GENERAL INSRTUCTIONS
&
COURSE CURRICULUM

FOR

Ph.D. in Zoology
(Effective from Academic Session 2024-25 onwards)

DEPARTMENT OF BIOSCIENCES
HIMACHAL PRADESH UNIVERSITY
(NAAC Accredited "A" Grade University)
SUMMERHILL, SHIMLA, 171005
HIMACHAL PRADESH, INDIA

Annexure-I

DEPARTMENT OF BIOSCIENCES
HIMACHAL PRADESH UNIVERSITY
SUMMER HILL, SHIMLA-171005
Ph.D. ZOOLOGY PROGRAMME

GENERAL INSTRUCTIONS/GUIDELINES FOR EXECUTION OF CURRICULUM

1. All candidates admitted to the Ph.D. program at the Department of Biosciences have to complete a minimum of 12 credits.
2. There will be three (3) courses in Ph.D. Zoology Programme. The students have to take **2 compulsory courses [PhDZL-101, RPE-PhD]** and at least one additional course out of **elective courses [PhDZL-102(i-ix)]**.
3. The detailed syllabi for PhD in Zoology offered by the Department are appended with a list of suggested readings.

Outline of the Course Work for Ph.D. in Zoology

Code	Title of Paper	Max Marks	Credits
RPE-PhD *(Common with all disciplines under Faculty of Life Sciences)*	Research and Publication Ethics	50	2 Credits
PhDZL-101 *(Common with all disciplines under Faculty of Life Sciences)*	Research Methodology	100	5 Credits
Elect any one of the following i.e. PhDZL-104(i-ix) (Elective)		100	5 Credits
PhDZL-102(i)	Advances in Animal Physiology		
PhDZL-102(ii)	Advances in Entomology		
PhDZL-102(iii)	Advances in Cytogenetics and Molecular Genetics		
PhDZL-102(iv)	Advances in fish and fisheries		
PhDZL-102(v)	Advances in Biodiversity and Wildlife		
PhDZL-102(vi)	Advances in Biochemistry		
PhDZL-102(vii)	Advances in Parasitology		
PhDZL-102(viii)	Advances in Radiation Biology		
PhDZL-102(ix)	Advances in Microbial Physiology and Genetics		
Total Marks/Credits		**250**	**12 Credits**

PhD in Zoology (Compulsory Courses)

RESEARCH AND PUBLICATION ETHICS

Course Code: RPE-PhD	Credits: 02	MM:50	L(2):T(0): P(0)

Course description

This course has a total of 6 units focusing on the basis of philosophy of science and ethics, research integrity, and publication ethics. Hands-on sessions are designed to identify research misconduct and predatory publication. Indexing and citation databases, open-access publications, research metrics(citations, h-index, Impact Factor,etc.), and plagiarism tools will be discussed in this course.

Objectives

a. Promote the importance of research integrity.

b. Discuss the principles of publication ethics.

c. Educate on identifying research misconduct and predatory publishing.

d. Discuss indexing and citation databases.

e. Provide information on open-access publications and research metrics.

f. Introduce various plagiarism detection tools.

Evaluation

Continuous assessment will be conducted through tutorials, assignments, quizzes, and group discussion. At the end of the course, a final written examination of 50 marks will be conducted.

a. Students who have at least 75% attendance in classes will be considered eligible for the final written examination.

b. The exam will be conducted for three hour duration.

c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 7 questions covering all the units. The first six questions (1, 2, 3, 4, 5 & 6) of 6 marks each will consist of one question from each unit, with internal choice provided, meaning there will be two questions from each unit. The 7th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii….x) each with 2 marks. There will be at least one question from each unit and students will be required to attempt any seven questions out of ten.

Course Content

Unit-01 Philosophy and Ethics

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: Definition, moral philosophy, Nature of moral judgements and reaction

Unit 02: Scientific conduct:

1. Ethics with respect to science research

2. Intellectual honesty and research integrity
3. Scientific misconduct: Falsification, fabrication and plagiarism (FFP)
4. Redundant publications: Duplicate and overlapping publications, salami slicing
5. Selective reporting & misrepresentation of data

Unit 03: Publication Ethics

1. Publication ethics: definition, introduction and importance
2. Best practices/ standards setting initiatives and guidelines: COPE, WAME etc.
3. Conflict of interest
4. Publication misconduct: Definition, concept, problem that lead to unethical behaviour and vice versa, and types;
5. Violation of publication ethics, authorship and contributionship
6. Identification of publication misconduct, complaints and appeals

Unit 04: Open-access Publishing

1. Open-access publications and initiatives
2. SHERPA/ RoMEO online resource to check publisher copyright and self-archiving policies
3. Software tools to identify predatory publications developed by SPPU
4. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal finder, Springer Journal *etc.*

Unit 05: Publication Misconduct

A. Group Discussions
   1. Subject specific ethical issues, FFP, authorship
   2. Conflict of interest
   3. Complains and appeals: Examples and fraud from India and abroad.

B. Software tools

   Use of plagiarism check software's like Turnitin, Urkund and other open-source software tools

Unit 06: Databases and Research Matrices

A. Databases
   1. Indexing databases
   2. Citation databases: Web of Science, Scopus *etc.*

B. **Research Matrices:**
   1. Impact factor of a journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
   2. Matrices: h-index, g index, i10 Index, almetices

Suggested Readings

Beall, J.(2012). Predatory publishers are corrupting open access.Nature,Vol.489(7415), 179. https://doi.org/10.1038/489 1 79a.

Bird, A.(2006). Philosphy of Science. Routledge.

Bretag, Tracey (2016). The Handbpook of Academic Integrity.Springer

Chaddah, P.(2018).Ethics in Competitive Research: Do not get scooped; do not get Plagiarized. ISBN:978-9387480865.

Grudniewicz, Agnes, D. Moher, Kelly D. Cobey+32 authors (2019). Predatory journels: no definition, no defense.Nature, Vol.576.

Indian National Science Academy (2019). Ethics in Science Education , Research and Governance (2019). ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf

Israel, Mark, Iain Hay (2006). Research Ethics for Social Scientists. London.

Lang, James M. (2013). Cheating Lessons: Learning from Academic Dishonesty. Harvard University Press.

Macintyre, Alasdair (1967).A Short History of Ethics. London.
National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research. Third Edition.National Academies Press.
Resnik, D.B.(2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10.
https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
Whitley Jr., Bernard E. & Patricia Keith-Spiegel (2001). Academic Dishonesty: An Educator's Guide. Psychology Press.

RESEARCH METHODOLOGY

Course Code: PhDZL-101	Credits: 5	MM: 100	L(5): T(0): P(0)

Course objectives:
To provide basic framework and guidelines for researchers to clearly and define research problems, hypotheses, and objectives

Course learning outcomes:
i. Will help the researchers to identify the most appropriate research design, sampling technique, and data collection and analysis methods.
ii. Researchers will be able to understand and comprehend the basics of research methodology and apply them in their research.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 01

Foundations of Research: Meaning, objectives of research; criteria of good research; basic steps of research; types of research.

Problem Identification & Formulation: selection of research problem.
Hypothesis: Qualities of a good Hypothesis, Null & Alternative Hypothesis, Hypothesis Testing, Logic & Importance
Review of related literature: Meaning, necessity and sources.

Unit 02

Research Process and Experiment Design: Concept and Importance in Research, features of a good research design, Exploratory Research Design concept, types and uses, Descriptive Research Designs concept, types and uses, Concept of Independent & Dependent variables.
Research Report: Writing preliminaries, main body of research, references and bibliography
Research and Development of Projects: Project formulation, National and international funding agencies for R & D projects, proposal submission.

Unit 03

Analytical Tools and Techniques in Research: Working principles, types, basic operation and application of Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Electrophoresis, Spectrophotometry, Chromatography and Mass spectrometry

Unit 04

Use of Tools / Techniques for Research: Search engines: NCBI, PubMed, Google Scholar, Thomson Reuters, SCI etc, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office. Bioinformatics tools and applications

Unit 05

Intellectual Property, Patent Database Search and Patent Writing Innovation: Introduction to Intellectual Property Rights (IPR), Basic forms of IPRs: – Patent, Copyright, Trademark, Designs, Process patent versus product patent, Art of writing a patent/innovation and claims, Preliminary patent.

Suggested Readings

1. Council of Biology Editors –CRE Style Manual, American Institute of Biological Sciences, Washington. D.C.
2. Effective Writing for Engineers, Managers, Scientists: Tichy AJ.
3. Scientific and Technical papers: Tribcase SF.
4. How to write and publish a scientific paper: Day RA.
5. Kothari, C. R. (2004). Research Methodology- Methods and Technique (New Age International, New Delhi)

Ph.D. in Zoology (Elective Courses)

ADVANCES IN ANIMAL PHYSIOLOGY

PhDZL-102(i)	Credit: 5	MM: 100	L(5): T(0): P(0)

Course objectives:

To examine how biological processes function, how they operate under different conditions and how these processes are regulated

Course learning outcomes:

i. Broadly define the structure and function of animals and explain the mechanisms and regulation of animal life at different levels of organization from the cell to the whole organism.

ii. Take a rigorous approach to evaluating new questions in physiology or pathophysiology by navigating the scientific literature including databases.

iii. Design and analyze basic laboratory experiments probing physiological mechanisms at all levels of organization from genes to whole organisms.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 01: Cellular, Neurophysiology and Hematology

1. Fundamental principles of cellular physiology, membrane bioelectricity
2. Ion channel physiology, Body fluids, and maintenance of homeostasis
3. Basics in hematology, Clinical hematology, Bone marrow, Blood & Blood cells
4. Bleeding disorders, Hematopoiesis, leukemia, leucopenia

5. Motor Functions of the Spinal Cord, the Cord Reflexes,
6. States of Brain Activity - Sleep, Brain Waves, Epilepsy, Psychoses, and Dementia

Unit 02: Cancer Pathophysiology

1. Cancer genetics and cell lines
2. Tumor immunology, Cancer therapeutics
3. Molecular techniques in cancer biology and available treatments

Unit 03: Gastrointestinal Physiology

1. General Principles of Gastrointestinal Function
2. Mixing of Food in the Alimentary Tract, Secretory Functions of the Alimentary Tract
3. Digestion and Absorption in the Gastrointestinal Tract
4. Physiology of Gastrointestinal Disorders

Unit 04: Endocrinology and Reproduction

1. Introduction to Endocrinology
2. Hormones and their mode of action
3. Reproductive and hormonal functions of the male and female reproductive system
4. Polycystic Ovarian Syndrome

Unit 05: Respiratory, Cardiac and Renal Physiology

1. Physiology & regulation of respiration, pulmonary ventilation,
2. Respiratory Insufficiency - Pathophysiology, Diagnosis, Oxygen Therapy
3. Cardiac cycle, cardiac output and stroke, Blood pressure & pulse
4. Coronary circulation, pulmonary & systemic circulation, Cardiovascular homeostasis
5. Kidneys in maintaining homeostasis, GFR, and Electrolyte balancing, Regulation of renal functions, Functions of ureters, bladder and urethra

Suggested Readings:

1. General and Comparative Animal Physiology, Hoar W. S. (ed), Prentice Hall, India
2. Comparative Physiology (Handbook of Physiology): Vol. 1, 2, Dantzler, W.H. (ed.) Oxford University Press, New York, USA
3. Animal Physiology: Adaptation and Environmental, Nelson K. S. (ed) Cambridge University Press, Cambridge, UK
4. Introduction to Anatomy & Physiology, David Sturgeon, Taylor & Francis, Henry Ling Ltd, NY
5. Introduction to Animal Physiology, Ian Kay. Taylor & Francis, Bios Scientific

ADVANCES IN ENTOMOLOGY

PhDZL-102(ii)	Credit: 5	MM: 100	L(5): T(0): P(0)

Couse Objectives:

i. To develop an understanding of the distribution and abundance of insects and their interaction with environment
ii. To learn modern techniques in insect science such as molecular biology etc.

Course Learning Outcomes:

i. Understand evolution and biodiversity generation through macro- and micro-evolutionary processes, including how these processes have formed and diversified insects.
ii. Attain a solid foundation in insect biology, including general entomology, basic systematics, morphology, physiology, and biodiversity.
iii. Understand evolution and biodiversity generation through macro- and micro-evolutionary processes, including how these processes have formed and diversified insects.
iv. Develop the ability to read and interpret scientific papers in entomology, and critically assess content.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 01: Insect Sociobiology

Concept of social evolution in insects; Role of cuticular hydrocarbon profiling and biogenic amines for insect recognition/aggression. Applications of insect societal rules and behavioral algorithm for human welfare. Social homeostasis and superorganisms.

Behavioural Physiology

The physiological causes of behaviour; hormone releasers and switches of behavioural states; higher control of hormonal causes of behaviour and effects of behaviour on physiology.

Unit 02: Insect Toxicology

Factors affecting the toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity. Problems associated with pesticide use in agriculture: pesticide resistance; resistance mechanisms and resistant management strategies; pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects.

Integrated Pest Management

Economic importance of insect pests, diseases and pest risk analysis. Development and validation of IPM module its implementation and impact on Insect pest and disease. Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programs.

Unit 03: Biochemistry of Insect Flight

Insect's lipids and lipoproteins and their role in flight mechanism. The coordination and integration of muscle metabolism. Respiratory fuels- carbohydrates, lipids and their metabolism. Limitations in insect flight mechanism.

Unit 04: Industrial application of knowledge of insect's sensory system

Sensory system application: Odour sensors, flow sensor using artificial sensory hair, visual navigation in insects. Robots based on insects design principle, flight and walking mechanism. Controlling insect behaviour through remote control and architectural insecticides.

Unit 05: Forensic Entomology

Advances in Forensic Entomology; Forensic Importance of Insects; Chemical Attraction & Communication, the role of aquatic insects in forensic investigations. Crime Scene Investigation; Collection at the Crime Scene; estimating the time since death; Forensic Entomotoxicology: Current concepts, trends, challenges and techniques.

Suggested Readings

1. Edward O. Wilson · 1971. The Insect Societies.
2. Morris Rockstein. 1974. The Physiology of Insecta, Second Edition, Vol II. Academic Press.
3. R. F. Chapman and Stephen J. Simpson. 2013. The Insects: Structure and Function. Cambridge University Press; 5th edition.
4. V. B. Wigglesworth. 1982. The Principles of Insect Physiology. Springer Dordrecht.
5. Pant N. C. and Ghai S. Ed. 1981. Insect Physiology and Anatomy. ICAR.
6. D. J. Candy, B. A. Kilby. 2013. Insect Biochemistry and Function. Springer New York.
7. Yu, S. 2015. The Toxicology and Biochemistry of Insecticides, 2nd edition, CRC, Boca Raton, 357 pp.
8. Gupta HCL.1999. Insecticides: Toxicology and Uses. Agrotech Publ., Udaipur.
9. Larry P. Pedigo. Entomology and Pest Management. 6th edition

10. Dr. Edward (Ted) Radcliffe. The IPM World Textbook. http://ipmworld.umn.edu/ipmchap.ht
11. G.S.Dhaliwal and R.Arora. Principles of insect Pest Management.
12. Dr K.P. Sanjayan. Insect Physiology.
13. Thomas A. Christensen. Methods in Insect Sensory Neuroscience.
14. Rivers, D. and G. Dahlem. The Science of Forensic Entomology. West Sussex: Wiley Blackwell. 1st ed.
15. J.H.Byrd and J.K. 2009. Forensic Entomology,Tomberlin, 3rd Edition.
16. J.Amendt, M.Lee Goff and C.P.Campobasso. 2010. Current Concept of Forensic Entomology.

ADVANCES IN CYTOGENETICS AND MOLECULAR GENETICS

PhDZL-102(iii)	Credit: 5	MM: 100	L(5): T(0): P(0)

Course Objectives:

i. To understand chromosomes' structure, function, and behaviour during cell division and their role in genetics and development.
ii. To learn the mechanisms of chromosomal inheritance and the genetic basis of chromosomal disorders.
iii. To Understand the principles of evolutionary theory, including natural selection, genetic drift, gene flow, and mutation.
iv. To learn about the history of life on Earth and the processes that drive evolutionary change.

Course Learning Outcomes:

i. Understand the role of chromosomes in genetic inheritance and cellular processes.
ii. Analyze and interpret chromosomal abnormalities, including numerical and structural changes.
iii. Understand the principles of taxonomy and classification of organisms based on evolutionary relationships.
iv. Understand the role of genetic variation and adaptation in evolution.
v. Apply cytogenetic knowledge to medical genetics, prenatal diagnosis, and genetic counselling.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.

c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 01: Genomics

1. Structural Genomics: Sequence Organization, Assigning Loci to Chromosomes, High Resolution Specific Genomes, Chromosome Maps, Physical Mapping of Genome Functional Sequencing, Use of Genome Maps in Genetic Analysis. Analysis, DNA genomics: Microarrays.
2. Functional genomics: Characterization of Proteome by Open Reading Frame Analysis, DNA Microarrays.

Unit 02: Cytogenetic Techniques

1. Karyotyping: Centromeric Index, Arm Ratio, Relative length, Idiogram.
2. Chromosome Mapping.
3. Banding Techniques: Giemsa staining, Giemsa C banding, Giemsa G banding, Quinacrine (Q) banding, R banding and Silver staining,
4. Measuring nuclear DNA: Micro-densitometry, The Feulgen Reaction
5. Human Pedigree Analysis

Unit 03: Molecular Tools

1. Molecular Probes.
2. Fluorescence in situ Hybridization
3. Discrete Genetic Markers as Probes for Studying Populations.

Unit 04: Evolutionary Genetics

Evolution of Multigene Families.

1. Neutrality, Molecular Clocks
2. Use of mt DNA in Studying Genetic Relationships.
3. Human Evolution: The Origin of Major Human Groups.
4. Discrete Genetic Markers as Probes for Studying Populations.

Unit 05: Genetic Engineering and Genome Editing

1. Recombinant DNA technology
2. Ethical, legal, and social implications of gene editing

3. Synthetic biology and its applications in gene synthesis and modification

Suggested Readings

1. Gardener, E.J., Simmons, M.J. and Snustad, D.P, Principles of Genetics. John Wiley & Sons.

2. Griffiths, A.JF.; Gelbar, W.M.; Miller, J.H. ad Lewontin, R.C. Modem Genetic Analysis. W. H.Freeman & Company.

3 McGregor, H.C.and Varley, J.M. Working With Animal Chromosomes. John Wiley & Sons.

4. Mitra, S. Genetics-A Blueprint of Life. Tata MCGraw-Hill Publishing Company. .

5. Dover, G.A. and Flavell, R.B. Genome Evolution. Academic Press.

ADVANCES IN FISH & FISHERIES

PhDZL-102(iv)	Credit: 5	MM: 100	L(5): T(0): P(0)

Course Objectives:

This course will provide students with an understanding of how fisheries operate and how fish reach human communities. This course has been designed to understand the identification and classification of commercially important fishes and other aquatic vertebrates by the students. The course objectives are to provide the students with an advanced knowledge of fish.

Course Learning Outcomes:

i. Critically evaluate the literature on fishes, their management

ii. underpins approaches to fisheries exploitation and management

iii. It will give a broad overview of different fisheries and the way they are managed, offering a clear view of the nature and scope of challenges in delivering greater sustainability against a background of rapid anthropogenic environmental change.

iv. It will equip students with the knowledge and skills necessary to take on management and monitoring roles in fisheries, such as in Inshore Fisheries and Conservation

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 01: Evolution and Ecology of fishes

Evolutionary strategies in fishes, gene and genome duplication, evolutionary genetics, biogeographical distribution, methods employed in phylogenetic studies and fish Identification. Fishes and their relationship with abiotic and biotic factors.

Unit 02 : Advances in Fish Physiology

Physiology of bimodal gas exchanges: Oxygen sensing; respiratory control, concept of fluid dynamics across respiratory structures. Environmental influences of fish cardiovascular physiology; cardiac plasticity in fish. Physiology of ion transport and excretion: Functional morphology of branchial ionocytes; understanding growth in fish: myogenic cells and growth; muscle satellite cells; muscle fiber dynamics, genetic and environmental factors regulating muscle growth; diversity and plasticity in muscle fiber. Reproduction and Fertility: Vitellogenin: structure, synthesis, and transportation of oocytes; egg envelop proteins; gonadal steroidogenesis; physiology of fertilization.

Unit 03 : Stock Assessment and Management, Aquaculture and Role of Genetics in Aquaculture

Marketing, tagging and population enumeration, length-weight relationship, age and growth, fecundity estimation, bio-indicators and biomonitoring. Application of statistical methods in fisheries, fish conservation and fishing laws. Fishing techniques: Remote sensing, sonar, radar; crafts and gears. Fishways and screens.

Aquaculture systems, harvesting and BMP. Evolution of intensive culture technologies, need for intensification in aquaculture, potential and innovative strategies for the development of cold-water aquaculture in India. Genetics in broodstock management of commercially important fish and shellfish, inbreeding depression and heterosisin; application of population genetics in fish resource conservation,

Unit 04: Fish Nutrition

Energy requirements of fish: principles and methods; factors affecting energy requirement; Bioenergetics of spawning, relationship between feeding and maturation. Energy relationship between egg and hatchlings. Role of probiotics and prebiotics in fish nutrition. Feed formulation: least cost formulation, linear programming; quality of feed ingredients and their biochemical composition; protein and energy supplements; vitamins and minerals premixes. Feed evaluation: Feed Conversion Ratio (FCR); Feed Efficiency Ratio (FER); Protein Efficiency Ratio (PER), Net Protein Utilization (NPU) and Biological Value (BV).

Unit 05: Toxicological Methods of Drugs Used in Aquaculture, Bioinformatics in Fish Industry

Impact of toxicants on fish health: Algal blooms, Important mycotoxins, Ichthyotoxins, chemical toxins, and other toxicants and their effects on fish health. Principles of drug action and assay; dose-response curves and their analysis; residual effects and withdrawal period of potential drugs. Specific toxicity tests, immunotoxicity, and carcinogenicity; types of toxicity and its measurement; acute, sub-acute or chronic and its manifestations; acute toxicity; Use of cell culture for toxicity assays; different assays for toxicity testing. Measurement of TD50/TC50; measurement of LD50/LC50; test for acute, sub-acute and chronic toxicity.

Bioinformatics related to genomics, proteomics or metabolomics. DNA barcoding – Species substitution, detection – mini barcodes, databases – fish trace, fish gen, AFLP, fish DB, RFE. Fish protein adulteration – protein-based methods- electrophoresis and immunological.

Suggested Readings

1. Allan, G. and Burnell, G. 2013. Advances in Aquaculture Hatchery Technology. Woodhead Publishing Limited.
2. Andrews C, Excell A and Carrington, N. 1988. The Manual of Fish Health. Salamander Books
3. ASTM Standards on Aquatic Toxicology and Hazard Evaluation 1993. ASTM, Philadelphia.
4. Bhat, I. A., Bhat, R. A. H. and Yousuf, D.J. 2021. A Textbook of Fish Toxicology, Narendra Publ. House, Delhi, (India).

5. Black, K.D. 2001. Environmental Impacts of Aquaculture. CRC Press
6. Burnell G, Allan, G. 2009. New Technologies in Aquaculture. 1st Edition. Woodhead Publishing Limited.
7. Cody R.P. and Smith, J.F. 1997. Applied Statistics and SAS Programming Language. Elsevier.
8. Dodds, Walter, K. 2002. Freshwater Ecology: Concepts and environmental applications. Academic Press, U.S.A.
9. Evans, D.H. and Claiborne, J.B. 2009. Physiology of Fishes. Fourth edition. CRC press.
10. Gjedrem Trygve et al. 2005. Selection and Breeding Programs in Aquaculture. Springer.
11. Gunderson, D.R. 1993. Surveys of Fisheries Resources. John Wiley and Sons, New York.
12. Halver and Hardy 2002. Fish Nutrition. An imprint. 3rd ed. Acad. Press.
13. Herwig, N. 1979. Handbook of Drugs and Chemicals used in the Treatment of Fish Diseases. Charles C Thomas, Springfield.
14. Hoboken, N.J. 2010. A Textbook of Modern Toxicology. John Wiley and Sons.
15. Jayaram, K.C. 2010. The freshwater fishes of the Indian Region. IInd edition. Narendra Publ. House, Delhi, (India).
16. Jhingran V.G. and Sehgal, K.L. 1978. Cold Water Fisheries of India. J. Inland. Fish. Soc. India. Sp. Publ.
17. Jhingran, V.G. 1975. Fish and Fisheries of India.
18. Kirpichnikov, V.S. 1981. Genetic Basis of Fish Selection. Springer-Verlag
19. Kocher, TD and Carol, A.S. (Edts.). 1997. Molecular Systematics of Fishes. Academic Press.
20. Liu, Zhanjiang (John). editor. 2017. Bioinformatics in Aquaculture: Principles and Methods 2017), Wiley Blackwell Publications.
21. Lynwood, Smith, S. 2003. Introduction to fish physiology. Narendra Publ. House, Delhi (India).
22. McGinn, N.A. editor. 2002. Fisheries in a changing climate. American Fisheries Society Symposium 32, Bethesda, MD.
23. Megrey, B. A. and Moksness, E. 2009.Computers in Fisheries Research. Springer, USA.
24. Mishra, B.K. 2007. Disease Management in Freshwater Pisciculture. Geeta Somani, Udaipur.
25. Pandey, B.N. 2011. Fisheries and Fish Toxicology. A. P. H. Publishing Corporation, New Delhi
26. Pillay, T.V.R. 1996. Aquaculture Principles and Practices. Blackwell Publishing, USA.
27. Purdom, C.E. 1993. Genetics and Fish Breeding. Chapman and Hall.
28. Wallingford, 2010. Fish Diseases and Disorders 2010. CABI, UK.
29. Welch, P.S. 1952. Limnology. McGraw Hill Book Co., New York.

ADVANCES IN BIODIVERSITY AND WILDLIFE

PhDZL-102(v)	Credit: 5	MM: 100	L(5):T(0): P(0)

Course Objectives:

1. To provide students with a comprehensive understanding of the concepts, levels, patterns, and scales of biodiversity, emphasizing species distribution, abundance, evenness, and richness.
2. To Explore the significance of wildlife, including physiological adaptations, social organization, and the impact of wildlife on human welfare.
3. To Identify and analyze the various threats to biodiversity and wildlife, including habitat destruction, invasive species, and climate change.
4. To Equip students with the practical skills and ethical considerations necessary for conducting field studies on biodiversity and wildlife.
5. To Examine historical and contemporary conservation efforts, policies, and projects aimed at preserving biodiversity and wildlife in India and globally.
6. To Understand the legal and institutional frameworks supporting biodiversity and wildlife conservation nationally and internationally.

Course Learning Outcomes:

After successful completion of the programme, students will be able to:

1. Describe India's status as a megadiverse country, identifying biodiversity hotspots and biogeographic zones within the country.
2. Analyze the physiological adaptations of wildlife, including hibernation, migration, mimicry, and habitat-specific adaptations.
3. Critically assess the major threats to biodiversity and wildlife, including habitat destruction, climate change, and human-wildlife conflict.
4. Demonstrate proficiency in planning and conducting field surveys, employing various sampling methods, and using field equipment and techniques ethically and effectively.
5. Utilize qualitative and quantitative methods to record and evaluate field data, applying relevant statistical software and GIS tools.
6. Evaluate different conservation strategies, both in situ and ex situ, and understand the significance of national parks, wildlife sanctuaries, and other protected areas.
7. Summarize the key features of major environmental laws and regulations in India, and explain the roles of national and international conservation organizations.
8. Get the concepts of ecotourism and the importance of traditional knowledge and practices in biodiversity and wildlife conservation.
9. Develop critical thinking skills to propose innovative solutions to current conservation challenges, considering ecological, social, and legal perspectives.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided, meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 01: Biodiversity and Wildlife

Concepts, definition, Levels of Biodiversity, Patterns and scales of Biodiversity (alpha, beta, and gamma), Concept of species distribution, Species abundance, species evenness and richness, Values and Importance of Biodiversity, Biodiversity Hot Spots, India as mega diverse country, Brief idea of Biogeographic zones of India, Biomes of world, Zoogeography

Basic concept, importance and significance of Wildlife, Wildlife and Human welfare

Physiological Basis of: Hibernation, Aestivation, Circadian rhythms, Mimicry, Migration (Fish and Bird), Social Organisation in Animals (Honey bee and Primates).

Adaptations to different Habitats; Animal adaptations to water, temperature, salinity, predation, Deep Sea and diving adaptations in animals, High-altitude adaptation.

Keystone species, Umbrella species and Flagship species.

Wildlife of India, Endangered and Endemic faunal species of India, Wildlife of Himachal Pradesh.

Unit 02: Threats to Biodiversity and Wildlife

Habitat Destruction, Habitat Fragmentation, Impact of Invasive Species, Pollution, Over Exploitation, Poaching and Illegal Trade of Wildlife.

Major wildlife diseases and their control, Human-wildlife conflict.

Global climate change and its effect on wildlife.

Unit 03: Methods to Study Biodiversity and Wildlife

Planning and execution of Field surveys: Field surveys & observations, Sampling methods and identifying study sites, Different methods of transects & quadrates, Techniques of field observation Camouflages & Observation stations Non-intruding / non-interfering techniques of field observations

Indirect Evidence such as Pugmark, Scat and Pellet, Dung and Droppings

Recording & Evaluation of Data: Field notebook and its records, Qualitative & Quantitative data, Field kit and its usage: Cameras, Binoculars, Camera traps etc.

Ethics in Field Studies: Dos & Don'ts in field studies, Regulatory permissions for field observations, Field collections and preservations

Methods to avoid Human-wildlife conflict: Electric Fencing, Trench Design, Line trapping, Mist netting and Pocket netting

Statistical software used in ecological studies: PAST, FLOCKER or any other software uses. Introduction of GPS, Map making, QGIS (Open source GIS), Remote Sensing

Unit 04: Biodiversity and Wildlife Conservation

History of Wildlife management and conservation in India

IUCN Threatened Categories, Threatened Wildlife Species of India and Himachal Pradesh

Biodiversity and Wildlife Conservation: *In situ* conservation, National Parks, Wildlife Sanctuaries, Biosphere Reserves, Community Reserve and Conservation Reserve, Ramsar Sites.

Ex situ conservation, Gene Bank, Sperm and Ova Bank, Seed Bank, Botanical Garden and Zoo, Captive Breeding(e.g. Western Tragopan)

Protected Area Network in India and Himachal Pradesh.

Special projects for the conservation of Wildlife in India: Project Tiger, Project Rhino, Project Elephant, Gir Lion Project, an account of conservation measures for Snow Leopard and River Dolphin in India

Unit 05: Laws, Legislation and Statuary Bodies for Conservation of Biodiversity and Wildlife

Salient Features of Indian Forest Act 1927, Wild Life (Protection) Act 1972, Biological Diversity Act 2002. Role of WWF, IUCN, Red Data Book. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), ZSI and Wildlife Institute of India in the conservation of Biodiversity and Wildlife, Ramsar Convention.

Concept of Ecotourism, Traditional Knowledge, Practices for conservation of Biodiversity and Wildlife.

Suggested Readings:

1. Introduction to Biodiversity, Belsare DK, (2007) A. P. H. Publishing Corp. New Delhi.
2. A Textbook of Biodiversity, K.V. Krishnamurtys, 2003, Talor and Francis
3. Biodiversity, Wilson, E O (1998), National Academy Press, New York
4. Global Biodiversity: Status of Earth's Living Resources. Groombridge B. (2011) Chapman and Hall Publ. London
5. Threatened Animals of India, B.K. Tikadar. (1983) ZSI Publication, Calcutta.
6. Book of Indian Animals. Prater, S.H(1988) Bombay Natural History Society, Mumbai
7. Fauna of Himachal Pradesh, State Fauna Series, (2021). 26 (Part-1 and 2), Zool. Surv. India, Kolkata)
8. Concepts in Wildlife Management. B. B. Hosetti. (2005) 2nd Revised & Enlarged Edn, 2005. Daya Publishing House, Delhi.
9. Wildlife Biology An Indian Perspective, Goutam Kumar Saha and Subhendu Mazumdar 2021, PHI Learning Private Ltd. Delhi
10. Zoogeography of India and Asia, Tiwari, S.K., CBS Publisher and Distributors, New Delhi.
11. Wildlife and Forest Conservation, Sinha, P.C., (1998) Anmol Publishing Pvt. Ltd., New Delhi.
12. Wildlife Conservation and Management, Mathur Reena.,(2018) Rastogi Publications Meerut.
13. Text Book of Wildlife Management, Singh, S.K. (2005) IBDC, Lucknow.
14. Remote Sensing: Principles and Applications, Sabbins, F.E., Freeman

15. The Ecology of Wildlife Diseases, Peter J. Hudson, Annapaola Rizzoli, Bryan T. Grenfell, Hans Heestrbeek and Andy P. Dobson (2002), Oxford University Press, Oxford

Handbook of Environment, Forest and Wildlife Protection Laws in India, Justice Kuldip Singh (1998), Natraj Publishers, Dehradun

ADVANCES IN BIOCHEMISTRY

PhDZL-102(vi)	Credit: 5	MM: 100	L(5):T(0): P(0)

Course Objectives:

The students will be able to undertake investigations and perform analyses that provide information about biochemical questions and help to solve biochemical problems.

Course Learning Outcomes:

Students may get knowledge about chemistry of life, including molecules and biochemical reactions Explain the physiopathological bases and the biochemical markers of the most prevalent diseases in our population.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 0:1 Covalent Properties of Proteins

1. Protein sequencing
2. Protein splicing
3. Covalent modifications.

Unit 02: Protein Structure and Folding

1. Protein tertiary structure and folding.
2. Folding overview.
3. Condensation and molten globules.
4. Amino acid sequence variations and membrane proteins folding.
5. Chaperonin-assisted protein folding.

Unit 03: Enzyme

1. Enzyme-substrate complementarity and the use of binding energy in catalysis.
2. The factors associated with catalytic, proximity and orientation distortion,
3. Enzyme purification by various methods and establishment of homogeneity of purified enzymes.
4. Enzyme characterization, Allosteric enzymes, properties, Kinetics and co-operatively, hill and Scatchard plot.

Unit 04: Medical Biochemistry and Molecular Biology

1. Digestive disorders; diseases of kidney and diseases of respiratory system
2. Diseases of cardiovascular system and diseases of respiratory system
3. Important prophylactic enzymes involve in various diseases
4. Free radicals and antioxidant enzymes with reference to parasitic diseases

Unit 05: Molecular Biology

1. Molecular markers in genome analysis; RELP, RAPD and AFLP analysis.
2. Application of RFLP in forensic disease prognosis.
3. DNA probes in diagnostic.

Suggested Readings

1. Clinical Biochemistry. Hawks
2. Enzymology, Dixon
3. Segel, LH.: Enzyme Kinetics, Wiley, NowYork1995.
4. White and Smith, Principals of Biochemistry. McGraw-Hill Now Yark, 1978.
5. Molecular Biology and Biotechnology, A Comprehensive desk references, R.A. Meyers, VCH Publishers, Now-York

ADVANCES IN PARASITOLOGY

PhDZL-102(vii)	Credit: 5	MM: 100	L(5):T(0): P(0)

Course Objectives:

The main objectives of this course is to make students capable of recognizing parasites which are important for human health and cause diseases.

Course Learning Outcomes:

i. Describe specific human and non-human parasitic diseases. Prepare and observe live parasitic specimens and test students' own seropositivity for a particular parasitic infection.

ii. Emphasis is placed throughout on the basic biology of the pathogens and their host-parasite relationships.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit-01

1. Introduction to Parasitology: Establishment of infection: Active and Passive entry, site selection in their host, entry into specific organs and cells.
2. Parasite induced modifications of the host: Effect on behaviour, growth, parasitic castration, modifications of the host cell by microsporidians, piroplasms and Plasmodium.

Unit-02

1. Classification and detailed account of medically parasitic protozoans: *Leishmania, Trypanosoma, Entamoeba, Babesia, Theileria, Balantidium, Cryptosporidium, Sarcocystis, Isospora, Microsporidium*

Unit-03

1. Classification and detailed account of medically important cestodes and their life cycle patterns: *Taenia saginata, T. solium, Echinococcus granulosus, Hymenolepis nana, H. diminuta, Diphyllobothrium latum.*
2. Role of tegument in the digestion and uptake of nutrients.

Unit-04

1. Classification and detailed account of medically important trematodes and their life cycle: *Fasciola hepatica, Fasciolopsis buski, Schistosoma spp, Opisthorchis, Clonorchis sinensis.*

Unit-05

1. Classification and detailed account of medically important nematodes and their life cycle patterns: *Ascaris lumbricoides, Dracunculus medinensis, Filarial worms, Trichinella spiralis, Trichuris trichuira, Toxocara spp, Strongyloides stercoralis, Ancylostoma duodenale, Necator americanus, Enterobius vermicularis.*

Suggested Readings

1. Cheng, T.C. General parasitology Academic Press, Inc. (1986)
2. Noble, E.R. and Noble, G.A: Parasitology, The biology of Animal parasites Lea and Fabiger
3. Andeson, D.R.: Comparative Protozoology, Cambridge Uni. Press.
4. Chandler, A.C. and Read, C.P.; Introduction of Parasitology, Willy Eastern,
5. Belding, D.A. A text book of Prasitology, Meredith pub. Co.
6. Baker, J.R. Parasitic Protozoa, Academic Press
7. Grell, K.G. Protozoology, Springer Verlag

ADVANCES IN RADIATION BIOLOGY

PhDZL-102(viii)	Credit: 5	MM: 100	L(5):T(0): P(0)

Course Objectives:

Explain the principles of radiation protection for both ionizing and non-ionizing radiation. Understanding the dose-response curves.

Course Learning Outcomes:

i. Students also learn to evaluate patient for effects, reactions and therapeutic responses; demonstrate effective oral and written communication skills; apply basic research methods; and formulate methods for the pursuit of lifelong learning.

ii. To conduct basic and translational research to elucidate the molecular mechanisms underlying cellular responses to ionizing radiation and chemotherapy focusing on critical cellular responses that include DNA repair, cellular senescence, cell proliferation cell death and inflammation.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 01: Histopathology

1. Histopathological studies on effects of Early radiation: lethal effects,
2. Prodromal radiation
3. Gastrointestinal tract with syndrome, associated glands, haemopoietic system and blood, reproductive system

4. Life-shortening and cataractogenesis

Unit 02: Cell Kinetics

1. Cell population kinetics
2. Techniques of cell population kinetics and analysis of cell survival curves
3. Imaging, Tomography, magnetic resonance imaging, radioimmunoassay
4. Uses of various radioisotopes in therapy and diagnosis.

Unit 03: Clinical Radiotherapy

1. Clinical radiotherapy- teletherapy, particle therapy, dose fractionation, oxygen effect, hyperthemia and chemicals in radiotherapy.
2. Application of Radio immune scintigraphy and Radio immuno therapy in the management of cancer.

Unit 04: Radiation Biology Laboratory

1. Design of Radioisotope Laboratory: Floor and room plans, hood and glove box
2. Remote handling of equipment, isotope, storage, isotope waste monitoring disposal, radiation equipment, and control of contamination.

Unit 05: Radiation Physics

1. Radiation detection & instrumentation; Exposure to radiation,
2. Dosimetry; Concept of Radiation protection and shielding; Medical imaging and radiation protection; Concept of waste disposal: Radioactive waste disposal, Bio-medical waste disposal, Incineration.

Suggested Readings

1. Fundamentals in radiation biology by Susan B Klein (*Indiana University, USA*) and Marc S Mendonca (*Indiana University, USA & Purdue University, USA*)
2. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Biology: A Handbook for Teachers and Students, Training Course Series No. 42, IAEA, Vienna (2010)

ADVANCES IN MICROBIAL PHYSIOLOGY AND GENETICS

PhDZL-102(ix)	Credit: 5	MM: 100	L(5):T(0): P(0)

Course Objectives:

To demonstrate comprehensive knowledge and understanding of the structural and metabolic diversity of microorganisms

Course Learning Outcomes:

i. Demonstrate critical understanding of genetic and physiological regulation in microorganisms.

ii. Microbial genetics is also important for understanding molecular techniques used to modify genes and proteins, manipulate bacteria, archaea, and eukaryotic organisms for fundamental research as well as practical applications in diverse areas of medicine and biotechnology.

Evaluation scheme: At the end of the course, a final written examination of 100 marks will be conducted.

a. Students with at least 75% attendance will be eligible for the final written examination.
b. The exam will be conducted for three hour duration.
c. The passing marks for PhD coursework will be 55% aggregate, with minimum 50% in each individual course.

NOTE: Instructions for setting question paper

There will be 11 questions covering all the units. The first 10 questions of explanatory answers (1, 2, 3, ...10) of 12 marks each will consist of one question from each unit, with internal choice provided , meaning there will be two questions from each unit (5x2=10). The students will be required to attempt one question from each unit. The 11th question will consist of 10 short answer type questions using Roman numerals (I, ii, iii, ...x) each with 5 marks, covering all the units. The students will be required to attempt any eight questions out of ten.

Course Content

Unit 01: Introduction

1. Principles of Microbial nutrition, approximate elementary con position of microbial cells, requirements of Carbon, Nitrogen, Phosphorus, Sulphur, Oxygen and Principal micronutrients (elements).
2. Nutritional categories or Microbes, glucose and amino acid transport in microbes.

Unit 02: Media Preparation

1. Composition of culture media, complex media, selective media, Mineral media, enrichment media, defined media
2. Isolation of pureline cultures, maintenance & Preservation of microbes, Microbial growth, phases of growth and measurement of growth
3. Concept of Energy, Pathways involving substrate level phosphorylation, oxidative phosphorylation Photosynthesis, carbohydrate metabolism

Unit 03: Biochemical Metabolisms

1. Protein metabolism, lipid metabolism, Purine and Pyrmidine metabolism.
2. Mutations & Mutagenesis: Types of mutagenesis, Biochemical basis of mutations, spontaneous and induced mutations.
3. Isolation of mutants, Replica plating, site directed mutagenesis. Conditional mutants, Reversion of mutations
4. Recombination: General Recombination, site specific, recombination, composite transposons, the tri-3-type transposons, transposable, Replication of transposable phage by transposition, transposable phage.

Unit 04: DNA Repair Mechanism

1. DNA repair mechanisms: DNA repair mechanism DNA damage in bacteria, photoreactivation, excision (dark repair, recombination, post replication repair, SOS repair system)
2. Structure of plasmid, Functions of plasmid, Replicator of Plasmids, Plasmid incompatibility, Conjugative plasmids, conjugation, DNA transfer, Integration and Hfr strains and F' factors.

Unit 05: Bacteriophage, Transduction & Transposons

1. Structure of bacteriophage, a typical phage life cycle, lysogenic life cycle, growth & assay for phage, RINA phage, single-stranded DNA phage, double standard DNA phage, Mn-whole mechanism of transfer of genetic material
2. Conjugation, transduction, transformation, Natural transformation, competence and uptake of DNA, Ame's test, Activation of carcinogens, treatment of *Salmonella typhimurium* cells with activated carcinogens, Reversion of mutants for histidine.
3. Transduction: Generalised and specialized transduction,
4. Types of transposons, detection of transposition in bacteria, Insertion sequences, Excision of transposons, Genetic phenomena mediated by transposons in bacteria.

Suggested Readings:

1. Daniel Lim; Microbiology; 2nd edition, WCB McGraw Hill, 1998.
2. J. Nicklin: Instant notes on Microbiology, viva books Pvt. Ltd. 1999.