K A N N U R U N I V E R S I T Y

(Abstract)

PG Programme in Applied Zoology under Choice based Credit Semester System –Scheme (full) & Syllabus for I & II Semesters– Implemented with effect from 2010 Admission – Orders issued.

ACADEMIC BRANCH

U.O.No.Acad/C2/6772/2008. Dated, K.U.Campus.P.O, 01-12-2010.

Read:1. U.O.No.Acad/C2/6772/2008 dated 15-03-2009& 10-03-2010.

2. Minutes of the meeting of the Curriculum Committee held on 16-08-2010.

3. U.O No Acad/C3/2049/2009 dated 11-10-2010.

4. Letter No.KU/Zool/July 2010 from the Course Director,Department of Zoology, Mananthavady Campus.

ORDER

1. The Scheme and Syllabus of M.Sc Applied Zoology Programme under Credit and Semester System was implemented in this University with effect from 2008 admission vide papers read (1) above.

2. The Curriculum Committee as per paper read (2) above, recommended modifications to the regulations of Credit Semester System and the revised regulations were implemented in this University changing the nomenclature of the Programme as 'Choice based Credit Semester System' with effect from 2010 admission as per paper read (3) above.

3.The Course Director, Dept. of Zoology, vide paper read (2), has forwarded the revised scheme (full) and syllabus for I& II Semesters of PG Programme in Applied Zoology in line with the revised regulations of Choice based Credit Semester System, for implementation with effect from 2010 admission.

4. The Vice Chancellor, after considering the matter in detail, and in exercise of the powers of the Academic council, conferred under section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction ***to implement the revised scheme(full) and syllabus(I & II Semesters) of PG Programme in Applied Zoology under Choice based Credit Semester System as approved by the Department Council and the Curriculum Committee, with effect from 2010 admission,*** subject to report to the Academic Council

5. The Regulation for Choice based Credit Semester System implemented in this University as per paper read (3) above will be applicable to this Programme also.

6. Orders are issued accordingly.

7. The revised Scheme (full) and Syllabus (I & II Semesters) of PG Programme in Applied Zoology effective from 2010 admission are appended.

Sd/-
REGISTRAR

To

1. The Director, Dept.of Zoology, Mananthavady Campus.
2. The Examination Branch (through PA to CE).

Copy to:

1. PS to VC/PA to PVC/PA to Registrar.
2. DR/AR-I (Academic).
3. SF/DF/FC.

Forwarded/By Order

SECTION OFFICER

Appendix to U.O.No Acad/C2/6772/2008 dated 01-12-2010.

KANNUR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Mananthavady Campus, Vemom P.O, Waynad (Dt.)

SCHEME & SYLLABUS

FOR

PG PROGRAMME

IN

APPLIED ZOOLOGY

Under Choice based Credit Semester System
2010 admission onwards

REGULATION, SCHEME AND SYLLABUS FOR PG PROGRAMME IN

APPLIED ZOOLOGY

(BIODIVERSITY: CONSERVATION AND MANAGEMENT)

1. ELIGIBILITY FOR ADMISSION:

Candidates who have passed and secured at least 55% marks in B Sc Zoology (Main) Degree examination of this University or an equivalent examination of any other university are eligible to apply for the MSc Applied Zoology (Biodiversity: Conservation and Management) course. Regulations regarding the reservation of the seats are as per the rules of Government of Kerala/Kannur University. Those who have appeared for the final year examination can also apply; however, they should produce the mark-sheet before the preparation of rank list.

2. ADMISSION PROCEDURE:

Admission to the course shall be based on the marks obtained in the qualifying examinations and that of an entrance test conducted by the Department of Zoology at a ratio of 60:40.The students who passed the qualifying examination are eligible for some weightage as decided by the University for the Programme.

3. EVALUATION:

a. Continuous assessment includes attendance,assignments, seminars, periodic written examination etc. Weightage to the components of the continuous assessment shall be given for all theory papers of the course as follows:

Written test papers	40%	Assignment	20%
Seminars	20%	Attendance	20%

b. For the end semester examination each question paper shall consists of three sections: Section A, B and C.

Section A consists of short paragraph answers, 4 to be answered out of 6, each carrying 5 marks.

Section B consists of short essay type questions, 2 to be answered out of 4, each carrying 8 marks.

Section C is consists of essay type questions, 2 to be answered out of 4, each carrying 12 marks.

c. For the end semester examinations, the duration of a four credit course shall be 3 hours.

d. The end semester examinations are conducted by a panel of examiners as stipulated by the University in its regulations.

e. Practical examinations for the Programme will be conducted at the end of each year.

f. Weightage to the components of Continuous Assessment shall be given for all practical papers of the Programme as follows:

Test Paper: 60% Practical Record: 20%
Attendance: 20%

The list of optional papers is subject to revision from time to time based on requirement, with the approval of the University.

g. The regulations of Choice based Credit Semester System for PG Programmes implemented with effect from 2010 admission will be applicable to this Programme also and if there is any inconsistency between the regulations and its application to M.Sc Applied Zoology Programme, the former shall prevail.

h. The scheme and syllabus is applicable from 2010 admission onwards.

SEMESTER WISE DISTRIBUTION OF COURSES,MARKS, CONTACT HOURS AND CREDITS

(FFECTIVE FROM 2010 ADMISSION)

Semester I

Sl. No	Course Code	Title of the Course	Contact hours/Week			Marks			Credits
			L	T/S	P	ESA	CA	Total	
1	ZOO C 101	Philosophy of Science, History of Biology, Evolution & Phylogeny	4	1	-	60	40	100	4
2	ZOO C 102	Behavioural Sciences	4	1	-	60	40	100	4
3	ZOO C 103	Chemistry for Biologists	4	1	-	60	40	100	4
4	ZOO C 104	Physics for Biologists and Statistics for Biologists	4	1	-	60	40	100	4
5	ZOO C 105	Practical –I (Biochemistry)	-	-	6	60	40	100	3
6	ZOO C 106	Practical –II (Biophysics &Biostatistics)	-	-	6	60	40	100	3
Total						**360**	**240**	**600**	**22**

Semester II

Sl. No	Course Code	Title of the Course	Contact Hours/Week			Marks			Credits
			L	T/S	P	ESA	CA	Total	
1	ZOO C 201	Cytogenetics and Molecular Biology	4	1	-	60	40	100	4
2	ZOO C 202	Biotechnology and Bioinformatics	4	1	-	60	40	100	4
3	ZOO C 203	Comparative Animal Physiology	4	1	-	60	40	100	4
4	ZOO C 204	Immunology and Parasitology	4	1	-	60	40	100	4
5	ZOO C 205	Practical III-(Cytogenetics, Molecular Biology and Biotechnology	-	-	6	60	40	100	3
6	ZOO C 206	Practical IV-(Animal Physiology and Parasitology)	-	-	6	60	40	100	3
Total						**360**	**240**	**600**	**22**

Semester III

Sl. No	Course Code	Title of the Course	Contact Hours/Week			Marks			Credits
			L	T/S	P	ESA	CA	Total	
1	ZOO C301	Developmental Biology	4	1	-	60	40	100	4
2	ZOO C 302	Ecology	4	1	-	60	40	100	4
3	ZOO E 303	Conservation Biology-I	4	1	-	60	40	100	4
4	ZOO E 304	Conservation Biology-II	4	1	-	60	40	100	4
5	ZOO C 305	Practical –V(Developmental Biology)	-	-	6	60	40	100	3
6	ZOO C 306	Practical VI-(Ecology & Conservation Biology)	-	-	6	60	40	100	3
Total						**360**	**240**	**600**	**22**

Semester IV

Sl. No	Course Code	Title of the Course	Contact Hours/Week			Marks			Credits
			L	T/S	P	ESA		Total	
1	ZOO C 401	Research Methodology-Concepts & Methods	4	1	-	60	40	100	4
2	ZOO E 402	Project	-	-	-	60	40	100	16
3	ZOO O 403	Human Physiology	3	-	-	60	40	100	3
Total						**180**	**120**	**300**	**23**

PROJECT WORK

The main objective of introducing a project work in the curriculum is that the student who completes this course should get hands on experience in independent research work in the field of biodiversity conservation and management. He/she should equip himself/herself to face challenges in Conservation Biology and should be able to provide trained manpower in the field.

A topic in the optional subject – Biodiversity: Conservation and Management shall be assigned to each student. The research work related to this topic will be carried out by each student under the supervision of a teacher. The report of the findings shall be submitted by each student in the form of a dissertation which shall be submitted for evaluation a day prior to the date of viva voce examination of the fourth semester. A declaration by the student to the effect that the dissertation submitted by him/her has not previously formed the basis for the award of any degree or diploma and a certificate by the supervising teacher to the effect that the dissertation is an authentic record of work carried out by the student under his supervision are to be furnished in the dissertation.

ZOO C 101 PHILOSOPHY OF SCIENCE, HISTORY OF BIOLOGY, EVOLUTION & PHYLOGENY

90 hrs

A. Philosophy of science

1. What is Science?

1.1 Origins of modern science.
1.2 Philosophy of Science- definition, scope.
1.3 Science and pseudo-science.

2. Scientific Reasoning

2.1 Deduction and induction
2.2 Hume's problem
2.3 Probability and induction

3. Explanation in Science

3.1 Hempel's covering law model of explanation
3.2 The problem of symmetry
3.3 The problem of irrelevance
3.4 Explanation and causality
3.5 Explanation and reduction

4. Scientific change and Scientific revolutions

4.1 Logical positivist philosophy of science
4.2 The structure of scientific revolutions
4.3 Incommensurability and theory ladenness of data

5. Science and its critics

5.1 Scientism.
5.2 Science and religion
5.3 Is Science value free?

B. History of Biology

1. An account on history of science

1.1 Ancient Greek philosophers 1
1.2 Brief account on the history of science
1.2.1 Before 17^{th} century; during 17^{th}, 18^{th} and 19^{th} centuries.

2. History of biology:

2.1 Seventeenth century:
2.1.1 Anatomists

2.1.2 Microscopists

2.2 Eighteenth century:

2.2.1 Great chain of being
2.2.2 Carl Linnaeus
2.2.3 Lamarck
2.2.4 Animal machine
2.2.5 Origin of physiology and embryology
2.2.6 Precursors to modern evolutionary theory.

2.3 Nineteenth century

2.3.1 Birth of associations and societies to promote science
2.3.2 Charles Darwin
2.3.2.1 Pre-Darwinian evolution
2.3.2.2 Origin of species
2.3.3 The emergence of biological disciplines
2.3.3.1 Experimental physiology
2.3.3.2 Cell theory; cell pathology; germ theory**.**

2.4 History of Biology during twentieth century:

2.4.1 First half of 20th century
2.4.1.1 Growth of microbiology and biochemistry
2.4.1.2 Genetics and heredity
2.4.2 Second half of 20th century
2.4.2.1 The architects of life - proteins, DNA and RNA
2.4.2.2 The origins and borderlines of life
2.4.2.3 Growth of genetic engineering
2.4.2.4 Growth of Biotechnology
2.4.2.5 Growth of Genomics
2.4.2.6 Growth of Recombinant DNA.

C. Evolution & phylogeny:

1. Introduction

1.1 What is evolution
1.2 Darwin's evolutionary theory
1.3 Evolution theories after Darwin
1.4 The evolutionary synthesis

2. Paleontology and evolutionary history

2.1 The evolutionary time scale
2.1.1 Eras, periods and epochs
2.2 Major events in the evolutionary time scale

3. Variations

3.1 Definitions
3.2 Sources of phenotypic variations
3.3 Principles of genetic variations in populations

3.4 Frequencies of alleles and genotypes
3.5 The Hardy-Weinberg Principle and its significance in evolution
3.6 Genetic variation in natural populations
3.7 Estimating the proportions of polymorphic loci
3.8 Variations at the DNA level
3.9 Variation among populations
3.9.1 Geographic variations
3.9.1.1 Patterns of geographic variations
3.9.1.2 Kinds of geographically variable characters
3.10 Genetic drift
3.11 Meiotic drive.

4. The Evolution of Biological Diversity

4.1 Patterns of origination and extinction
4.1.1 Causes of extinction
4.1.2 Origination and diversification.

5. Molecular population genetics
5.1 Patterns of change in nucleotide and amino acid sequences
5.2 Emergence of Non-Darwinism-Neutral Hypothesis.

6. Quantitative Genetics
6.1 Quantitative traits
6.2 Types, Analysis, Evolution
6.3 Quantitative traits and natural selection
6.3.1 Quantitative trait loci
6.4 Hheritability and realized heritability
6.5 Genotype – environment interactions
6.6 Threshold traits
6.7 Norm of reaction and phenotypic plasticity
6.8 Inbreeding depression and heterosis
6.9 Phylogenetic gradualism and punctuated equilibrium.

7. Genetics of Speciation
7.1 Species
7.1.1 Phylogenetic and biological concepts
7.2 Isolation
7.2.1 Patterns and mechanisms
7.2.2 Genetic basis of reproductive isolation
7.3 Modes of speciation
7.3.1 Allopatric, parapatric and sympatric
7.3.2 Polyploidy and recombinational speciation

8. Molecular Evolution
8.1 Concepts of neutral evolution
8.2 Molecular divergence and molecular clocks
8.3 Molecular tools in phylogeny

8.4 Protein and nucleotide sequence analyses
8.5 Origin of new genes and proteins
8.6 Gene population and divergence
8.7 Micro- and macro-evolution

REFERENCES

Philosophy of Science

1. Alan Chalmers. What is this thing called science? University of Queensland Press, Open University press, 3rd revised edition, Hackett,1999
2. Elliott Sober. Philosophy of Biology, West view press 2000
3. Richard Dewitt. Worldviews: an introduction to history and philosophy of science. Blackwell publishing 2004.
4. Boyd, R., Gasper, P., and Trout, J.D. (eds., 1991), The Philosophy of Science, Blackwell Publishers, Cambridge, MA.
5. Glazebrook, Trish (2000), Heidegger's Philosophy of Science, Fordham University Press.
6. Gutting, Gary (2004), Continental Philosophy of Science, Blackwell Publishers, Cambridge, MA.

History of Biology:

1. Allen, Garland E. Thomas Hunt Morgan: The Man and His Science. Princeton University Press: Princeton, 1978. ISBN 0-691-08200-6
2. Allen, Garland E. Life Science in the Twentieth Century. Cambridge University Press, 1975.
3. Annas, Julia Classical Greek Philosophy. In Boardman, John; Griffin, Jasper; Murray, Oswyn (ed.) The Oxford History of the Classical World. Oxford University Press: New York, 1986. ISBN 0-19-872112-9
4. Bowler, Peter J. The Earth Encompassed: A History of the Environmental Sciences. W. W. Norton & Company: New York, 1992. ISBN 0-393-32080-4
5. Bowler, Peter J. Evolution:The History of an Idea. University of California Press, 2003. ISBN 0-52023693-9.
6. Browne, Janet. The Secular Ark: Studies in the History of Biogeography. Yale University Press: New Have, 1983. ISBN 0300024606
7. Bud, Robert. The Uses of Life: A History of Biotechnology. Cambridge University Press: London, 1993. ISBN 0521382408
8. Coleman, William Biology in the Nineteenth Century: Problems of Form, Function, and Transformation. Cambridge University Press: New York, 1977. ISBN 0-521-29293-X
9. de Chadarevian, Soraya. Designs for Life: Molecular Biology after World War II. Cambridge University Press: Cambridge, 2002. ISBN 0521570786
10. Davies, Kevin. Cracking the Genome: Inside the Race to Unlock Human DNA. The Free Press: New York, 2001. ISBN 0-7432-0479-4
11. Holmes, Frederic Lawrence. Meselson, Stahl, and the Replication of DNA: A History of "The Most Beautiful Experiment in Biology". Yale University Press: New Haven, 2001. ISBN 0300085400
12. Kay, Lily E. The Molecular Vision of Life: Caltech, The Rockefeller Foundation, and the Rise of the New Biology. Oxford University Press: New York, 1993. ISBN 0-19-511143-5

13. Larson, Edward J. Evolution: The Remarkable History of a Scientific Theory. The Modern Library: New York, 2004. ISBN 0-679-64288-9
14. Lennox, James (2006-02-15). "Aristotle's Biology". Stanford Encyclopedia of Philosophy.
15. Lovejoy, Arthur O. The Great Chain of Being: A Study of the History of an Idea. Harvard University Press, 1936. Reprinted by Harper & Row, ISBN 0-674-36150-4, 2005 paperback: ISBN 0-674-36153-9.
16. Magner, Lois N. A History of the Life Sciences, third edition. Marcel Dekker, Inc.: New York, 2002. ISBN 0-8247-0824-5
17. Mason, Stephen F. A History of the Sciences. Collier Books: New York, 1956.
18. Mayr, Ernst. The Growth of Biological Thought: Diversity, Evolution, and Inheritance. The Belknap Press of Harvard University Press: Cambridge, Massachusetts, 1982. ISBN 0-674-36445-7
19. Mayr, Ernst and William B. Provine, eds. The Evolutionary Synthesis: Perspectives on the Unification of Biology. Harvard University Press: Cambridge, 1998. ISBN 0-674-27226-9
20. Morange, Michel. A History of Molecular Biology, translated by Matthew Cobb. Harvard University Press: Cambridge, 1998. ISBN 0-674-39855-6
21. Secord, James A. Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation. University of Chicago Press: Chicago, 2000. ISBN 0-226-74410-8
22. Serafini, Anthony The Epic History of Biology, Perseus Publishing, 1993. Sulston, John. The Common Thread: A Story of Science, Politics, Ethics and the Human Genome. National Academy Press, 2002. ISBN 0309084091
23. Smocovitis, Vassiliki Betty. Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology. Princeton University Press: Princeton, 1996. ISBN 0-691-03343-9
24. Spangenburg R and D K Moser. History of Science from the Ancient Greeks to the Scientific Revolution. 2000. Universities Press.
25. Spangenburg R and D K Moser. History of Science in the 18th Century. 2000. Universities Press.
26. Spangenburg R and D K Moser. History of Science in the 19th Century. 2000. Universities Press.
27. Spangenburg R and D K Moser. History of Science from 1895 to 1945. 2000. Universities Press.
28. Spangenburg R and D K Moser. History of Science from 1946 to 1990s. 2000. Universities Press.
29. Summers, William C. Félix d'Herelle and the Origins of Molecular Biology, Yale University Press: New Haven, 1999. ISBN 0-300-07127-2
30. Zimmer, Carl. Evolution: the triumph of an idea. HarperCollins: New York, 2001

Evolution & Phylogeny:

1. Brian K Hall, 2008. Evolution. (Fourth Edition) Jones and Bartlett Publishers.
2. Brian, K. Hall and Benedikt, Hallgrimsson (2008). Strickberger's Evolution, 4th Edition. Jones and Bartlett Publishers Intenational, London
3. Burton S Guttman, 2007. Evolution. One world oxford
4. Charles W. Fox and Jason B. Wolf (2006). Evolutionary Genetics. Oxford University Press, New York .
5. Derek K. A. Briggs, Jonathan A. Eisen, Dawd B. Goldstein, Nipan H Patel, and Nicholas H Barton, 2007. Evolution. CSHL Press.

6. Dobzhansky, T.H. (1951) Genetics and Origin of Species, Columbia University Press.
7. Dobzhansky, T.H., F.J. Ayala, C.L. Stebbines and J.M. Valentine. (1977) Evolution. Freeman, San Francisco.
8. Futuyma, D.J., (1997) Evolutionary Biology, 3rd edionSinauer Associates, INC Publishers, Dunderland.
9. Futuyma, D. J. (2005). Evolution. Sinauer Associates Inc. Sunderland, Massachusetts.
10. Hartl, D.L. and Clark, A. G. (1997). Principles of population genetics 3rd Edition. Sinauer Associates Inc. Sunderland, Massachusetts.
11. Fetzer J H. The Evolution of Intelligence (2005). The evolution of Intelligence. Open Court, Chicago.
12. Hartl, D.L.,and Calrk, A.G. (1989) A Primer of Population Genetics, 2nd edn. Sinauer Associates, Inc., Massachusetts.
13. Jha, A. P. (1993) Genes and Evolution, John Publication, New Delhi
14. Kennath V. Kardong, 2006. Vertebrates – Comparative Anatomy, Function, Evolution. (Fourth edition). Mc Graw Hill.
15. King, M. (1993) Species Evolution: the role of chromosomal change. The Cambridge University Press, Cambridge.
16. Lynn J Rothschild and Adrian M Lister.(2003). Evolution on Planet Earth. Academic Press.
17. Mark Ridley (1996). Evolution 2nd edition. Blackwell Science Inc. Massachusetts .
18. Necholas Baston, Derek E. G Briggs, Jonathan A Eisen, Danie Goldstein, Nipan H Patel.
19. Ohta, T. and Aoki (1985) Population Genetics and Molecular Evolution, Japanese Scientific Society Press, Japan.
20. Roger Lewin, 1999. Human Evolution (Fourth edition). B. Blackwell science.
21. Smith, J. M. Evolutionary Genetics. Oxford University Press, New York.
22. Strikberger, M.W. (2000) Evolution., Jones and Bartett Publishers, London.

ZOO C 102 BEHAVIOURAL SCIENCES

90 hrs

1. Introduction:

1.1 Approaches and methods in study of behavior

1.1.1 Studies in laboratory

1.1.1.1 Neuroanatomical or lesion or ablation technique

1.1.1.2 Neurophysiological technique

1.1.1.3 Neurochemical technique

1.1.2 Studies in wild

1.1.2.1 Methods of location of animals

1.1.2.2 Methods of identification and naming of animals

1.1.2.3 Methods of observation of behavior patterns of animals

1.2 Proximate and ultimate causes of behaviour

2. Physiology of behaviour:

2.1 Neural basis of behavior

2.1.1 Brain and behavior

2.1.2 Role of nervous system upon reflexes

2.2 Hormones and behavior

2.2.1 Basic categories of hormones related to animal behavior
2.2.1.1 Activational or releaser hormones
2.2.1.2 Organizational hormones
2.2.2 Groups of hormones controlling animal behavior
2.2.2.1 Primary or direct producers of behavior
2.2.2.2 Secondary or indirect producers of behavior
2.2.3 Hormonal impact on various behavipoural patterns
2.3 Biological clocks
2.3.1 Types of biological clocks
2.3.1.1 Circannual clocks
2.3.1.2 Circatidal clocks
2.3.1.3 Circalunar or Circasynodic clocks
2.3.1.4 Semilunar or Circasyzygic Clocks
2.3.1.5 Circadian clocks
2.3.2 Theories for the mechanism of the biological clock

3. Genetics of behaviour
3.1 Hybridization
3.2 Single or multiple gene effect
3.3 Gene mutations which influence behavior
3.4 Relationship between genes and environment in control of behavior

4. Ecology of Behaviour
4.1 Natural Selection
4.2 Adaptations
4.3 Adaptive convergence and adaptive divergence
4.4 Behaviour with special reference to K and r selected species

5. Social Behaviour:
5.1 Basic Social Units
5.2 Cultural transmission
5.2.1 Parts of cultural transmission
5.2.1.1 Social learning
5.2.1.2 Teaching
5.2.2 Modes of cultural transmission
5.2.2.1 Vertical cultural transmission
5.2.2.2 Horizontal cultural transmission
5.2.2.3 Oblique cultural transmission
5.3 Cooperation
5.3.1 Paths to co-operation
5.3.1.1 Kin selection
5.3.1.2 Reciprocity
5.3.1.3 Byproduct mutualism
5.3.1.4 Group selection
5.3.2 Range of co-operative behavior
5.3.2.1 Helping in the birthing process
5.3.2.2 Social grooming
5.3.2.3 Group hunting

5.3.2.4 Nest raiding
5.3.3 Interspecific co-operation
5.3.4 Role of Altruism and reciprocal altruism in co-operation

5.4 Communication
5.4.1 Components of communication system
5.4.2 Signals in communication system
5.4.3 Types of communication systems
5.4.3.1 Chemical communication
5.4.3.2 Visual communication
5.4.3.3 Auditory communication
5.4.3.4 Tactile communication
5.4.3.5 Electrical communication
5.4.3.6 Complex communication systems

5.5 Habitat selection
5.5.1 Habitat
5.5.2 Micro habitat
5.5.3 Models of habitat choice
5.5.3.1 Ideal Free Distribution model (IFD)

5.6 Territoriality
5.6.1 Territory
5.6.2 Size of territory
5.6.3 Territory and foraging
5.6.4 Territory and breeding
5.6.5 Territory and learning
5.6.6 Interspecific territoriality
5.6.7 Economy of territoriality
5.6.8 Functions of territoriality

5.7 Migration
5.7.1 Bird Migration
5.7.1.1 Types of migration
5.7.1.2 Causes of migration
5.7.1.3 Classification based on migratory status
5.7.1.4 Orientation and navigation in migration
5.7.1.5 Conditional strategy hypothesis of migration
5.7.2 Fish migration
5.7.2.1 Types of migration based on causes
5.7.2.2 Classification migratory fishes
5.7.2.3 Factors influencing migration

5.8 Aggression
5.8.1 Types of aggression
5.8.2 Intraspecific aggression
5.8.2.1 Inerspecific aggression
5.8.3 Causes of aggression
5.8.4 Game theory models of aggression
5.8.4.1 Hawk-dove game model
5.8.4.2 The war of attrition model
5.8.4.3 Sequential assessment model

5.9 Foraging

5.9.1 Foraging strategies
5.9.2 Learning and Foraging
5.9.3 Optimal Foraging Theory

5.10 Antipredation
5.10.1 Different methods of antipredatory behaviour
5.10.2 Learning and antipredator behaviour
5.10.3 Inter-populational differences in antipredator behaviour

6. Sexual Behaviour:

6.1 Sexual selection
6.1.1 Types of sexual selection
6.1.1.1 Intersexual selection
6.1.1.2 Intrasexual selection

6.2 Different mating systems
6.2.1 Monogamy
6.2.1.1 Categories based on male potential investment
6.2.1.1.1 Facultative monogamy
6.2.1.1.2 Obligate monogamy
6.2.1.1.3 More male investment monogamy
6.2.1.2 Categories based on territoriality
6.2.1.2.1 Territorial monogamy
6.2.1.2.2 Female defense monogamy
6.2.1.3 Categories based on temporal relationship between male and female
6.2.1.3.1 Annual or seasonal monogamy
6.2.1.3.2 Permanent or perennial monogamy

6.2.2 Polygamy
6.2.2.1 Polygyny
6.2.2.1.1 Territorial polygyny
6.2.2.1.2 Harem polygyny
6.2.2.1.3 Resource based polygyny
6.2.2.1.4 Successive or serial polygyny
6.2.2.1.5 Simultaneous polygyny
6.2.2.2 Polyandry
6.2.2.2.1 Territorial polyandry
6.2.2.2.2 Nonterritorial polyandry
6.2.2.2.3 Polygynous-polyandry (polygynandry)
6.2.2.2.4 Serial or successive polyandry
6.2.2.2.5 Simultaneous polyandry

6.2.3 Promiscuity
6.2.3.1 Broadcast promiscuity
6.2.3.2 Overlap promiscuity
6.2.3.3 Lek or area promiscuity
6.2.3.4 Heirarchial promiscuity

7. Parental Care:

7.1 Parts of parental care
7.1.1 Care before birth
7.1.2 Care after birth
7.1.3 Early parental care

7.2 General features of parental behavior
7.3 Factors affecting parental care
7.4 Types of parental care
7.5 Care and attachment
7.6 Parent –offspring conflict

8. Evolution of behaviour:

8.1 Patterns of evolution of behaviour
- 8.1.1 Divergent evolution of behaviour
- 8.1.2 Convergent evolution of behaviour

8.2 Prime movers of behavioural evolution
- 8.2.1 Phylogenetic Inertia
- 8.2.2 Ecological pressure

8.3 Microevolution of behaviour
8.4 Methods in study of evolution of behaviour
- 8.4.1 Comparison at the species level
- 8.4.2 Comparison at the phyletic level

8.5 Domestication and behavioural changes

REFERENCES

1. Amita Sarkar, 2004. Development of Animal Behaviour, discovery publishing house
2. Bolchuis J J and Hogan J A.(1999). The development of Animal Behaviour. Blackwell Publishers.
3. Boulenger, E.G 2003, An Introduction to animal behaviour, Discovery publishing house, New Delhi.
4. Goodenough, J.; McGuire B. and Robert, W. (1993) Perspectives on Animal behaviour. John Wiley and Sons, Lond.
5. John alcock (2001) animal behaviour – 7th edition. Sinauer assn. publ.
6. John Alcock, 2005. Animal Behaviour, (8th edition). Sinauer Associates, Inc. publishers.
7. Lee Alan Dugattan (2004) Principles of animal behaviour w.w. Norton & company.
8. Lehner, P. (1996) Handbook of Ethological methods. Cambridge Univ. Press, Lond.
9. Manning, A. and Dawkins, M.S. (1995) An Introduction to Animal Behaviour. Cambridge University Press.
10. Manning, A.(1967) An Introduction to Animal Behaviour. Edward Arnold Pub., London
11. Martin, P. and Bateson, P. (2001) Measuring Behaviour–an Introductory guide. Cambridge Univ. Press
12. Postlewait, J.H. and Hopkins, B.L. (1995) Nature of life. McGraw Hill
13. Salim,A (1996) Book of Indian Birds. BNHS, India
14. Slater, P.J.B. (1995) An Introduction to Ethology. Cambridge Univ. Press. Lond.
15. Slater, P.J.B. (1999) Essentials of Animal Behaviour. Cambridge Univ. Press.
16. Slater, P.J.B. and Halliday, T.R. (1994) Behaviour and Evolution. Cambridge Univ. Press. Lond.

ZOO C 103 CHEMISTRY FOR BIOLOGISTS

90 hrs

1. Introduction:

1.1. Biochemistry and organisation of cells.
1.2. Molecular logic of life.
1.3. Chemical unity and biological diversity.
1.4. Biopolymers.
1.5. The physical roots of the biochemical world.

2. Bioenergetics & oxidative metabolism:

2.1 Laws of thermodynamics in biological system entropy, enthalpy, concept of free energy; 2.2 High-energy compounds; role of ATP in the biological system.

3. Carbohydrates:

3.1 Structure of monosaccharides, disaccharides, oligosaccharides and polysaccharides (chitin, bacterial cell wall and glycogen).
3.2 Physical and chemical properties of monosaccharides.
3.3 Glycolysis; fate of pyruvate; gluconeogenesis; HMP pathway; glycogenolysis; glycogenesis.
3.4 Regulation of glycogen synthesis and breakdown.
3.5 Citric acid cycle; electron transport chain; oxidative phosphorylation; redox potential; chemi-osmotic hypothesis; uncouplers; inhibitors of electron transport chain.

4. Lipids:

4.1 Classification of lipids, classification of fatty acids.
4.2 Physical and chemical properties of lipids.
4.3 Structural lipids in membranes; sphingolipids in biological recognition.
4.4 Oxidation of fatty acids (saturated, unsaturated and odd carbon), Ketone bodies
4.5 Biosynthesis of fatty acids; biosynthesis and degradation of cholesterol.
4.6 Prostaglandins.

5. Amino acids and proteins:

5.1 Structure of different amino acids in proteins. Physical and chemical properties of amino acids. Peptide bonds; Zwitter ions.
5.2 Metabolism of amino acids; transamination, decarboxylation and deamination reactions in the biological system; inborn errors in metabolism.
5.3 Classification of proteins; glycoproteins and proteoglycans
5.4 Structure of proteins; Ramachandran plot
5.5 Nitrogen excretion and urea cycle.

6. Enzymes:

6.1 Introduction
6.2 Classification and nomenclature
6.3 Specificity, various factors influencing velocity of enzyme catalysed reactions
6.4 Michaelis-Menten equation & Kinetics
6.5 Line weaver-Burk plot
6.6 Enzyme inhibition-reversible and irreversible (competitive and non-competitive) with examples. Enzyme inhibition in the treatment of AIDS
6.7 Regulatory enzymes- Allosteric enzymes
6.8 Zymogens, isozymes

7. Nucleic acids:

7.1 Chemistry, biosynthesis and degradation of nucleic acids

7.2 Structure of DNA and RNA; Sequencing of DNA.

8. Vitamins:

8.1 Chemical nature and functions of vitamins

8.2 Role of B-complex vitamins as coenzymes.

REFERENCES

1. Alberts, Johnson, Lewis, Raff Roberts Walter- 2008- Molecular
2. Berg, J.M., Tymoczko, J. L. and Stryer, L. (2002) Biochemistry, W.H. Freeman and Co., New York.
3. Biology of the Cell (5th ed.)-Garland Science
4. Campbell, Farrel, 2007, Biochemistry (5th ed) Thomson, Brooks and Cole Publ.
5. Das, D. (2000) Biochemistry, Academic Publishers, Calcutta
6. David D. Plummer, 2008. an introduction to practical Biochemistry (3rd ed) Tata McGrawHill.
7. Deb, A C 2008. Comprehensive Viva and Practical Biochemistry. Central Publ.
8. Deb, A C 2008. Fundamentals of Biochemistry. New Central Book Agency.
9. Debajyotjhi Das, 2008. Biochemistry. Academic Publ.
10. Devlin, T.W. (2000). A Text Book of Biochemistry with Clinical Correlations, Wiley-Liss, NY.
11. Donald J Voet, Jubith J Voet, Charlotte, W. Pratt, 2007. Prinicples of Biochemistry (3rd ed). John Wiley.
12. Eric E Conn, Paul K Stumpf, George Bruening, Roy H Dol, 2007. Outlines of Biochemistry (5th Ed) Wiley India.
13. Garret, Grisha, 2005. Biochemistry (3rd ed). Thomson Brooks/cole Publ.
14. Gerald, Litwalk, 2008. Human Biochemistry and Disease. Academic Press.
15. Guptha, R C and S. Bhargav, 2006. Practical Biochemistry (4th ed.). CBS Publ.
16. Jayaraman, J 2007. Lab. Manual in Biochemistry, New Age International Publ.
17. Jermy M Berg, John L Tymoczko, Lubert Stryer, 2007, Biochemistry. (6th ed.) Freeman Publ.
18. Keith Wilson and John Walker, 2008. Principles and Techniques of Biochemistry and Mol. Biol. (6th Ed). Cambridge. Univ. Press.
19. Lehninger A.L., Nelson D.L. and Cox M.M. (2000). Principles of Biochemistry, II Ed. Worth Publishers, NY.
20. Mathews, van Holde, Ahern, 2007. Biochemistry (3rd ed). Pearson Edu.
21. Michael M Cox, David L. Nelson, 2008. Prionciples of Biochemistry (5th ed). Freeman Publ.
22. Murray K.K., Granner D.K., Mayes P.A. and Rodwell V.W. (1993). Harper's Biochemistry 23rd Ed. - A Lange Medical Book, Prentice Hall International, UK.
23. Narayanan, P. (2000) Essentials of Biophysics. New Age International (P) Ltd., Publishers, New Delhi
24. Pattabhiraman, T. N 2008. Laboratory manual and Practical Biochemistry (4th ed). All India Publ.
25. Rober K murrey, Daryl K Granner, Victor W Rodwell, 2006. Harpers Illustrated Biochemistry (27th ed) Mc Graw Hill.
26. S P Singh, 2007. A Text Book of Biochemistry (4th ed) CBS.
27. Stryer, L. (1995) Biochemistry, IV Ed. Freeman & Co., NY.
28. Sathyanarayana, U and Chakrapani, U 2008, Biochemistry (3rd ed.). Uppala Author Publ.

29. Westhead, D.R., and Parish, J.H (1998) *Instant Notes* in Biochemistry, Bios Scientific Publishers Ltd., U.K.
30. L Veerakumari, 2007, Biochemistry, MJP Publishers.
31. William J Marshal, Stephan K Bangert, 2008. Clinical Biochemistry, Metabolic & Clinical Aspects (2nd ed). Churchil Livingstone.
32. William J Marshal, Stephen K Bangert, 2008. Clinical Biochemistry (6th ed)

ZOO C 104 PHYSICS FOR BIOLOGISTS AND STATISTICS FOR BIOLOGISTS

90 hrs

A. Physics for Biologists:

1. Biophysical methods:

1.1 Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy.
1.2 Structure determination using X-ray diffraction and NMR, analysis using light scattering;
1.3 Different types of mass spectrometry and surface plasma resonance methods.
1.4 Laser and its application in Biology

2. Radiation biology:

2.1 Properties of different types of radioisotopes normally used in biology, their detection and measurement.
- 2.1.1 Autoradiography
- 2.1.2 G.M. counter
- 2.1.3 Incorporation of radioisotopes in biological tissues and cells
- 2.1.4 Applications of tracer techniques.
- 2.1.5 Radiation protection and therapy; safety guidelines.

3. Bioacoustics:

3.1 Physical basis of hearing
- 3.1.1 Physical aspects of sound transmission in the ear;
- 3.1.2 Echocardiography
- 3.1.3 Ultrasonography.

4. Biophysics of vision:

4.1 Eye as an optical instrument;
- 4.1.1 Formation of image.

5. Electrophysiological methods:

5.1 Single neuron recoding
5.2 Patch clamp recording
5.3 ECG, EEG, PET, MRI, CAT

6. Biophysical methods and their applications:

6.1 Microscopy
- 6.1.1 Bright field

6.1.2 Phase contrast
6.1.3 Fluorescence
6.1.4 SEM
6.1.5 TEM
6.1.6 STEM
6.2 Colorimetry;
6.3 Spectrophotometry
6.4 Flow cytometry
6.5 Gel-filtration
6.6 TLC
6.7 HPLC
6.8 Gel electrophoresis
6.9 Centrifugation
6.9.1 Differential
6.9.2 Density gradient
6.9.3 Ultracentrifugation.

B. Statistics for biologists:

1. Introduction:
1.1 Attributes and variables
1.1.1 Collection, classification and tabular presentation of data.

2. Diagrammatic and graphical presentation of data:
2.1 Bar diagram
2.2 Pie diagram;
2.3 Histograms
2.4 Frequency polygon
2.5 Frequency curve.

3. Measures of central tendency:
3.1 Arithmetic mean
3.2 Median
3.3 Mode.

4. Measures of dispersion:
4.1 Range
4.2 Mean deviation
4.3 Quartile deviations
4.4 Standard deviation
4.5 Variance.

5. Probability:
5.1 Basic concepts and definition
5.1.1 Classical definition and relative frequency definition
5.1.2 Laws of probability
5.1.3 Probability distribution (binomial, poisson and normal distribution).

6. Sampling:

6.1 Random sampling
6.2 Sample designs
6.3 Sampling distribution and standard error
6.4 Sampling surveys.
6.5 Statistical inference:
6.6 Testing of hypothesis
6.7 Level of significance
6.8 Critical region
6.9 Type I error and Type II error
6.10 Standard tests like Z-test, *t*-test and X^2 test; estimation.

7. Analysis of variance:

7.1 ANOVA.

8. Regression analysis and correlation analysis:

8.1 Types of regression
8.1.1Methods of regression
8.2 Kinds of correlation
8.2.1 Degree and types of correlation

REFERENCES

Physics for Biologists

1. Cotterill Rodney (2004). Biophysics: an Introduction. Wiley student edition
2. Daniel, M. (2002) Basic Biophysics for Biologists. Agro Botanica, Bikaner
3. Das, D. (1991) Biophysics and Biophysical Chemistry, Academic Publishers, Calcutta
4. Dr. R.N Roy, 2007. A Text Book of Biophysics. Central Publishers.
5. Ernster, L. (Ed.) (1985) Bioenergetics, Elsevier, New York.
6. Foyer, C. H. (1984) Photosynthesis. Wiley, New York.
7. Gurumani N. Research Methodology
8. Hoppe, W. *et al*., (eds.) (1983) Biophysics. Springer Verlag, Berlin.
9. Lehninger, A. L. (1971) Bioenergetics. W. A. Benjamin, London.
10. Marimuthu R (2008). Microscopy and microtechnique. MJP Publishers.
11. Marshall, A.G. (1978) Biophysical Chemistry, Principles, Techniques and Applications, John Wiley & Sons, New York.
12. Mohan P Arora, 2007. Biophysics. Himalaya publishing house.
13. Narayan, P. (2000) Essentials of Biophysics. New Age International (P.)Ltd.,
14. Nicholis, D.G. and Ferguson, S.J. (1992) Bioenergetics, Academic Press, New York.
15. Pattabhi Vasantha & N Gautham (2009). Biophysics (2nd Ed). Narosa.
16. P. Narayana, 2007. Essentials of Biophysics. (Second edition). New age International publishers.
17. Roy, R. N. (1996) A Text Book of Biophysics. New Central Book Agency Pvt.,Ltd., Calcutta.
18. S.K Agarwal, 2005. Advanced Biophysics. APH
19. Sandhu, G.S. (1990) Research Techniques in Biological Sciences. Anmol Publications, New Delhi.

20. Slayter, E. M. (1970) Optical methods in biology. Wiley Interscience.
21. Upadhyay, A. Upadhyay, K. and Nath, N. (1997) Biophysical Chemistry: Principles and Techniques. Himalaya Publishing House, Nagpur.
22. Upadhyay, Upadhyay and Nath, 2008. Biophysical chemistry – Principles and Techniques. Himalaya Publishing house.
23. White, D.C.S. (1974) Biological Physics, Chapman and Hall, London.

Statistics for Biologists

1. Agarwal, B. L. (1996) Basic Statistics. New Age International (P) Ltd. Publishers, New Delhi.
2. Bailey, N. T. J. (1981) Statistical Methods in Biology. Hodder and Stongtton, London.
3. Campell, R.C. (1978) Statistics for Biologists. Balcker and Sons Publishers, Bombay.
4. Caswell, F. (1982) Success in Statistics. John Murray Publishers, Ltd., Mumbai.
5. Dixon and Massy. Statistical Analysis (3rd Edition), Mc Graw Hill, New York.
6. Elhance, D.N. (1985) Fundamentals of Statistics. Kitab Mahal., Allahabad.
7. Finney, D.J. (1980) Statistics for Biologists. Chapman & Hall, London.
8. G.V Rao and N. K Tiwari, 2008. Biostatistics and computer applications. Pharma med press.
9. Gupta, C.B. and Gupta, V. (2002) Statistical Methods. Vikas Publishing House, New Delhi.
10. Gupta, S.P. (1996) Statistical Methods. Sultan Chand & Sons Publishers, New Delhi.
11. Heel Elementary Statistics (2nd Edn.) John Wiley & Sons Inc., New York.
12. Hughes, G. Statistics Addition, Wesley Publishing Co.
13. Jazar and Jerrold (1999) Biostatistical Analysis. Pearson Education.
14. Jerrold H Zar, 2004. Biostatistical analysis. (4th ed.) Pearson.
15. N. Gurumani, 2005. An introduction to Biostatistics, MJP Publishers.
16. Norman T.J Bailey, 2004. Statistical methods in Biology (Third Edition). Cambridge.
17. Parzen, E. Modern Probability Theory. John Wiley & Sons, Inc., New York.
18. Pillai, R.S.N. and Bagavathi (1987) Practical Statistics. S Chand and Co.,Pvt.,Ltd. New Delhi.
19. Vashisth, A. K 2008. Text book of biostatistics ARISE publishers and distributors
20. Veer bala Rstogi, 2008. Fundamentals of Biostatistics. ANE books India.
21. Wayne, D. W. (1987) Biostatistics – A Foundation Analysis in the Health Sciences, John Wiley & Sons, New York.
22. Waynew Daniel. 2007. Biostatistics. A foundation for analysis in the health sciences (7th ed.) Wiley India.

ZOO C 105 PRACTICAL I (BIOCHEMISTRY)

1. Quantitative estimation of carbohydrates
- 2.1 Estimation of total carbohydrate
- 2.2 Estimation of blood glucose by colorimetric methods
- 2.3 Estimation of sugar (Anthrone method)

2. Quantitative estimation of proteins
- 2.1 Estimation of serum proteins by colorimetric method (Biuret method)
- 2.2 Estimation of total proteins (Lowry's method)

3. Quantitative estimation of lipids
- 3.1 Estimation of serum cholesterol
- 3.2 Estimation of total lipids in the serum (using phosphovanillin method)

4. Enzyme assays

4.1 Determination of salivary amylase activity-effect of substrate concentration
4.2 Determination of salivary amylase activity - effect of pH
4.3 Estimation of acid phosphatase
4.4 Estimation of alkaline phosphatase
4.5 Estimation of serum amylase

5. Estimation of urea

ZOO C 106 PRACTICAL II (BIOPHYSICS & BIOSTATISTICS)

Biophysics

1. Absorption spectrum of potassium permanganate.
2. Determination of absorption coefficient and concentration of unknown solutions by calibration as well as by absorption coefficient.
3. Separation of mixtures of sugars and amino acids by paper/thin layer chromatography.
4. Micrometry
5. Phase contrast microscope, camera Lucida, Photomicrography equipment.
6. Determination of coefficient of viscosity.
7. Determination of pH of various biological fluids using pH meter.

Biostatistics

1. Preparation of frequency distribution for the data of a group of people according to height.
2. Diagrammatic presentation of data in the form of bar diagrams and pie diagrams.
3. Graphic presentation of a population distribution according to age in the form of histogram, frequency polygon and frequency curve.
4. Computation of measures of central tendency and dispersion in anthropometric data of school children.
5. Simulation of binomial and poison distributions.
6. Design an experiment by the method of ANOVA.
7. Correlation analysis and regression analysis of a data of heights and weights of a group of students.

II SEMESTER

ZOO C 201 CYTOGENETICS AND MOLECULAR BIOLOGY

90 hrs

A. Cytogenetics:

1. Membrane systems of cell:

1.1 Plasma membrane:
1.11 Structure and function of plasma membrane
1.12 Molecular models of plasma membrane structure
1.13 Movement of substances across cell membranes (diffusion, active transport and pumps).
1.2 Cytomembrane systems:

1.21 Structure, function and membrane trafficking
1.22 Endoplasmic reticulum
1.23 Golgi complex
1.24 Types of vesicle transport and their functions
1.25 Cellular uptake of particles and macromolecules

2. **Cellular energy transactions**:
   2.1 Role of mitochondria and chloroplasts.

3. **Signal transduction**
   3.1 The basic elements of cell signaling systems.
   3.2 G protein coupled receptors and their second messengers
   3.3 Protein- Tyrosine phosphorelation as a mechanism for signal transduction.
   3.4 The role of calcium as an intracellular messenger

4. **Cell Cycle Mechanisms**:
   4.1 Genetic regulation of cell division in yeast and eukaryotes
   4.2 Molecular basis of cellular check points
   4.3 Molecular basis of Neoplasia.

5. **Human cytogenetics:**
   5.1 Numerical and structural abnormalities of human chromosomes–syndromes
   5.2 Gene mutations
   5.3 Chromosome based heritable diseases in humans (Haemophilia, colour blindness)

6. **Microbial genetics:**
   6.1 Bacterial transformation, transduction, conjugation and bacterial chromosome.
   6.2 Bacteriophages: structure and morphology of T_4 and lambda phages.

7. **Transposable genetic elements:**
   7.1. Genetic instability and the discovery of transposable elements
   7.2. Transposons in bacteria
      7.1.1 IS elements, the Tn family
      7.1.2 Mu phage as a transposable element
   7.2 Transposons in eukaryotes
      7.2.1 Controlling elements in maize
      7.2.2 P elements in *Drosophila;*
   7.3 Retroposon type transposition
      7.3.1 Yeast Ty elements
      7.3.2 Alu family
   7.4 Retroviruses and transposition

8. **Apoptosis:**
   8.1 Intrinsic pathway of apoptosis
   8.2 Extrinsic pathway of apoptosis

B. Molecular Biology:

1. **Genes and genomes:**
   1.1 Genomes of prokaryotes and eukaryotes
   1.2 Organelle genomes
   1.3 Evolution of genomes.

2. **Characteristic features of eukaryotic genome:**
   2.1 Chromosomal content and C-value paradox
   2.2 Unique, moderately repetitive and highly repetitive DNA sequences
   2.3 Reassociation kinetics of the above types of DNA
   2.4 Cot value and complexity of the genome

3. **Chemistry and Structure of nucleic acids:**
   3.1 Topology of nucleic acids
   3.2 Supercoiling and topoisomerases
   3.3 Different forms of DNA (A, B, C & Z).

4. **Replication of DNA:**
   4.1 Models of DNA replication: Semiconservative mode (Experiments of Messelson and Stahl and that of Cairns), rolling circle mode and D-loop mode of replication. Role of antisense RNA in replication initiation in plasmids.
   4.2 Okazaki fragments and semi-discontinuous synthesis.
   4.3 Enzymes and accessory proteins involved in DNA replication.
   4.4 Primosome, replisome, Telomeric DNA and regulation of telomere length; reverse transcription.

5. **DNA Repair:**
   5.1 Excision repair, mismatch repair light dependant repair and SOS response

6. **The genetic code:**
   6.1 Characteristic features of the genetic code (triplet, comma less, non-overlapping a universal nature of the code).
   6.2 Deciphering the code
   6.3 Degeneracy of the code: Wobble hypothesis
   6.4 Reading frame and frame shift.

7. **Transcription in prokaryotes and eukaryotes.**
   7.1 Initiation of transcription, elongation, termination and anti-termination
   7.2 Promoter, enhancer and silencer sites
   7.3 Transcription factors.
   7.4 Post transcriptional modification of RNA
      7.4.1 Capping and Tailing of mRNA
      7.4.2 Removal of intron sequences by RNA splicing in mRNA, *t* RNA and r RNA, Splicing and Ribozyme. Biochemistry of ribozymes
      7.4.3 Cis – and trans-splicing
      7.4.4 RNA editing- g RNA.

8. **Details of translation:**
   8.1 Initiation, elongation and termination of protein synthesis

8.2 Structure of *t* RNA
8.3 Various steps and factors involved in translation.

9. Regulation of gene expression in bacteria:
9.1 The operon model. : *Lac* operon, *lac* repressor, negative and positive control
9.2 Basic features of tryptophan operon
9.3 Operator-repressor regulation and attenuation regulation

10. **Regulation of gene expression in phages:**
10.1 Circuit of lytic cycle and lysogeny
10.2 Lytic cascade in λ phage
10.3 Transduction - generalized and specialized.

11. Regulation of gene expression in eukaryotes:
11.1 Regulation at transcriptional level
11.1.1 Activation of transcription
11.1.2 Repression of transcription
11.2 Regulation at translational level
11.2.1 Regulation by gene arrangement
11.2.2 Regulation by alternate pathways of transcript splicing
11.2.3 Anti - sense RNA strategies for regulating gene expression; molecular mechanisms of anti-sense molecules.

REFERENCES

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., and Watson, J.D. (2000). Molecular Biology of the Cell. Garland, NY
2. Alberts, Johnson, Lewis, Raff Roberts Walter- 2008- Molecular Biology of the Cell (5th ed.)- Garland Science
3. Becker, W.M., Rece, J. B. and Poenie, M. F. (1996) The World of the Cell. The Benjamin/Cummings Publishing Company.
4. Benjamin Lewin, Lynne Cassimeris, Vishwqanath R. Lingappa, George Plopper(Lead ed). Leslie Pond, Jamie Kass (Scientific ed)- 2007. Cells- Jones and Bartlett Publishers.
5. David Freifelder 2008.Molecular Biology (2nd ed)- Narosa Publishing House.
6. De Robertis, E.D.P. &. De Robertis E.M.F (!995) . Cell and Molecular biology. (Lea & Febiger, 1987) B.I. Waverly, New Delhi.
7. E.D. P. De Robertis 2006. Cell and Molecular Biology (8th ed)Lippincott Williams and Wilkins
8. George M.Malacinski 2002. Essentials of Molecular Biology (4th ed) Jones and Bartlett Publishers.
9. Gerald Karp 2007. Cell and Molecular Biology (5th ed)-Wiley P.K.Gupta, 2008. Cell and Molecular Biology (3rd ed) Rastogi Publications.
10. Karp, G. (2002) Cell and Molecular Biology. John Wiley, New York.
11. Klinemith, L. J. and Kish, V. M. (1995) Principles of Cell and Molecular Biology. 2nd Ed. Harper Collins College Publishers.
12. Lehninger A.L., Nelson D.L. and Cox M.M. (1993). Principles of Biochemistry, II Ed. Worth Publishers, NY.
13. Lewin, B., Genes VII (2000). Oxford University Press, New York
14. Lizabeth A. Allison 2007. Fundamentals of Molecular Biology- Blackwell Publishing

15. Lodish, Berk, Kaiser, Krieger, Scott, Bretscher, Ploegh Matsudaira 2008. Molecular Cell Biology (6th ed)-W.H. Freeman and Company.
16. Lodish, H., Baltimore, D., Berk, A., Zipursky, S.L., Matsudaira , P. and Darnell, J. (2000). Molecular Cell Biology . III Ed. Scientific American Books, New York.
17. Malcinski, G. M. and Freifelder, D. (1998) Essentials of Molecular Biology. 3rd Ed. Jones and Bartlett Publishers.
18. Pavel A. Pevzner. –Computational Molecular Biology- An Algorithmic Approach-Parentice – Hall of India
19. Pragya Khanna 2008. Cell and Molecular Biology Ik International
20. Purves, W.K., Orians, G.H. and Heller, H.C, (1995) The Cell and Heredity., Life, The Science of Biology, 4th edn., Sinauer Associates, Inc., MA.
21. S.C. Rastogi 2008. Cell and Molecular Biology (2nd ed)- New Age International Pvt. Ltd.Publishers.
22. Snustad, D.P. and Simmons, M.J. (2000) Principles of Genetics. 2nd Ed. John Wiley & Sons Inc.
23. Synder, L. and Champness,W. (1997) Molecular Genetics of Bateria ASM Press Washington, DC.
24. T. A Brown 2007 Genomes (3rd ed) Garland Science Publishing (Taylor and Francis Group).
25. Tamarin, R.H. (2002) Principles of Genetics, Tata McGraw-Hill, New York, New Delhi.
26. Thomas D. Pollard, William C.Earnshan (with JenniferLippincott Schwartr) 2008.Cell Biology-Saunders (2nd ed)
27. Tobin, A.J. and Morel, R.E. (1997) Asking about cells, Harcourt Brace & Co.
28. Watson J.D., Gilman M., Witkowski J. and Zoller, M. (1992). Recombinant DNA, II Edition, Scientific American Books, W.H.Freeman and Company.
29. Watson, Baker, Bell, Gann, Levine, Losick-2008. Molecular Biology of the Gene (6th ed)- Pearson International ed.
30. Watson, J. D., Hopkins, N. H. Roberts, J. W. Steits, J. A. and Weiner, A.M. (1987) Molecular Biology of the Gene Vols. I & II. The Benjamin/Cumming Publishing Company.
31. Wayne M. Becker, Lewis J.Kleinsmith, Jeff Hardin, Gregory Paul Bertoni-2009. The world of the Cell (7th Ed)- Pearson International ed.
32. Benjemin A. Pierce 2008. Genetics- A Conceptual Approach (3rd ed)- W.H. Freeman and Company
33. Benjemin Lewin. 2008- Genes IX Jones and Barjlett Publishers.
34. Charles W. Fox, Jason B. Wolf. 2006- Evolutionary Genetics- Concepts and Case Study- Oxford
35. Daniel L. Hartl and Andrew G. Clark, 2007. Principles of Population Genetics 94th ed)- Sinauer Associates Inc. Publishers.
36. David A. Micklos, GregFreeyer and David A. Crotty. 2002. DNA Science (2nd ed)- CSHL Press.
37. Emmanuel, C. Rev.Fr. S. Ignacimuthu S.J., S. Vincent. 2006. Applied Genetics- Recent Trends and Techniques. M.J.P. Publishers.
38. Gardner, Simmons, Snustad 2007. principles of Genetics (8th ed)- Wiley India
39. Hancock, J.T. 2008. Molecular Gwenetics- Viva Books Pvt. Ltd.
40. Klug, Kummings, Spencer, Palladino 2009. Concepts of Genetics (9th ed)- Pearson International Edition
41. Larry Snyder and Wendy Champness. 2007. Molecular Genetics of Bacteria (3rd ed)- Asin Press.
42. McGuffin 2008. Behavioural Genetics (5th ed)-Woth Publishers
43. Monroe W. Strickberg 2008. Genetics (3rd ed)-Pearson Education
44. Peter D. Turnpenny, Sian Ellard, 2007. Elements of Medical Genetics (13th ed)- Churchil Livingstone.

45. Robert H. Tamarin, 2007. Principles of Genetics (7th ed)- Tata Mcgraw- Hill Publishing Company Ltd.
46. Robert Plomin, John C. DeFries, Genald E. Mc Clearn, Peter
47. Sandhya mithra 2005. Genetic Engineering- principles and Practice- Macmillan India Ltd.
48. Snustad, Simmons. 2003-Principles of genetics (3rd ed)- Wiley.
49. William S. Klug, Michael R. Cummings.2005. Concepts of Genetics (7th ed) –Pearson Education
50. Winter,P.C. Gi Hickey and H.L.Fletcher 2003. Instant Notes Genetics (2nd ed) Viva Books Pvt. Ltd.

ZOO C 202 BIOTECHNOLOGY AND BIOINFORMATICS

90 hrs

A. <u>Biotechnology</u>:

1. Biotechnology: An Overview
- 1.1 Scope and importance of biotechnology
- 1.2 Biotechnology in India.

2. Chimaeric DNA, Molecular Probes and Gene Libraries
- 2.1 Restriction enzymes for cloning
  - 2.1.1 Techniques of restriction mapping
- 2.2 Construction of chimaeric DNA
- 2.3 Molecular probes (production, labeling and uses)
- 2.4 Southern, northern and western blotting
- 2.5 Dot and slot blots
- 2.6 Construction and screening of genomic and cDNA libraries
- 2.7 Chromosome walking and chromosome jumping (including reverse genetics).

3. Cloning and Expression Vectors:
- 3.1 Cloning vectors for recombinant DNA (plasmids, phages, cosmids, viruses, transposons, YAC, MAC, etc.)
- 3.2 Expression vectors for high level of expression of cloned genes (use of promoters and expression cassettes including baculovirus)
- 3.3 Binary and shuttle vectors.

4. Polymerase Chain Reaction (PCR) and Gene Amplification:
- 4.1 Gene amplification
  - 4.1.1 Basic PCR and its modifications (inverse PCR, anchored PCR, PCR for mutagenesis, asymmetric PCR)
  - 4.1.2 Application of PCR in biotechnology and genetic engineering
  - 4.1.3 DNA polymorphism- RAPDs, VNTRs, SSRs
- 4.2 Gene tagging
- 4.3 DNA fingerprinting.

5. Isolation, Sequencing and Synthesis of Genes:
- 5.1 Isolation of genes (for specific proteins, tissue specific proteins, etc.)

5.2 Synthesis of genes
    5.2.1 Gene synthesis machines.

6. Animal Cell and Tissue Culture:
6.1 Laboratory facilities
6.2 History and scope of animal cell and tissue culture
6.3 Advantages and disadvantages of tissue culture
6.4 Culture media for cells and tissues
6.5 Culture procedures
    6.5.1 Primary Culture,
    6.5.2 Cell Lines and Cloning:
        6.5.2.1 Disaggregation (enzymatic and mechanical) of tissue and primary culture
        6.5.2.2 Cultured cells and evolution of cell lines
        6.5.2.3 Maintenance of cultures - cell lines
        6.5.2.4 Somatic cell fusion; artificial skin and artificial cartilage

7. Hybridoma and Monoclonal Antibodies:
7.1 Hybridoma technology and the production of monoclonal antibodies
7.2 Antibody engineering using genetic manipulations (Fv, Fab, Fc)
7.3 Alternatives to hybridoma technology
7.4 Production of human and humanized antibodies
7.5 Uses of monoclonal antibodies (diagnosis, imaging, therapy, vaccines, enzymes, etc.).

8. Molecular Maps of Animal Genomes:
8.1 Molecular markers (RFLPs, RAPDs, mini satellites, microsatellites)
8.2 Physical maps using molecular markers (using deletions, FISH, YAC, etc.)
8.3 Human genome mapping
    8.3.1 Organizing of human genome
    8.3.2 Sequencing of human genomes.

9. Biotechnology in Medicine:
9.1 Animal and human health care (vaccines, diagnosis and cure of diseases including gene therapy and transplantation of bone marrow)
9.2 Genetic counseling (antenatal diagnosis, fetus sexing)
9.3 Forensic medicine (identification of murderers and rapists, etc.).

10. Use of Microbes in Industry and Agriculture:
10.1 Isolating and culturing of micro-organisms
10.2 Production of organic compounds by microbial fermentation (ethanol, acetone/butanol, gluconic acid, etc.)
10.3 Production of enzymes by micro-organisms (amylases, proteases, lipases)
10.4 Production of antibiotics by micro-organisms
    10.4.1 Microbial transformations
    10.4.2 Single cell proteins (SCP) from micro organisms
10.5 Sewage treatment using microbial systems
10.6 Biotechnology in paper industry
10.7 Biohydrometallurgy and biomineralization
10.8 Biofertilizers

10.9 Bioinsecticides
10.10 Applications of genetically engineered bacteria.

11. Intellectual Property Rights (lPR) and Protection (lPP):

11.1 Intellectual property
11.1.1 Intellectual property rights (patents, trade secrets, copyright, trademarks); choice of intellectual property protection
11.1.2 GATT and TRIPS.

12. Patenting of Biological Material:

12.1 International conventions
12.2 International cooperation
12.3 Obligations with patent applications
12.4 Implications of patenting
12.5 Patents for higher animals
12.6 Patenting transgenic organisms and isolated genes
12.7 Patenting of genes and DNA sequences
12.8 Plant breeder's rights (PBRs) and farmer's rights.

B. Bioinformatics:

1. Bioinformatics – I:

1.1 Biological data bases – generalized and specialized data bases- DNA, protein and carbohydrate data bases
1.2 EST, GSS, SNP and RNA databases
1.3 Nucleic acid sequence data bases
1.3.1 Premier institutes for data bases
1.3.2 Nucleic acids and amino acid codes used in database formats.

2. Bioinformatics – II:

2.1 Sequence alignment and its evolutionary basis
2.2 Searching the database for sequence similarity
2.2.1 Search programmes with special reference to FASTA, BLAST and CLUSTAL W.
2.3 Application of bioinformatics in phylogenetic analysis.

REFERENCES

Biotechnology:

1. A K Chatterjee, 2007. Environmental Biotechnology (2nd Ed.) Prentice Hall.
2. A K Srivaaasthaava, R K Singh and M P Yadav, 2005. Animal Biotechnology, Oxford and IBH.
3. Alexander N Glasser, Hiroshi Mikaido, 2008. Microbial Biotechnology (2nd Ed). Cambridge Publ.
4. Ashok Mukhopadhyay, 2008. Animal Cell Technology. I K International Publ.
5. Bernad, R Glick and Jack J Pasternak, 2002. Molecular Biotechnology, Panima Publ.
6. Biotechnology by Open Learning, 1991. Infrastructure and activities of cells. Butterworth-Heinemann.

7. Biotechnology by Open Learning, 1992. Analysis of Amino acids, proteins, Nucleic acids. Butterworth-Heinemann.
8. Biotechnology by Open Learning, 1992. Biosynthesis and true integration of cell metabolism. Butterworth-Heinemann.
9. Biotechnology by Open Learning, 1992. Biotechnological innovations in animal productivity. Butterworth-Heinemann.
10. Biotechnology by Open Learning, 1992. In vitro cultivation of animal cells. Butterworth-Heinemann.
11. Biotechnology by Open Learning, 1992. Principles of Cell Energetics. Butterworth-Heinemann.
12. Biotechnology by Open Learning, 1993. Genome management in Prokaryotes.. Butterworth-Heinemann.
13. H K Das, 2008. Biotechnology (3rd ed). Wiley India Publ.
14. Helen and Kreuzer and Adrianne Massey, 2008. Molecular Biology and Biotechnology (a guide for teachers) (3rd Ed.) ASM Press.
15. Helen Kreuzer and Adrianne Massey, 2008. Molecular Biology and Biotechnology (3rd Edition). ASM Press.
16. K Vaidyanath, K Prathapa Reddy and K Sathyaprasad, 2008. Biology and Biotechnology (2nd Ed). B S Publ.
17. L P Rema, 2006. Applied Biotechnology. MJP Publications.
18. Lee Yun Kun (2004). Microbial Biotechnology. World Scientific Publishing Cooperative Lts.
19. M H Fulekar, 2005. Environmental Biotechnology. Oxford and IBH.
20. Norman E, 2008. Biotechnology (1st Ed). Saroop and Sons Publ.
21. P Ramdas, 2008. Animal Biotechnology. MJP Publications.
22. Ravishankar Rai Vittal, Rajiv Bhatt, 2008. Biotechnology. Narosa Publ
23. S Ignacimuthu, 2008. Biotechnology. Narosa Publ.
24. Sambrook and Russell, 2001. molecular Cloning: A lab. Manual (3rd ed.) Vols. I – III. CSHC Press.
25. U Sathyanarayana, 2008. Biotechnology. Arumana Sen Books and Allied Ltd.
26. Biotechnology by Open Learning, 1993. Principles of enzymology for technological application. Butterworth-Heinemann.
27. Biotechnology by Open Learning, 1991. The molecular fabric of cells. Butterworth-Heinemann.
28. Timothy Palzkill, 2002. Proteomics, Springer.
29. James D Watson, Amya Caudy, Richard M Mayers, Jan A Witkowski, 2007. Recombinant DNA. CSHL Press.

Bioinformatics:

1. Alberts, B. Bray, D. Lewis, J., Raff, M. Roberts, K. Watson, J.D. (2000). Molecular Biology of the Cell. Garland, NY.
2. Arunima Mukherjee, 2008. Bioinformatics (1st Ed.) Oxford.
3. Dan E Krane and Michael L Raymor, 2008. Bioinformatics. Person Education.
4. Gupta, P.K. (1999).Elements of Biotechnology, Rastogi Publications , Meerut.
5. Gupta, P.K.(1999).Genetics, Rastogi Publications, Meerut
6. Gupta, P.K.(2000). Cell and Molecular Biology, Rastogi Publications, Meerut.
7. Jin Xiony, 2006. Essential Bioinformatics, Cambridge.
8. Karp, G. (2002) Cell and Molecular Biology. John Wiley, New York

9. Lehninger A.L., Nelson D.L. and Cox M.M. (1993). Principles of Biochemistry, II Ed. Worth Publishers, NY.
10. Lewin , B.,(2000) Genes. Oxford Univ.Press, NY.
11. Lodish,H. Baltimore , D. Berk ,A. Zipursky, S.L. , Matsudaira , P. and Darnell, J. (1995). Molecular Cell Biology, Scientific American Books, New York.
12. Mayers R.A. (Ed) Molecular Biology and Biotechnology: A Compr. Desk Reference. VCH Publishers, Inc., NY.
13. Neelam Yadav, 2004. A hand book of Bioinformatics. Anmol Publications
14. Watson J.D., Gilman M., Witkowski J. and Zoller, M (1992). Recombinant DNA, II Edition, Scientific American Books, W.H.Freeman and company, NY.
15. Zhumus Ghosh, Bibekanand Mallik, 2008. Bioinformatics. Oxford.

ZOO C 203 COMPARATIVE ANIMAL PHYSIOLOGY

90 hrs

1. Nutrition, Digestion and Absorption:

1.1 Ruminant and non ruminant herbivory
1.2 Biochemistry of digestion and absorption of
- 1.2.1 Carbohydrate
- 1.2.2 Protein
- 1.2.3 Fat

1.3 Liver and biliary system
1.4 Neuronal and hormonal regulation of nutritional intake
1.5 Secretion of digestive enzymes
1.6 Hunger drive and thirst.
1.7 Physiology of gastro-intestinal disorders
- 1.7.1 Ulcer and Constipation

1.8 Nutritional disorders
- 1.8.1 Obesity, starvation, anorexia and vitamin deficiency

2. Circulation

2.1 Circulation of body fluids - cytoplasm, hydrolymph, haemolymph, lymph and blood, respiratory pigments - structure and function
- 2.1.1 Circulatory mechanisms and fluid compartments, movement of body fluids open system, closed system and lymph channel

2.2 Heart
- 2.2.1 Types of hearts, chambered hearts, tubular heart, ampular heart, lymph heart, neurogenic and myogenic heart
- 2.2.2 Pace makers and specialized conducting fibres
- 2.2.3 Cardiac cycle and cardiac output
- 2.2.4 Blood pressure neural and chemical regulation of all above
- 2.2.5 Myocardial infarction and atherosclerosis
- 2.2.6 ECG
- 2.2.7 Cerebral circulation, blood brain barrier and cerebrospinal fluid
- 2.2.8 Placental circulation

3. Respiration

3.1 Comparison of respiration in different animal groups [brief account only]
3.2 Anatomical considerations
3.3 Neural and chemical regulation of respiration
3.3.1 Respiratory centres
3.3.2 Factors regulating respiration
3.4 Periodic breathing
3.5 Metabolic rate
3.5.1 Basal metabolic rate and its measurement, R.Q and calculation based on it
3.6 Respiratory adjustments
3.6.1 Hypo ventilation, hypoxia, oxygen therapy, dyspnea, hyper ventilation, hypercapnia
3.7 Respiratory buffering systems
3.8 Respiratory system in exercise
3.9 Oxygen toxicity, increased pressure of gas, decompression and inert gas narcosis
3.10 Respiration in unusual environment
3.10.1 Foetal and neonatal respiration
3.10.2 High altitude diving

4. Excretion

4.1 Comparison of excretion in different animal groups [brief account only].
4.1.1 Osmoregulation, contractile vacuole, coelomoducts, flame cells, green glands, malpighian tubules and invertebrate nephridia
4.2 Vertebrate kidney
4.2.1 Mechanism of tubular reabsorption and secretion
4.2.2 Counter current mechanism
4.2.3 Regulation of urine formation
4.2.4 Concept of plasma clearance
4.3 Excretory products
4.4 Waste elimination and micturition
4.5 Regulation of water balance, electrolyte balance and acid base balance
4.6 Kidney disorders
4.6.1 Acute renal failure, chronic renal failure-glomerulonephritis and pyelonephritis
4.7 Artificial kidney
4.8 Diuretic hormones.

5. Nerve physiology:

5.1 Neurons, action potential
5.2 Gross neuroanatomy of brain and spinal chord
5.3 Peripheral nervous system
5.4 Neurotransmitters and neurohormones
5.5 Synaptic transmission
5.6 Electrical and chemical transmission
5.7 Drug modified transmission and synaptic junction
5.8 Neural disorders
5.8.1 Parkinson's disease, Epilepsy, Schizophrenia, Alzheimer's syndrome and Dyslexia

6. Sensory and effector physiology:

6.1 Structural and functional classification, modality, intensity, exteroceptors interoceptors, secondary sense cells, sensory transduction and sensory coding

6.2 Chemical senses
6.2.1 Gustatory and olfactory reception mechanisms
6.3 Mechanoreceptors
6.3.1 Structure of Hair cell
6.3.2 Vertebrate ear Structure; physiology of hearing and organ of equilibrium
6.4 Vertebrate eye
6.4.1 Structure; physiology of image formation
6.5 Electro and thermoreceptors
6.6 Somatic sensations
6.6.1 Pain receptors; pain suppression (analgesia) system in the brain and spinal cord; headache

7. Muscle

7.1 Skeletal muscle
7.1.1 Ultrastructure and molecular organization
7.1.2 Red and white muscle
7.1.3 Protein components of muscle (mechanism and theory)
7.1.4 Contraction and relaxation of muscle
7.1.5 Energetics of muscle contraction
7.1.6 Muscle twitch, summation, tetanus, catch muscle and fibrillar muscle
7.1.7 Muscles and exercise

8. Reproductive physiology:

8.1 General pattern of reproduction
8.2 Role of hormones in reproduction in human male
8.3 Role of hormones in implantation, pregnancy, parturition and lactation in human female
8.4 Impact of senescence and age on reproduction

9. Endocrinology:

9.1 Endocrine glands
9.2 Basic mechanism of hormone action
9.3 Neuroendocrine regulation
9.4 Pheromones

REFERENCES

1. Bruce M Koeppen, and Bruce A Stanton, 2009. Berne and Levy Physiology. (6th edition). Elseiver publishers.
2. Clancy, J. and Mc Vicar, A. J. (1995) Physiology and Anatomy. Edward Arnold, London.
3. David Randall, Warren burggron, Kathleen French, 2002. Eckert Animal Physiology – Mechanisms and Adaptations. (5th dediiton). W.H Freeman and company.
4. Eckert,R, Animal Physiology, Mechanisms and Adaptation, W.H. Freeman & Company.
5. Gerard J tortora 2006, A brief atlas of the skeleton, surface anatomy and selected medical images. John wiley and sons, Inc.
6. Gerard J Tortora, Bryan H Derrickson, 2009,Principles of Anatomy and Physiology, (12th edition) Volumr -1. John Willey and sons, INC.

7. Gerard J Tortora, Bryan H Derrickson, 2009,Principles of Anatomy and Physiology, (12th edition) Volumr -2. John Willey and sons, INC.
8. Gilllian pocock and chistopher D Richards, 2001. Human physiology - The basis of medicine. Oxford university press.
9. Guyton and hall, 2007, Text book of medical Physiology. (11th edition). Elsevier publisher.
10. Guyton, A.C. and Hall, J.E. (2001) Text Book of Medical Physiology, 10th Edn. Prism Books, Pvt., Ltd. Harcourt Asia Ltd., India Edn.
11. Hoar, W.S. (1966) General and Comparative Animal Physiology, Prentice Hall, Inc., USA.
12. Jan kay, 2000, Introduction to animal physiology. Viva book private limited.
13. Jensen, D. (1976) The Principles of Physiology, Appleton-Century-Crofts, New York.
14. K. Sembulingam, Prema sembulingam, 2008. Essentials of Medical Physiology, (4th edition. Jaypee brothers medical publishers (p) Ltd.
15. Knut Schmidt – Nielson, 2007. Animal Physiology – Adaptation and environment. (5th edition) Cambridge university press.
16. Lauralee Sherwood, Hillar kaladrof, and Paul H Yancey, 2005, Animal physiology from genes to organisms. Thomson books publishers.
17. Pat Willmer, Graham stone and Ian Johnston, 2005.Environmental physiology of Animals. (2nd edition) Black well publishing.
18. Prosser ,C.L., (1973) Comparative Animal Physiology, W.B. Saunders & Co
19. Prosser,C.L. Environment and Metabolic Physiology, Wiley-Liss
20. R.C Sobti, 2008. Animal physiology, Narosa publishing house.
21. Randall, D., Burgrenn, W. and French, K. (1997), Animal Physiology, W. H. Freeman & Co., New York.
22. Schiemdt-Neilsen, K.K. (1994) Animal Physiology, Adaptation and Environment, Cambridge.
23. Sperelakis,N. and Banks, R.O. eds.(1993) Physiology, Little, Brown & Co., London.
24. Strand, F. L. (1978) Physiology: A regulatory Systems Approach, 4th Ed. Macmillan Publishing Co., New York.

25. Stuart Ira fox, 2006 Human physiology. (9th edition). Mc Graw hill higher education press.
26. William S hoar, 2004. General And Comparative Physiology. (3rd edition). Prentice hall and India Private Limited.

ZOO C 204 IMMUNOLOGY AND PARASITOLOGY

90 hrs

A. Immunology

1. Historical background and scope of immunology

1.1 Overview of the immune system
1.2 Types of immunity
1.2.1 Innate immunity
1.2.2 Acquired immunity
1.3 Cells and organs of immune system
1.3.1 Primary and secondary lymphoid organs.

1.3.2 Haematopoiesis: Myeloid lineage; lymphoid lineage; cells of immune system.

2. Antigens (Immunogens):

2.1 Characteristic features of antigens
2.2 Factors affecting antigenecity (immunogenecity)
2.3 Epitopes; haptens
2.4 Adjuvants; role of adjuvants in enhancing immunogenicity
2.5 Superantigens

3. Antibodies (Immunoglobulins):

3.1 Structure of a typical antibody molecule
3.2 Different classes of immunoglobulins (IgA, IgD, IgG, IgM and IgE).
3.3 Hybridoma technology
3.3.1 Monoclonal antibodies; applications of monoclonal antibodies.

4. Organization and expression of immunoglobulin genes:

4.1 Primary immunoglobulin gene rearrangement
4.2 Immunoglobulin genes
4.3 Somatic recombination of gene segments
4.4 Rearrangement of V, D and J gene segments
4.5 V(D)J recombinase
4.6 Generation of immunoglobulin diversity;

5. Major histocompatibility complex:

5.1 Antigen processing and presentation
5.2 General organization MHC class I and MHC class II
5.3 MHC genes
5.4 Regulation of MHC expression
5.5 Functions of MHC complex

6. Complement system:

6.1 Classical pathway
6.2 Lectin pathway
6.3 Alternate pathways of compliment activation
6.4 Formation of membrane attack complex (MAC)
6.5 Compliment control proteins

7. Antigen-antibody interactions:

7.1 Serology: Use of serology in various diagnostic assays
7.2 ELISA, RIA, Immunoelectrophoresis.
7.3 Agglutination reactions
6.3.1 Haemagglutinations, WIDAL test.
7.4 Precipitation reactions

8. Failure of host defense mechanisms

8.1 Immunodeficiency diseases
8.3 Acquired immune deficiency syndrome

9. Hypersensitivity reactions:

9.1 Type I hypersensitivity/Immediate (IgE mediated) hypersensitivity (allergy)
9.2 Type II hypersensitivity
9.3 Type III hypersensitivity
9.4 Delayed type hypersensitivity (DTH)

10. Auto-immunity

10.1 Making and breaking of self tolerance
10.2 Autoimmune diseases
    10.2.1 Organ specific auto-immune disease
    10.2.2 Systemic auto-immune diseases
10.3 Genetic and environmental basis of autoimmunity

11. Transplantation immunology

11.1 Graft rejection
    11.1.1 Role of T cells in graft rejection
11.2 General immunosuppressive therapy
11.3 Specific immunosuppressive therapy
11.4 Clinical transplantation.

12. Vaccination

12.1 Requirements for an effective vaccine.
12.2 Different types of vaccines
    12.2.1 Live attenuated vaccine
    12.2.2 Inactivated polypeptides as vaccines
    12.2.3 Recombinant vaccines
    12.2.4 DNA vaccines.
12.3 Route of vaccination

B. Parasitology

1. General Parasitology:

1.1 Introduction to Parasitology:
    1.1.1 Parasitism and types of parasitic infection
    1.1.2 Kinds of hosts
    1.1.3 Transmission of parasites
    1.1.4 Parasitic zoonosis

2. Parasite host specificity

2.1 Isolation of parasite populations
2.2 Kinds of parasite host specificity
2.3 Specificity factors related to infection and growth
2.4 Comparative host specificity
    2.4.1 Protozoans
    2.4.2 Cestodes
    2.4.3 Trematodes
    2.4.4 Nematodes
2.5 General rules and principle

3. **Protozoan parasites of higher vertebrates (**brief account on life cycle of any one species):
   - 3.1 Babesia
   - 3.2 Theilaria
   - 3.3 Trypanosoma
   - 3.4 Plasmodium

3. **Trematode parasites of higher vertebrates (**brief account on life cycle of any one species):
   - 4.1 Schistosoma,
   - 4.2 Fasciola
   - 4.3 Echinostoma
   - 4.4 Paramphistomum

REFERENCES

Immunology:

1. Abbas, A.K., Lichtman, A.K. and Pober, J.S. (1997) Cellular and Molecular Immunology. W. B. Saunders Co. New York.
2. Abul K Abbar, Andrew H Lichtman and Shiv Pillae, 2007. Cellular and Molecular Immunology (Sixth edition). Saunders publication.
3. Applications (2nd ed.) Mc Graw Hill Inc., New York.
4. Cunningham, A. J. (1978) Understanding Immunology, Academic Press, New York, London.
5. David Mal., Anne cooke, Michael Owen, John Trowsdale and Brian Champion, 1996. Advanced Immunology (3rd edition. Mosby Publication.
6. David Male, Jonathan Brostoff, David B Roth and Ivan Roitt, 2006,. Immunology. (7th edition) Mosby Publications.
7. Godkar,P.B.(1998) A Text Book of Medical Laboratory Technology, Bhalani Publishing
8. Goldsby, R.A., Kindt, T. J. and Osborne, B.A. (2000) Immunology (4th ed.). W.H. Freeman and Company, New York.
9. Gupta, P.K.(1999). Cell and Molecular Biology, Rastogi Publication.
10. Harlay, J.P. and Klein, D.A. (1996) Microbiology (3rd Ed.)Wm.C.Brown Publishers, USA.
11. Harper, D.R. (1994) Molecular Virology, Bios Scientific Pub., UK.
12. House, Mumbai.
13. Joshi,K.R. and Osamo,N.O. (1994) Immunology. Agro Botanical Publishers (India), Bikaner.
14. Kenneth Murphy, Paul Travers and Mark walport, 2008. Immunobiology. (7th edition). Garland Science.
15. Kindt, Goldsby and Osborne, 2007. Immunology (Sixth edition). Free man Publication.
16. Kuby, J. (1997) Immunology. W.H. Freeman & Company, New York.
17. McKane, L. and Kandel, J. (1996) Microbiology-Essentials &
18. Nandini Shetty, 2005. Immunology (Second edition) New age International Pvt. Ltd.
19. Pelczar, M. J. (Jr.), Chan, E.C.S. and Krieg, N.R. (1998) Microbiology, Tata Mc Graw Hill
20. Peter J Delves, Seamus J Martin, Dennies R Burton and Ivan M Roitt. 2006. Essentials immunology. (11th edition). Oxford.
21. Peter wood, 2006. Understanding Immunology. Pearson Publication.
22. Publishing Company, New Delhi.
23. Rajeshwar Reddy, K 2007. Text book of Immunology. AITBS Publication.
24. Roderick Nairn and Matthew Helbert, 2002. Immunology. Elseiver Mosby Publication.
25. Roitt, I., Brostoff, J. and Male, D. (1993) Immunology. Mosby- year Book Europe Ltd., London.
26. Shetty, N. (1993) Immunology. Wiley Eastern Ltd., New Delhi.

27. Vaman Rao, C. 2005. Immunology. (Second edition) Narosa Publication.

Parasitology:

1. Cheng TC (1986): General Parasitology, Academic Press, N.Y.
2. Cox FEG (1993): Modern Parasitology – a text book of Parasitology, Blackwell Scientific, London.
3. Bogitsch B J & Cheng T.C. (1999): Human Parasitology. Acadsemic Press.
4. Chatterjee K D (1981): Parasitology Chatterjee Med. Publ.
5. Noble ER and Noble GA (1982): Parasitology, Lea & Fabiger, Philadelphia.
6. Soulsby EJL (1982): Helminths, Arthropods and Protozoa of domestic animals.ELBS.
7. Pathak KML (1987): Parasitic ZoonosesWalkalin D (1996): Immunity to parasites, Cambridge Univ. Press.
8. Marquardt WC, Demacre RS & Grieve RB (2000): Parasitology and Veterinary Biology, Harcout Academic Press.
9. J.D Smyth, 1996. Animal Parasitology. Cambridge publishers.
10. P. Chakraborty, Nishith K Pal. 2008. Manual of practical microbiology and Parasitology, NCBA publishers.
11. N.C Dey and T.K Dey, 2004, Practical microbiology, Protozoology and Parasitology, NCBA publishers.
12. C.K Jayaram Paniker, 2007, Text book of medical parasitiology, Jaypee publication.
13. William C Marquardt, Richard S Demaree and Robert B Grieve, 2000, Parasitology vector Biology, (Second edition), Harcourt academic press.
14. D.R Arora B arora, 2008, Medical Parasitology, (second edition) CBS publishers.
15. WHO (1991): Manual of Basic Techniques for a Health Lab, Academic Publisher, Culta, Calcutta..
16. Fleck SL & Moody A.H. (1988): Diagnostic Techniques in Medical Parasitology, ELBS.
17. ZSI (1980): Proceedings on the Workshop on Techniques in Parasitology, ZSI, Calcutta, India.
18. Agricultural Devpt. And Advisory Service: Manual of Vety. Parasitological Lab. Tech., London.
19. Gillespie's, SH & Hawkey PN (1995): Medical Parasitology – A practical approach, Oxford Univ. Press, N.Y.
20. Roberts, LS and J Janovy (2006): Foundations of Parasitology (McGraw Hill)Bush A O, et al. (2001): Parasitism – The diversity and ecology of Animal Parasites.

ZOO C 205 Practical III (CYTOGENETICS, MOLECULAR BIOLOGY & BIOTECHNOLOGY)

Cytogenetics:

1. Chiasma frequency studies using grasshopper testes squashes.
2. Preparation of chromosomes from rat or mouse bone marrow or human or any other lymphocyte cultures.
3. Analysis of metaphase chromosomes from rat or mouse bone marrow or any other suitable material by means of G and C banding.
4. Preparation of human karyotype from photographs (Xerox copies would be sufficient) of chromosome spreads – Normal and abnormal

5. Identification of human blood cell types and demonstration of drumstick on neutrophils, employing any suitable stain. Staining of human buccal epithelial smear to demonstrate Barr body.
6. Preparation and analysis of salivary gland polytene chromosomes of *Drosophila* larvae.
7. Cell fractionation and isolation of nuclei from a suitable tissue e.g., rat liver.
8. Histochemical staining of carbohydrates (PAS), Protein (Bromphenol blue), lipids (Sudan Black), DNA (Feulgen stain), DNA and RNA (Methyl Green –Pyronin)

Molecular Biology and Biotechnology

1. Induction of chromosome aberrations in roots of *Allium cepa* or any other suitable material such as *Tredescontia* by a suitable clastogenic agent and its demonstration by means of root tip squashes.
2. Maintenance of *Drosophila melanogaster* culture. Demonstration of sex-linked inheritance by means of suitable crosses e.g., wild type with white eye color mutant.
3. Gene mapping of *Drosophila melanogaster*, using textbook problems.
4. Extraction of DNA, RNA and Proteins followed by their estimation. Estimation of DNA by diphenylamine test and RNA by orcinol and protein by Lowry *et al* methods.
5. Maintenance of *E.coli* culture (Shake and surface cultures) and quantitative evaluation (number of cells/ml) of a given sample of culture by dilution and plating.
6. Isolation of genomic DNA (Isolation of DNA from cultured cells and tissues)
7. Isolation of RNA from Yeast.
8. *Drosophila* banding techniques and karyotyping.
9. Preparation of restriction fragments and their separation by electrophoresis

REFERENCES

28. Winchester, A. M. (1964) Laboratory Manual, Genetics Brown Co., Publ. Dubuque, Iowa.
29. Jayaraman, J. (1981) Laboratory Manual in Biochemistry. Wiley Eastern Ltd.
30. Neidharth, F.C. and R.F. Beyd (1965) Cell Biology – A Laboratory Text. Burgees Publ Co.
31. Copenhaver, M.W. (1964) Bailey's Textbook of Histology. Sci. Book Agency, Calcutta.
32. Humason, G.L. (1962) Animal Tissue Techniques. W.H. Freeman and Co.
33. Bradshaw, L. J. (1966) Introduction to Molecular Biological Tech.. Prentice Hall Inc., USA.

ZOO C 206 PRACTICAL IV (ANIMAL PHYSIOLOGY AND PARASITOLOGY)

Animal Physiology

1. Detection of digestive enzymes in the hepatopancreas of crab
2. Diffusion of substances through intestine of frog.
3. Effect of osmotic stress on rate of respiration.
4. Determination of osmotic concentration of human RBC.
5. Enumeration of human RBC.
6. Determination of vertebrate haemoglobin

7. Total and differential count of WBC

Parasitology:

1. Preparation and uses of blood and tissue impression smears.
2. Collection and preservation of Protozoan parasites.
3. Collection and preservation of trematode parasites.
4. Collection and preservation of vector arthropods.
5. Collection and study of intra-molluscan study of trematodes from freshwater gastropods.
6. Collection and study of metacercariae from freshwater fishes and other hosts.
7. Study of medically important larval forms of insect pests.
8. Study of prepared permanent slides of parasites.
9. Collection, Preservation and identification of snail hosts of Trematode parasites.

Sd/-
Dr.P.K.Prasadan,
Course Director, Dept. of Zoology,
Mananthawady Campus.

K A N N U R U N I V E R S I T Y
(Abstract)

M.Sc Applied Zoology Programme under Choice based Credit Semester System – Syllabus for III & IV Semesters– Implemented with effect from 2010 Admission – Orders issued.

ACADEMIC BRANCH

U.O.No.Acad/C2/6772/2008. Dated, K.U.Campus.P.O, 22-07-2011.

Read: 1. U.O.No.Acad/C2/6772/2008 dated 01-12-2010.
2. Minutes of the meeting of the Department Council held on 06-07-2011.
3. Letter No.KU/Zool/COMM7/July 2011 dated 08-07-2011 from the Course Director, Department of Zoology, Mananthavady Campus.

ORDER

1. The revised Scheme (full) and Syllabus (I & II Semesters) of M.Sc Applied Zoology Programme under Choice based Credit Semester System were implemented in this University with effect from 2010 admission vide papers read (1) above.

2.The Course Director, Dept. of Zoology, vide paper read (3), has forwarded the syllabus for III & IV Semesters of M.Sc Applied Zoology Programme as approved by the Department Council vide paper read (2) above for implementation with effect from 2010 admission.

3. The Vice Chancellor, after considering the matter in detail, and in exercise of the powers of the Academic council, conferred under section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction ***to implement the syllabus for III & IV Semesters of M.Sc Applied Zoology Programme under Choice based Credit Semester System as approved by the Department Council effective from 2010 admission,*** subject to report to the Academic Council.

4. The U.O read (1) above stand modified to this extent.

5. Orders are issued accordingly.

6. The implemented Syllabus is appended.

Sd/-
REGISTRAR

To
3. The Director, Dept.of Zoology, Mananthavady Campus.
4. The Examination Branch (through PA to CE).

Copy to:
1. PS to VC/PA to PVC/PA to Registrar.
2. DR/AR-I (Academic).
3. SF/DF/FC.

Forwarded/By Order

SECTION OFFICER

M.Sc Applied Zoology Programme

III SEMESTER

ZOO C 301 – DEVELOPMENTAL BIOLOGY 90 hrs

1. **Developmental dynamics of cell specification**:
   1.1 Autonomus specification
   1.2 syncitial specification
   1.3 Conditional specification; morphogenetic gradient.
2. **Cell fate, potency, determination and differentiation.**
3. **Genomic equivalence and cytoplasmic determinants.**
4. **Genomic imprinting.**
5. **Cell cell communication in development:**
   5.1 Induction and Competence:
      5.1.1 Cascade of induction – reciprocal and sequential inductive events; instructive and permissive interactions; epithelial- mesenchymal interactions.
   5.2 Paracrine factors.
   5.3 Signal transduction cascades – fibroblast growth factors and RTK pathway; JAK-STAT pathway, hedgehog family; wnt family.
   5.4 Juxtacrine signaling and cell patterning eg. *C. elegens*; the notch pathway.
6 **Gametogenesis, fertilization and early development**:
   6.1 Production of gametes
   6.2 Cell surface molecules in sperm egg recognition
   6.3 Slow block polyspermy (mammals)
   6.4 Fast block polyspermy (sea urchin)
   6.5 Zygote formation, cleavage, blastula, gastrulation, formation of germ layers.
7 **Genetics of axis specification in Drosophila:**
   7.1 Early Drosophila development
   7.2 Genes that pattern the Drosophila body plan
   7.3 Primary axis formation during oogenesis
   7.4 Generating dorsal-ventral pattern in the embryo
   7.5 Segmentation and anterior-posterior body plan
   7.6 Segmentation genes; homeotic selector genes.
8 **Early development and axis formation in amphibians:**
   8.1 Primary embryonic induction
   8.2 Mechanism of axis determination in amphibians
   8.3 Functions of the organizer
   8.4 The regional specificity induction
   8.5 Specifying the left right axis
9 **Later embryonic development**:
   9.1 Formation of the neural tube
   9.2 Differentiation of the neural tube
   9.3 Differentiation of neurons

9.4 Chromosomal sex determination - in Drosophila & mammals
9.5 Environmental sex determination

10 **Post embryonic development:**
10.1 Metamorphosis; Insects and amphibians
10.2 Regeneration
10.3 Aging: senescence genes; role of free radicals; hormones and aging

11 **Teratogenesis**

12 **Endocrine disruptors**

13 **Stem cells: Embryonic stem cell; adult stem cell; medical application**

14 **Impacts of pesticide on development**

REFERENCES

1. Balinsky. B I (1981). An introduction to Embryology. Holt Saunders.
2. Berril M J and Karp G. (1978). Development. Tata Mc Grawhill.
3. Davidson H. (1986). Gene activity in early development. Academic Press.
4. Gilbert S F. (2006). Developmental Biology 8yh edition. Sinauer Assoc.
5. Gilbert L I, Tata J R and Atkinson D G (1996). Metamorphosis. Academic Press.
6. Klaus Kalthoff (2001). Analysis of Biological Development. 2nd edn. Mc Graw Hill..
7. Slack J (2001). Essential Developmental Biology. Blackwell Publ. UK.
8. Snustard, D P, Simmons, M J and Jenkins J P (1997). Principles of genetics. John Y B and Sons.
9. Twyman, R M (2001). Instant notes in Developmental Biology. Bios Sci. Oxford.
10. Walpert L. Beddington R, Jessel T, Lawrence P, Meyerowitz E and Smith J. (2002). Principles of Development. Current Biology. Oxford.

ZOO C 302 – ECOLOGY 90 hrs

1.1 Ecosystem

1.2 Concept of the ecosystem

1.3 Properties of Ecosystem

Biomagnifications; Ecological efficiency; Ecological niche; Edge Effects; Ecotones; Ecocline; Ecotype; Dame concept; Ecological Equivalents

2. Energy Concepts

2.1 Energy flow within the Ecosystem

2.2 Laws of thermodynamics

2.3 Concept of productivity

Primary productivity; Measurement of primary production; Secondary productivity; Energy partitioning in food chains and food webs; Metabolism and size of Individuals

2.4 Decomposition

2.5 Ecological footprint

2.6 Carbon footprint

3. **Population Ecology**
   - 3.1 Life table
   - 3.2 Survivorship curves
   - 3.3 Dispersion
   - 3.4 Concept of carrying capacity
   - 3.5 Population fluctuation and cyclic oscillations
   - 3.6 Population Growth curves: Sigmoid growth curve; J-shape growth curve; Catastrophic growth curves
   - 3.7 Regulation of population: Density independent and density dependent mechanisms of population regulation
   - 3.8 r- and K- selection
   - 3.9 Population interactions: Mutualistic interactions; Symbiotic relationship; Parasitism; Predation; Competition

4. **Biodiversity**
   - 4.1 Values of biodiversity: Intrinsic values; Instrumental values; Uniqueness value
   - 4.2 Types of biodiversity
     - 4.2.1 Species diversity
     - 4.2.2 Genetic diversity: Importance of genetic diversity; Processes that diminish genetic diversity
     - 4.2.3 Ecosystem diversity
       - 4.2.3.1 Terrestrial ecosystems: Tropical rain forest; Temperate evergreen forest; Temperate grassland; Desert
       - 4.2.3.2 Aquatic ecosystems: Marine Ecosystem; Freshwater Ecosystem; Estuary
       - 4.2.3.3 Fragile Ecosystem: Wetland
   - 4.3 Diversity indices: Dominance indices; Shannon index; Brillouin index; Rank Abundance Diagrams; Jaccard Coefficient; Sorensen coefficient; Cluster Analysis
   - 4.4 Biodiversity –Hot spots

5. **Ecopolitics**
   - 5.1 Environmental activism: Local level; National level; International level
   - 5.2 Types of environmental activism: Eco-feminism; Eco-tourism; Deep ecology; Radial ecology;Spiritual/Theological ecology

REFERENCES

1. Bossel, Earth at a crossroads- Path for a sustainable future. CambridgeUniversity Press.
2. Brewer, R. (1994) Science of ecology. Saunders, USA
3. Caughley, Graeme, Sinclair and Antony (1994) Wild life Ecology and Management. Blackwell Science, USA
4. Chauhan, T.S. and Joshi, K.N. (1996) Applied remote sensing and Photo-Interpretation. Vigyan Prakash, Jodhpur
5. Cunningham, P.W. and Woodworth,S. B.(1999) Environmental Science.WCB/McGraw Hill
6. Damodaran et. al. Nature and the Orient ecological history of South Asia. Oxford Press.
7. Francois Ramade (1984) Ecology of Natural resources. John wiley and Sons, N. York

8. Fred Van Dyke (2003) Conservation biology: foundations, Concepts, Applications. McGraw Hill.
9. Goldman, R.C. (1994) Limnology. McGraw Hill book Co., London
10. Hunter M L (2002). Fundamentals of Conservation Biology. Blackwell Science.
11. Jhanwar, M.L. and Chauhan, T.S. (1998) Remote sensing and Photogrammetry. Vigyan Prakash, Jodhpur.
12. Kormondy, E.J. (1986) Concepts of Ecology. Prentice hall, New Delhi
13. Krebs, C.J. (1985) Ecology: The experimental analysis, distribution and abundance. Harper Collins, N.York
14. Odum, E.P. (1971) Fundamentals of Ecology. Saunders, USA
15. Mukerjee,(1982) Endangered animals of India. ZSI, India
16. Moss, B. (1998) Ecology of freshwater. Blackwell Science, USA
17. Michael L and R M Schoch (2003) Environmental Science. Jones & Bartlett Publ.
18. Miller, Tyler Jr. G. (2005) Living in the Environment: Principles, Connections and Solutions. Thirteenth edition. Thomson Brooks/Cole.
19. Myneni.(2008). Environmental law. Asia Law House.
20. Negi, S.S. (1993) Biodiverstiy and Conservation in India. Indian Publ. Co.
21. Odum, E.P. (1997) Ecology: A bridge between science and society. Sinauer ass. Inc.
22. Odum E P and G W Barrett (2005). Fundamentals of Ecology. Cengage Learning India Pvt. Ltd.
23. Osborne, P.L. (2000) Tropical Ecosystems and Ecological concepts. Cam. Univ. Press
24. Peter, S. (2002) Ecology: Theories and Applications. Prentice Hall of India
25. Quarrie, J.E.G. (1992) Earth Summit, 1992. The Regency press, London
26. Ricklefs, R.E. (1990) Ecology. W.H.Freeman & Co., Sanfrancisco
27. Smith, R. (1996) Ecology and Field Biology. Addison Wesley, USA
28. Southwood, T.R.E. and Henderson,P.A. (2000) Ecological methods. Blackwell Science
29. Scragg, A. (1999) Environmental Biotechnology. ELBS
30. Seragelglin (1999) Biotechnology and Biosafety. World Bank, Washington, D.C.
31. UNEP (1995) Global Biodiversity Assessment. Cambridge univ. Press., Lond.
32. Wild, A. (1993) Soil and Environment: An Introduction. Cambridge University Press, UK.
33. Wilson, E.O. (1992) The diversity of life. Harvard Univ. Press, USA
34. S C Bhatia. (2008) Ecology & Sustainable Development (1&2), Atlantic publishers.
35. Richard B. Primack. (2002) Essentials of Conservation Biology, Sinaur Publishers, USA.
36. Robert E Ricklefs, Gary L Miller. (2000) Ecology-(4th Edition), WH Freeman & Company, New York.
37. Colin R Townsend, John l Harper. (2000) Essentials of Ecology-3rd Edition, Blackwell Publishers.
38. N S Subrahmanyam, V S S Sambamurty (2008) Ecology - 2nd Edition, Narosa Publishers.
39. Michael L Mickinney (2007) Environmental Science-Systems & Solutions, Jones & Bartlet, 2nd Edition, Oxford University press.
40. Danial D Chiras (2010) Environmental Science 8th Edition, Jones& Bartlet Publ.
41. Townsend (2008) Ecological Applications toward a sustainable World, Blackwell Publishers.

ZOO E 303- CONSERVATION BIOLOGY –I 90 hrs

1. **Conservation and its Importance**
   1.1 Meaning of conservation

1.2 Approaches to conservation
1.3 Conservation biology-principles
1.4 Categories for conservation status
1.5 Economic Evaluation of conservation: Cost benefit analysis; Safe minimum standard criteria

2 Threats to Biodiversity

2.1 Extinction: Current human caused mass extinction; Secondary Extinction; Extinction vulnerability
2.2 Anthropogenic impacts
2.2.1 Habitat disruction, degradation, fragmentation and loss
2.2.2 Overexploitation: Types of exploitation; Consequences of exploitation
2.2.3 Pollution: Air pollution; Water pollution; Noise pollution; Land
2.2.4 Pollution
2.3 Exotic/ Invasive species: Impacts; Success rates
2.4 Genetic threats to small populations: Genetic drift; Inbreeding depression; Mutational meltdown

3 Conservation of Biodiversity

3.1 Conservation strategies
3.1.1 In-situ conservation: Protected Areas; National parks
3.1.2 Ex-situ conservation: Seed banks; Botanical gardens; Zoos
3.2 Conservation in Captivity: Problems of captive breeding; Adaptations to captivity

4 Conservation Techniques

4.1 PCR for genotyping endangered species
4.2 RAPD as a tool of taxonomic assessment
4.3 DNA Fingerprinting – the use of satellite markers
4.4 RELP for assessment of genetic variation among individuals

REFERENCES

1. Bossel, Earth at a crossroads- Path for a sustainable future. CambridgeUniversity Press.
2 Caughley, Graeme, Sinclair and Antony (1994) Wild life Ecology and Management. Blackwell Science, USA
3 Cunningham, P.W. and Woodworth,S. B.(1999) Environmental Science.WCB/McGraw Hill
4 Fred Van Dyke (2003) Conservation biology: foundations, Concepts, Applications. McGraw Hill.
5 Goldman, R.C. (1994) Limnology. McGraw Hill book Co., London
6 Hunter M L (2002). Fundamentals of Conservation Biology. Blackwell Science.
7 Jhanwar, M.L. and Chauhan, T.S. (1998) Remote sensing and Photogrammetry. Vigyan Prakash, Jodhpur.
8 Kormondy, E.J. (1986) Concepts of Ecology. Prentice hall, New Delhi
9 Krebs, C.J. (1985) Ecology: The experimental analysis, distribution and abundance. Harper Collins, N.York
10 Levin Simon Asher (2001). Encyclopedia of biodiversity (5 volumes). Academic Press.
11 Odum, E.P. (1971) Fundamentals of Ecology. Saunders, USA
12 Mukerjee,(1982) Endangered animals of India. ZSI, India
13 Michael L and R M Schoch (2003) Environmental Science. Jones & Bartlett Publ.

14 Miller, Tyler Jr. G. (2005) Living in the Environment: Principles, Connections and Solutions. Thirteenth edition. Thomson Brooks/Cole.
15 Myneni.(2008). Environmental law. Asia Law House.
16 Negi, S.S. (1993) Biodiverstiy and Conservation in India. Indian Publ. Co.
17 Odum, E.P. (1997) Ecology: A bridge between science and society. Sinauer ass. Inc.
18 Odum E P and G W Barrett (2005). Fundamentals of Ecology. Cengage Learning India Pvt. Ltd.
19 Osborne, P.L. (2000) Tropical Ecosystems and Ecological concepts. Cam. Univ. Press
20 Peter, S. (2002) Ecology: Theories and Applications. Prentice Hall of India
21 Quarrie, J.E.G. (1992) Earth Summit, 1992. The Regency press, London
22 Ricklefs, R.E. (1990) Ecology. W.H.Freeman & Co., Sanfrancisco
23 Senger DS. (2007). Environmental law. Prentice Hall of India.
24 Smith, R. (1996) Ecology and Field Biology. Addison Wesley, USA
25 Southwood, T.R.E. and Henderson,P.A. (2000) Ecological methods. Blackwell Science
26 Scragg, A. (1999) Environmental Biotechnology. ELBS
27 Seragelglin (1999) Biotechnology and Biosafety. World Bank, Washington, D.C.
28 UNEP (1995) Global Biodiversity Assessment. Cambridge univ. Press., Lond.
29 Wild, A.(1993) Soil and Environment: An Introduction. Cambridge University Press, UK.
30 Wilson, E.O. (1992) The diversity of life. Harvard Univ. Press, USA
31 Richard B. Primack (2002) Essentials of Conservation Biology, Sinaur Publishers, USA.
32 Michael J Conroy & john P Carroll (2009) Quantitative Conservation of Vertebrates, Wiley-Blackwell.
33 I R New (2006) Conservation Biology in Australia.Oxford Uty. Press.

ZOO E 304 –CONSERVATION BIOLOGY – II 90 hrs

1. The Legal Foundations of Conservation Biology

1.1 National laws relating to Biological Diversity
- 1.1.1 Convention on Biological Diversity (1992)
- 1.1.2 TRIPS agreement
- 1.1.3 The Biological Diversity Act 2002
- 1.1.4 Regulation of access to biological diversity
- 1.1.5 Biological Diversity Rules, 2004

1.2 The National Biodiversity Authority
1.3 The State biodiversity boards
1.4 International Agencies: Governmental and Nongovernmental organizations
1.5 Major international conservation laws and treaties
- 1.5.1 International protection of migratory species
- 1.5.2 International protection of endangered species
- 1.5.3 International protection of habitats and ecosystems
- 1.5.4 Protection of commercially valuable species

1.6 Rio summit
1.7 Copenhagen summit

2. Conservation in Practice

2.1 People as agents of conservation
2.2 Conservation biology as vocation
2.3 Articulating personal mission and purpose in conservation
2.4 Building a professional network of contacts and references in conservation

2.5 Conservation as a social process
2.6 Emerging trends in conservation biology
2.7 IUCN
2.8 WWF

3. **Conservation of Population**
   3.1 Managing populations: Managing invasive populations**;** Managing metapopulations of spatially disjunct subunits

4. **Conservation of Ecosystems**
   4.1 Conservation of Habitats and Landscapes: Preservation and conservation of habitats; Landscape management
   4.2 Conservation of Terrestrial Ecosystems: Forests; Grass lands; Deserts
   4.3 Conservation of Aquatic Ecosystems: Management of freshwater habitats for conservation; Conservation of marine habitats and biodiversity; Conservation of Wetlands

5. **Restoration Ecology**
   5.1 Definition and development
   5.2 Restoration protocols and procedures for ecological restoration
   5.3 Restoring terrestrial and aquatic ecosystem
   5.4 Biocultural restoration

6. **Conservation and Management of Specific Taxon**
   6.1 Specific conservation requirements and management guidelines (two representative cases): Invertebrates (with specific reference to Arthropods); Fishes; Amphibians; Reptiles; Birds; Mammals

REFERENCES

1. Bossel, Earth at a crossroads- Path for a sustainable future. CambridgeUniversity Press.
2. Brewer, R. (1994) Science of ecology. Saunders, USA
3. Caughley, Graeme, Sinclair and Antony (1994) Wild life Ecology and Management. Blackwell Science, USA
4. Chauhan, T.S. and Joshi, K.N. (1996) Applied remote sensing and Photo-Interpretation. Vigyan Prakash, Jodhpur
5. Cunningham, P.W. and Woodworth,S. B.(1999) Environmental Science.WCB/McGraw Hill
6. Damodaran et. al. Nature and the Orient ecological history of South Asia. Oxford Press.
7. David L Hawksworth (2007). Vertebrate Conservation and Biodiversity. Springer
8. David McDonald and Katrina Service (2007). Key topics in conservation Biology. Blackwell..
9. David Storch et. al. (2007). Scaling Biodiversity. Cambridge University Press.
10. Francois Ramade (1984) Ecology of Natural resources. John wiley and Sons, N. York
11. Fred Van Dyke (2003) Conservation biology: foundations, Concepts, Applications. McGraw Hill.
12. Garrey K Maffe et al. (1997). Principles of Conservation Biology. Sinauer Associates.
13. Goldman, R.C. (1994) Limnology. McGraw Hill book Co., London
14. Hunter M L (2002). Fundamentals of Conservation Biology. Blackwell Science.
15. Jhanwar, M.L. and Chauhan, T.S. (1998) Remote sensing and Photogrammetry. Vigyan Prakash, Jodhpur.
16. Joshi PC and Namitha Joshi (2009). Biodiversity and Conservation.APH Publishing Co.

17. Kevin J Kaston & John Spicer (2004). Biodiversity an Introduction.
18. Kormondy, E.J. (1986) Concepts of Ecology. Prentice hall, New Delhi
19. Krebs, C.J. (1985) Ecology: The experimental analysis, distribution and abundance. Harper Collins, N.York
20. Michael L and R M Schoch (2003) Environmental Science. Jones & Bartlett Publ.
21. Michael J Jeffries. Biodiversity and Conservation (2005). Routlej
22. Miller, Tyler Jr. G. (2005) Living in the Environment: Principles, Connections and Solutions. Thirteenth edition. Thomson Brooks/Cole.
23. Moss, B. (1998) Ecology of freshwater. Blackwell Science, USA
24. Mukerjee,(1982) Endangered animals of India. ZSI, India
25. Myneni.(2008). Environmental law. Asia Law House.
26. Navjoth Sodhi et al. (2007). Tropical Conservation Biology. Blackwel.
27. Negi, S.S. (1993) Biodiverstiy and Conservation in India. Indian Publ. Co.
28. Odum E P and G W Barrett (2005). Fundamentals of Ecology. Cengage Learning India Pvt. Ltd.
29. Odum, E.P. (1971) Fundamentals of Ecology. Saunders, USA
30. Odum, E.P. (1997) Ecology: A bridge between science and society. Sinauer ass. Inc.
31. Osborne, P.L. (2000) Tropical Ecosystems and Ecological concepts. Cam. Univ. Press
32. Peter, S. (2002) Ecology: Theories and Applications. Prentice Hall of India
33. Pandey et al (2007). Biodiversity. APH Publishing corporation.
34. Quarrie, J.E.G. (1992) Earth Summit, 1992. The Regency press, London
35. Ricklefs, R.E. (1990) Ecology. W.H.Freeman & Co., Sanfrancisco
36. Ranjith Daniels (2005). Amphibians of Peninsular India. Universities Press.
37. Scragg, A. (1999) Environmental Biotechnology. ELBS
38. Seragelglin (1999) Biotechnology and Biosafety. World Bank, Washington, D.C.
39. Simon Asher Levin (2001). Encyclopedia of biodiversity. (five volumes) Academic Press.
40. Singh RB (2009). Biogeography and Biodiversity Rawat Publications.
41. Smith, R. (1996) Ecology and Field Biology. Addison Wesley, USA
42. Southwood, T.R.E. and Henderson,P.A. (2000) Ecological methods. Blackwell Science
43. UNEP (1995) Global Biodiversity Assessment. Cambridge univ. Press. Lond.
44. Wild,A.(1993) Soil and Environment: An Introduction. Cambridge University Press, UK.
45. Wilson, E.O. (1992) The diversity of life. Harvard Univ. Press, USA
46. Richard B. Primack (2002) Essentials of Conservation Biology, Sinaur Publishers, USA.
47. Michael J Conroy & john P Carroll (2009) Quantitative Conservation of Vertebrates, Wiley-Blackwell.
48. I R New (2006) Conservation Biology in Australia. Oxford Uty. Press.

ZOO C 305 – PRACTICAL V (DEVELOPMENTAL BIOLOGY)

1. Induced ovulation in fish/frog
2. Effect of bilateral eyestalk ablation on moulting in the crab *Barytelphusa cunicularis.*
3. Ovarian index under de-eyestalking of a crustacean.
4. Collection, preservation and permanent preparation of invertebrate larval forms (any five)
5. Rearing of amphibian embryo & larvae and identification of different developmental stages.
6. Vital staining of chick embryo.
7. Histological preparation of chick embryo (any two stages).
8. Preparation of permanent/temporary stained whole mounts of chick embryo.
9. Sperm count of frog
10. Regeneration study on amphibian tadpole

ZOO C 306 - PRACTICALVI (ECOLOGY & CONSERVATION BIOLOGY)

1. Identification of marine plankton.
2. Separation and Identification of soil micro arthropods applying Berlese funnel
3. Sampling methods: Pitfall traps, Line transect, Quadrate sampling, Point quarter sampling
4. Intertidal studies: rocky shores, sandy (marine) shore, muddy shore and estuaries.
5. Estimation of salinity, pH, phosphates, chlorides and silicates in water samples.
6. Estimation of dissolved oxygen
7. Determination of dissolved Carbon dioxide

IV SEMESTER

ZOO C 401– RESEARCH METHODOLOGY- CONCEPTS & METHODS 90 hrs

1. Sampling methods: direct, indirect.
2. Methods of recording physical parameters in field studies.
3. Remote sensing: Applications
4. GIS
5. Digital photography and Videography; photomicrography.
6. Scientific Writing: Literature collection, methodology of writing scientific reports, research papers, popular science articles; dissertation/thesis; research project proposals.
7. Open access publishing and open source software.
8. Scientific drawing.
9. Preparation and display of museum specimens: dry preservation (slides; insect boxes); wet preservation.
10. Taxidermy and museology.
11. Micrometry, Cytophotometry.
12. Molecular taxonomy

References:

1. Slayter, E.M. (1970) Optical methods in biology. Wiley Interscience
2. Daniel, M. (2002) Basic biophysics for Biologists, Agrobotanica, Bikaner
3. Willard, H.H., Merritt, L.L., Dean, J.A. and Settle, F.A. (2000) Instrumental methods of analysis, 7th edn. CBS publication
4. Kealey, D. and P.J. Haines (2002) Analytic. Chem., Instant Notes, Viva books Pvt. ltd. N. Delhi
5. Upadhyay, A. Upadhyay, K. and Nath, N. (1977) Biophysical Chemistry: Principles and Techniques, Himalaya Publ. house
6. Nolting, B, (2003) methods in modern biophysics, Springer, Berlin
7. Gautham, N.V.P. (2003) Biophysics. Narosa Publ. house, N. Delhi.
8. Biological Techniques:
9. Richard Dawkins (2008). Modern Science Writing. Oxford University Press
10. Paul Oliver (2008). Writing your thesis. Sage Publications.
11. Ranjith Kumar (2008). Research Methodology (4th edn). Pearson Education
12. Michael R Peres (2007). Focal Encyclopedia of Photography. Elsevier
13. Liz Hamp-Lyons & Ben Heasly (2008) Study writing. Cambridge University Press.

ZOO E 402 PROJECT WORK

PROJECT WORK

The main objective of introducing a project work in the curriculum is that the student who completes this course should get hands on experience in independent research work in the field of biodiversity conservation and management. He/she should equip himself/herself to face challenges in Conservation Biology and should be able to provide trained manpower in the field.

A topic in the optional subject – Biodiversity: Conservation and Management shall be assigned to each student. The research work related to this topic will be carried out by each student under the supervision of a teacher. The report of the findings shall be submitted by each student in the form of a dissertation which shall be submitted for evaluation a day prior to the date of viva voce examination of the fourth semester. A declaration by the student to the effect that the dissertation submitted by him/her has not previously formed the basis for the award of any degree or diploma and a certificate by the supervising teacher to the effect that the dissertation is an authentic record of work carried out by the student under his supervision are to be furnished in the dissertation.

ZOO O 403 HUMAN PHYSIOLOGY

1. Introduction:

1.1. Scope and fields of Physiology

2. Nutrition:

2.1. Food requirements

2.2. Carbohydrates, Proteins, Fats, Minerals, water and vitamins

3. Digestion:

3.1. Human digestive system

3.2. Digestive enzymes and their role in digestion

3.3. Digestion of carbohydrates, proteins and lipids

3.4. Digestive hormones

4. Respiration:

4.1. Structure of lungs

4.2. Brief account of respiratory mechanisms

4.3. Respiratory pigment

4.4. Gas transport

4.5. External and Internal (Tissue) respiration

4.6. Adaptations to high altitude and diving

5. Circulation:

5.1. Composition, properties and functions of blood

5.2. Heart-structure and function

5.3. Blood pressure and its role; regulation of blood pressure

5.4. Human - Cardiac cycle

5.4.1. Origin of heart beat

5.4.2. Regulation of heart beat

5.4.3. Pulmonary circulation

5.4.4. Systemic circulation

5.4.5. Coronary circulation

5.5. Cardiac diseases

5.6. ECG

6. Excretion:

- 6.1. Kidney structure and function
- 6.2. Mechanisms of urine formation
- 6.3. Hormonal regulation of excretion

7. Nervous system:

- 7.1. Nervous tissue
- 7.2. Neuron - structure
- 7.3. Types of neurons and their distribution
- 7.4. Nerve Impulse - definition - conduction of impulse
- 7.5. Synapse - synaptic transmission of impulses
- 7.6. Autonomic nervous system
- 7.7. Receptors
    - 7.7.1. Chemo receptors
    - 7.7.2. Touch receptors
    - 7.7.3. Equilibrium receptors
    - 7.7.4. Photo receptor - Structure of eye
    - 7.7.5. Phono receptor- Structure of ear

8. Muscular System:

- 8.1. Mechanism of contraction
- 8.2. Muscle twitch
- 8.3. Tetanus
- 8.4. Muscle Fatigue
- 8.5. Isotonic and isometric contraction
- 8.6. Aerobic and Isometric exercises.

9. Endocrine system:

- 9.1. Structure, secretions and functions of endocrine glands
    - 9.1.1. Hypothalamus
    - 9.1.2. Pituitary
    - 9.1.3. Thyroid
    - 9.1.4. Parathyroid
    - 9.1.5. Adrenal
    - 9.1.6. Thymus
    - 9.1.7. Islets of Langerhans
    - 9.1.8. Sex organs
- 9.2. Endocrine diseases

10. Immune system:

- 10.1. History of immunology
- 10.2. Innate immunity
    - 10.2.1. Inflammation
- 10.3. Complement system
- 10.4. Adaptive immunity
- 10.5. Lymphocytes
    - 10.5.1. T cells
    - 10.5.2. B lymphocytes and antibodies
- 10.6. Immunization
- 10.7. Immuno deficiencies

10.8. Autoimmunity
10.9. Hypersensitivity

11. Reproductive System:

11.1. Reproductive Organs
11.2. Hormonal control of reproduction

Sd/-
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