structure and Function, 4th edition, ELBS.
3. Gilbert et al., 2005: Comprehensive Molecular Insect Science, Volume 1- 7, Elsevier.
4. Gillot, 1995, Entomology, 2nd edition, Plenum Press.
5. Gullan & Cranston, 2000, The Insects: An Outline of Entomology, 2nd edition, Blackwell.
6. Gupta, 1979, Insect Hemocytes, Cambridge University Press.
7. Imms, 1997, A General Text Book of Entomology, 2 volumes, Asia Publishing House.
8. Kerkut and Gilbert, 1985, Comprehensive Insect Physiology, Biochemistry and Pharmacology, Volumes 1-13, Pergamon.
9. Klowden, 2002, Physiological Systems in Insects, Academic Press.
10. McGavin, 2001, Essential Entomology, Oxford Univ. Press.
11. Rockstein, 1978, Biochemistry of Insects, Academic Press.
12. Wigglesworth, 1972, Principles of Insect Physiology, ELBS.

AL

## Agricultural Entomology

### Unit I

Insect - plant interactions, herbivory, leaf chewing, plant mining and boring, sap sucking, gall formation, seed predation.

### Unit II

Insect feeding preference and host-plant selection, plant toxins and their effect on insects, insects and plant reproductive biology, pollination, myrmecochory, host-plant resistance.

### Unit III

Ground-dwelling insects, insect-fungal interactions, fungus farming by leaf-cutter ants, fungus cultivation by termites; Environmental monitoring using aquatic insects Unit IV Sericulture, Apiculture, Lac culture.

### Unit V

Major insect pests of the following crops, their life cycles, nature of damage caused and pest management: paddy, pulses, cotton crops, vegetables, fruits and stored grain; Polyphagous insect pest: locusts, termites, gram pod borer, aphids.

### Unit VI

Environmental impact of insecticides, insect resistance to insecticides and resurgence.

### Suggested Readings

1. Alford, 1999, A textbook of Agricultural Entomology, Blackwell.
2. Atwal, 1986, Agricultural pests of India and South-East Asia, Kalyani Publishers.
3. Dhaliwal and Arora, 1996, Principals of Insect Pest Management, National Agncultural Technology Information Centre, Ludhiana
4. Dhaliwal and Arora, 1994, Trends in Agricultural Insect Pest Management, Commonwealth Publ.
5. Gillot, 1995, Entomology, 2nd Edition, Plenum Press
6. Gullan & Cranston, 2000, The Insects: An Outline of Entomology, 2nd Edition, Blackwell
7. Harborne, 1993, Introduction to Ecological Biochemistry, 4th Edition.
8. Hill, 2002, Pest of Stored Foodstuffs and Their Control, Springer
9. Singh, R. 2012. Elements of Entomology. Rastogi Publication.

DJ

## Recent Trends in Biochemistry-I

### Unit I

Nucleic acids, analysis of chromatin organization, promoter analysis and characterization.

### Unit II

Post-transcriptional regulation, epigenetic regulation of gene expression.

### Unit III

Proteins, purification and characterization of proteins, structure-function relationship.

### Unit IV

Proteins of immune system and their applications, receptors and cell signaling.

### Unit V

Enzymology, applications of enzyme kinetics, enzyme distribution, diversity and evolution.

### Unit VI

Principles and applications of enzyme assay, enzyme technology.

### Suggested Readings

1. Watson et al., 2008, Molecular Biology of the Gene, 6th Edition, Cold Spring Harbor
2. Brown, 2006, Genomes, 3rd Edition, Garland Science)
3. Krebs et al, 2011, Lewin's Gene X, Jones & Bartlett
4. Lodish et al, 2008, Molecular Cell Biology, 6th Edition, Freeman
5. Sambrook & Russel, 2001, Molecular Cloning: A Laboratory Manual, 3rd Edition, and Cold Spring Harbor.
6. Zubay et al, 1998, Biochemistry, 4th Edition, WCB.
7. Voet & Voet, 2004, Biochemistry, 4th Edition, John Wiley.
8. Berg et al., Biochemistry, 6th Edition, Freeman.
9. Rawn, 1989, Biochemistry, Neil Patterson.
10. Kindt et al., 2007, Kuby's Immunology, 6th Edition, Freeman
11. Price & Stevens, 1988, Fundamentals of Enzymology, 2nd Edition, Oxford.
12. Engel, 1981, Enzyme Kinetics: The steady state approach, Chapman & Hall.
13. Fersht, 1985, Enzyme Structure and Mechanisms, Freeman.

al

## Recent Trends in Biochemistry-II

### Unit I

Basic concept of metabolic regulation: concept of metabolic energy transduction, regulatory mechanisms of major metabolic pathways and their significance.

### Unit II

Neurochemistry of aging and brain disorders: chemical basis of neuronal function, neurochemical alterations during brain aging, neurochemical basis of brain disorders, genetic susceptibility of brain disorders.

### Unit III

Learning and memory, molecular mechanism of learning and memory, effect of age on learning and memory, molecular alterations during memory related disorders.

### Unit IV

Biochemical basis of cancer: basic mechanism of carcinogenesis, biochemical alterations during carcinogenesis, regulatory mechanisms as targets for cancer therapy.

### Unit V

Biochemical adaptations: concept of homeostasis, stress and strain and their biochemical responses, acclimation, acclimatization and adaptation.

### Unit VI

Metabolic alterations for short term adaptations, genetic basis of evolutionary adaptations.

### Suggested Readings

1. Nelson et al, 2007, Lehninger's Principles of Biochemistry, 5th Edition, MacMillan Worth.
2. Zubay et al, 1998, Biochemistry, 4th Edition, WCB.
3. Voet & Voet, 2004, Biochemistry, 4th Edition, John Wiley.
4. Kanungo, 1980, Biochemistry of Aging, Academic Press.
5. Eric Kandel, 2000, Principles of Neural Science, Mc Graw Hill.
6. Squir et al, 2003, Fundamental Neuroscience, Academic Press.
7. Guyton & Hall, 2006, Text Book of Medical Physiology, 11 Editions, W. B. Saunders.
8. Pecorino, 2008, Molecular Biology of Cancer: Mechanisms, Targets and Therapeutics, Oxford Univ. press.
9. Wang, 2010, Cancer Systems Biology, CRC Press.
10. Hochachka & Somero, 2002, Biochemical Adaptation - Mechanism and Process in Physiological Evolution, Oxford Univ. Press.

BL

## Techniques in Animal Sciences

### Unit I

Microscopy: Basic principle and types: Fluorescence microscopy, Confocal microscopy, Principles of histology; Processing of tissue for double staining.

### Unit II

Cell culture techniques: Primary and secondary culture, Cell lines and their maintenance, Cryopreservation.

### Unit III

Detection of gene expression at cellular level, Hybridization based: In situ hybridization, Antibody based: Immunocytochemical detections.

### Unit IV

Homogenization and centrifugation, Principle and applications of bioassay, RIA, ELISA Electrophoresis.

### Unit V

Principle and applications of 5.1. PAGE (native, denaturing and 2D), Agarose gel electrophoresis.

### Unit VI

Gel filtration and affinity chromatography.

### Suggested Readings

1. S. Sadasivam and A. Manickam, 2005. Biochemical Methods. New Age International Private Ltd., New Delhi.
2. Pears (1993) Histochemistry: Theoretical & Applied (Vol I, II, III). ChurchillLivingstone
3. Wilson & Walker (2006). Principles of Biochemical and Molecular Biological Techniques.
4. Sambrook et al (2001) Molecular Cloning: A Laboratory Manual (Vol I, II, III) CSHL

an



## Advances in Toxicology

### Unit I

Definition of pesticides, brief history, Toxicology of pesticides (LD50 and LC50), Dose response relationship, Carcinogenic, Mutagenic and Teratogenic effects, Method of testing chemicals on insect and evaluation of toxicity.

### Unit II

Classification and function of pesticides: Organochlorines, Organophosphorus insecticides, Carbamates, Pyrethroids, other plant origin bio-insecticides, neonicotinoids and nitrogenous insecticides; fumigants; IGRs, attractants, repellents and anti-feedants. Properties of few individual insecticides i.e. DDT, HCH (BHC), Lindane, Endosulfan, Parathion, Malathion, Carbaryl, Cypermethrin, etc.

### Unit III

Mode of action of insecticide: Central Nervous system, Acetylcholinesterase and other modes of action. Metabolism of insecticides: Phase I and Phase II reactions and metabolism of other pesticides.

### Unit IV

Toxicological symptoms of Organochlorines, Organophosphorus, Carbamates, Pyrethroids, plant origin pesticides and other bio-pesticides, Toxicological studies in insects: penetration of pesticides through insect cuticle, entry of pesticide into animal body, resistance against pesticide, management of resistance.

### Unit V

Safer pesticides: Next generation pesticides for plant protection.

### Unit VI

Use of nanopesticides in plant protection, delivery technology and their behaviour in different ecosystem. Therapy and antidotes: Type and severity of contamination and medical aid.

## Suggested Readings

1. The Complete Book of pesticide management, Whitford, F., Wiley Interscience, John Wiley and Sons, UK
2. Safer Insecticides, Hodgson, E., and Kuhr, R. J., (ed), Marcel Dekker Inc., New York, USA
3. Pesticide Application Methods, Matthews, G, A., Blackwell Science, London, UK
4. Pesticide Biochemistry and Physiology, Wilkinson, C. F., Plenum Press, New York, UK
5. Metabolic pathways of agrochemicals Part II, Roberts, T. R., and Hutson, D. H. The Royal Society of Chemistry, UK
6. Chemical Ecology of Insects, Carde, R. T., and Bell, W. J., Chapman & Hall, New York, USA

*BN*

## Biodiversity and its Conservation

### Unit I

Introduction to biodiversity, Levels of biodiversity: Genetic, species, community and ecosystem.

### Unit II

Magnitude and distribution: Diversity gradients and related hypotheses, methods for biodiversity monitoring, megadiversity zones and hot spots.

### Unit III

Biodiversity and ecosystem functions: Concepts and models, Biodiversity and ecosystem services: Provisioning, regulating, supporting and cultural.

### Unit IV

Threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red data book.

### Unit V

Strategies for biodiversity conservation.

### Unit VI

Principles of biodiversity conservation, in- situ and ex-situ conservation strategies; Biodiversity act.

## Suggested Readings

1. V.H. Heywood, and R.T. Watson, 1995. Global Biodiversity Assessment. UNEP, Cambridge University Press.
2. D. Hill, M.Fasham, and P. Shaw, 2005. Handbook of Biodiversity Methods: Survey, Evaluation and Monitoring. Cambridge University Press.
3. A. E. Magurran, 1988. Ecological Diversity and Its Measurement. Princeton University Press, Princeton, New Jersey.
4. J.S Singh, S.P Singh, S.R. Gupta, 2006. Ecology Environment and Resource Conservation. Anamaya Publishers, New Delhi
5. Van Dyke, Fred, 2008. Conservation Biology: Foundations, Concepts, Applications, 2nd edition McGraw Hill, New York, USA
6. Peter J. Bryant, 2009, Biodiversity and Conservation, University of California, Irvine, USA

01/

## Molecular Basis of Human Diseases

### Unit I

Major signaling pathways in human Diseases MAP Kinase Pathways, PI3K-PKB/Akt Pathway Signaling mTOR Signaling, Calcium Signaling, the Cyclic AMP Pathway, The Wnt Signaling Hedgehog Signaling, Notch Pathway Signaling by the TGF- $\beta$  Superfamily JAK/STAT Pathway, Toll-like Receptor Signaling and Immunoreceptor Signaling.

### Unit II

Tools and techniques, Animal Models of Human Diseases and Cancer Gene therapy, Pharmacogenomics, Genetic & Epigenetic Pathways of Disease Overview and concept of epigenetics, Bioinformatics analyses of human genome.

### Unit III

Recent advancement in Cancer and Stem Cell Research Hallmarks of Cancer: Gene Regulation & Apoptosis Stem Cells/Regeneration and Cancer Genetic & Epigenetic determinants of Cancer Pharmacogenetics of cancer and its perspectives in clinical applications.

### Unit IV

Regenerative medicine in Type 1 and Type 2 Diabetes, Cardiovascular, Central Nervous System, Stem cell based therapy.

### Unit V

Protein aggregation in human diseases Mechanism of protein aggregation and clearance of aggregated proteins. Protein aggregates-induced toxicity, Self-propagation of pathogenic protein aggregates.

### Unit VI

Aggregated proteins in human diseases, such as Prions, Alzheimer's disease, Parkinson's diseases, Serum Amyloidosis. Role of amyloid in HIV transmission. Strategies for preventing protein aggregation in pathological conditions.

### Suggested readings

1. Alberts, Garland Molecular Biology of the Cell 5th ed. 2008.
2. Annual reviews of Biochemistry.
3. International Review of Cell and Molecular Biology.
4. Nature reviews, Nature Reviews Cancer.
5. Nature Reviews Focus on Stem cells, 2021.
6. Nature Reviews Molecular Cell Biology.
7. Stem Cell Reviews and Reports.
8. TRENDS journals/ Trends in Cell Biology/ Trends in Biochemistry/Trends in Molecular Medicine/ Trends in Biotechnology/ Trends in Genetics.

*AN*

## Drug and Gene Delivery Systems

### Unit I

Basic concepts of drug and gene delivery Introduction to drug/gene delivery Biological barriers, Encountered during drug/gene delivery.

### Unit II

Controlled drug delivery systems: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations.

### Unit III

Targeted drug/gene delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications.

### Unit IV

Concepts of Nanomedicine Concepts of nanomedicine Nanoparticles types-Metallic and Polymeric nanoparticles, Polymers: Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

### Unit V

Nanoparticles for drug/gene delivery Tools and techniques for characterization of nanoparticles in vitro and in vivo.

### Unit VI

Nanoparticles as drug/gene delivery vectors Nanoparticles for drug delivery Nanoparticles for gene delivery Nanoparticles for siRNA delivery.

### Suggested reading

1. Sinko, P.J, Martin's Physical Pharmacy and Pharmaceutical Sciences, 7th edition, Lippincott Williams & Wilkins, Philadelphia PA (2017) (ISBN 978-1-4511-9145-5). Link to eBook is accessible through course Canvas site.\*
2. Allen LV, Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 11th edition, Lippincott, Williams & Wilkins, Philadelphia, PA (2018) (ISBN 978-1496347282). Link to eBook is accessible through course Canvas site.\*
3. Journals in the field of Gene delivery and Nanotechnology 4 Jonathan Hadgraft , Transdermal Drug Delivery Systems: Revised and Expanded (Drugs and the Pharmaceutical Sciences) - 2019

BL

## Parasitology

### Unit I

Introduction to parasitology: Animal associations and host - parasite relationship: Distribution of diseases and zoonosis caused by animal parasites.

### Unit II

Morphology, lifecycle mode of infection of Plasmodium, molecular biology of Plasmodium- drug target, mechanism of drug resistance, vaccine strategies and proteomic approaches.

### Unit III

Morphology, lifecycle and mode of infection of Leishmania, molecular biology of Leishmania Drug targets, drug resistance and vaccine strategies.

### Unit IV

Morphology, lifecycle. mode of infection of Entamoeba and Giardia , morphology, biology, lifecycle and mode of infection of gastrointestinal, nematodes (*Ascaris lumbricoides*, *Ancylostoma duodenale*, *Enterobius vermicularis*) and *Wuchereria bancrofti*.

### Unit V

Morphology biology, lifecycle and mode of entry of Fasciola, Taenia and Schistosoma: molecular biology of nematodes, cestodes and trematodes and vaccine strategies.

### Unit VI

Pathology of helminth infections; immune response and self defense mechanisms, immune evasion and biochemical adaptation parasites; parasites of veterinary importance; parasites of insects and their significance, host parasite interactions.

### Suggested Readings

1. Ecology of Parasites by A.P Diwan , A.K Arora , Anmol Publications , New Delhi
2. Foundations of Parasitology by Roberts L.S. and Janovy J; M.c Graw - Hill Publishers, New York U.S.A
3. Modern Parasitology: A Textbook of Parasitology by F.E.G.Cox., WileyBlackwell, U.K.