

M.Sc., ZOOLOGY

SYLLABUS (with effect from July 2018)

**Department of Biology
The Gandhigram Rural Institute (Deemed to be University)
Gandhigram – 624 302
Dindigul District
Tamil Nadu
India**

M.Sc., ZOOLOGY PROGRAMME

SCHEME OF EXAMINATION

FIRST SEMESTER									
	Course code	Course Title	C	L	P	E	CFA	ESE	Total
CORE COURSES	18ZOOP0101	Animal Diversity I – Invertebrata	4	4	-	3	40	60	100
	18ZOOP0102	Animal Diversity II – Chordata	4	4	-	3	40	60	100
	18ZOOP0103	Environmental Biology@	4	4	-	3	40	60	100
	18ZOOP0104	Molecular Biology#	4	4	-	3	40	60	100
	18ZOOP0105	Developmental Zoology & Immunology@	3	3	-	3	40	60	100
	18ZOOP0106	Animal Diversity I & II –Practicals	1	-	3	3	60	40	100
	18ZOOP0107	Environmental Biology – Practicals	1	-	3	3	60	40	100
CNCC	18GTPP0001	Gandhi in Everyday Life	-	2	-	-	50	-	50
		Total credits	21						

SECOND SEMESTER									
	Course code	Course Title	C	L	P	E	CFA	ESE	Total
CORE COURSES	18ZOOP0208	Biochemistry & Animal Physiology@	4	4	-	3	40	60	100
	18ZOOP0209	Entomology	4	4	-	3	40	60	100
	18ZOOP0210	Cell Biology & Genetics	4	4	-	3	40	60	100
	18ZOOP0211	Biostatistics	4	4	-	3	40	60	100
	18ZOOP0212	Biochemistry & Animal Physiology –Practicals	1	-	3	3	60	40	100
	18ZOOP0213	Summer Internship	2	-	-	-	50	-	50
NME	-	Non Major Elective	4	4	-	3	40	60	100
CNCC	18ENGP00C1	Communication and Soft Skills	-	2	-	-	50	-	50
		Total credits	23						

THIRD SEMESTER									
	Course code	Course Title	C	L	P	E	CFA	ESE	Total
CORE COURSES	18ZOOP0314	Instrumentation Techniques and Research Methods @	4	4	-	3	40	60	100
	18ZOOP0315	Economic Zoology	4	4	-	3	40	60	100
	18ZOOP0316	Fundamentals of Microbiology	4	4	-	3	40	60	100
	18ZOOP0317	Instrumentation Techniques – Practicals	1	-	3	3	60	40	100
	18ZOOP0318	Fundamentals of Microbiology-Practicals	1	-	3	3	60	40	100
	18ZOOP0319	Field Visit	-	-	-	-	50	-	50
ME	18ZOOP04EX	Major Elective	4	4	-	3	40	60	100
MC	18ZOOP03MX	Modular course	2	2	-	-	50	-	50
VPP	18EXNP03V1	Village Placement Programme	2	-	-	-	50	-	50
		Total credits	22						

FOURTH SEMESTER									
	Course code	Course Title	C	L	P	E	CFA	ESE	Total
CORE COURSES	18ZOOP0420	Biotechnology & Genetic Engineering	4	4	-	3	40	60	100
	18ZOOP0421	Seminar	2	2	-	-	50	-	50
	18ZOOP0422	Dissertation	6	12	-	-	75	75*+ 50**	200
	18ZOOP0423	Extension / Field Visit	-	-	-	-	50	-	50
MC	18ZOOP04MY	Modular course	2	2	-	-	50	-	50
		Total credits	14						
		Overall credits 80							

# Courses may offered under MOOC/NPTEL based on availability online and the syllabus also modified as per MOOC/NPTEL with equal credits	@ A portion of the Course may offered under MOOC/NPTEL based on availability online
*Evaluation by External Examiner	**Evaluation by External and Internal Examiners
C-Credits	ESE-End Semester Assessment
P-Practical Hours	CNCC-Compulsory Non Credit Course
L-Lecture Hours	MC- Modular course
E-Exam Hours	ME – Major Elective
CFA-In-semester continuous assessment	VPP – Village Placement Programme

List of Major Elective Courses(4 credits)	List of Modular Courses(2 Credits)
18ZOOP03E1 Aquaculture	18ZOOP03M1 Advanced Molecular Techniques
18ZOOP03E2 Ornamental Fish Culture	18ZOOP03M2 Bioinformatics
	18ZOOP04M1 Rural Biotechnology
	18ZOOP04M2 Parasitology

18ZOOP0101 ANIMAL DIVERSITY I - INVERTEBRATA Credits – 4

Objectives:

- To know the International nomenclature and classification of Invertebrates
- To understand the salient features, affinities and economic importance of Invertebrates

Learning Outcomes:

The Course will provide an overview to know International Nomenclature and classification of Invertebrates, functional activities of organisms, affinities, morphological features, larval forms and economic importance of invertebrates.

- Understand animal's classification system and their zoological nomenclature.
- Describe the salient features of phyla such as Protozoa, Porifera, Coelentrata, Platyhelminthes, Annelida, Arthropoda, Mollusca and Echinodermata
- Understand the functional activities of organisms
- Realise the structural peculiarities & affinities of ctenophore
- Understand the parasitic adaptations of tape worm, flukes and flat worms & realise the diseases caused by these parasites
- Learn the larvae of crustacean and their significance
- Understand the connecting link between annelids and arthropoda
- Realise the role of hormones in metamorphosis of insects and torsion in gastropoda
- Understand the role of water vascular system in echinodermata
- Realise the economic values of each phylum of invertebrata

Unit I

Brief Introduction

Classification - Broad outline - International nomenclature - Classification of phylum (upto classes) Protozoa- Amoeba; Porifera - Sponges; Coelenterata - Hydra; Platyhelminthes – Taenia solium; Annelida - Earth worm; Arthropoda - Cockroach, Mollusca - Pila globosa and Echinodermata - Star fish - Salient features.

Unit II

Protozoa, Porifera and Coelentrata

Protozoa - feeding, Locomotion and reproduction –Porifera- Origin and systematic position. Deep sea & Freshwater sponges. Coelenterata- Polymorphism, Reproduction in Coelenterates, Ctenophora- Structural peculiarities, general characters and affinities.

Unit III

Platyhelminthes and Annelida

Platyhelminthes - Functional morphology and adaptive biology for parasitic mode and human diseases. Annelida - Different classes of Annelida - Morphological features and affinities. Metamerism in Annelids.

Unit IV

Arthropoda and Mollusca

Arthropoda: Phylogeny of Arthropoda, Crustacean larvae and their significance. Connecting link between annelids and arthropods - Metamorphosis in insects - Mollusca: Origin of Mollusca, Torsion in Gastropoda.

Unit V

Echinodermata and Minor Phyla

Echinodermata - Water Vascular System. Significance of Echinoderm larvae Minor Phyla: Structural peculiarities and affinities of Rotifera. Invertebrate fossils -Trilobites, Brachiopoda, Cephalopoda and Echinodermata. Economic importance of Invertebrates.

Text books

1. R.L. Kotpal-2017, Modern text book of Zoology- Invertebrate- Rastogi Publication, Meerut.
2. M.Ekabaranatha Iyar and T.N.Ananthakrishnan (Recent Edition) Manual of Zoology. Vol. I. Part I & II, Visvanathan Publications, Chennai
3. N.C Nair, A. Thangamani, S. Leelavathy, S. Prasanakumar, N. Soundrapandian, T.Murugan L. M. Narayanan and N. Arumugam, 2017, Animal diversity (Invertebrata& Chordata), Saras Publication, Nagarcoil.
4. Fatik Baran Mandal (2012) Invertebrata Zoology, PHI, Learning Private Limited, New Delhi – 110001.
5. Frank. A. Brown (2002) Invertebrates, Biotech Books, Delhi – 110035.

References

1. R. L. Koptal- 2017, Animal Diversity, Rastogi Publication, Meerut.
2. E.L.Jordan and P.S. Verma 2009 Invertebrate Zoology, S.Chand& Company Ltd, New Delhi.
3. N. Arumugam 2002, Invertebrate Zoology, Saras publication, Nagercoil.
4. Frank A.Brown 2002 Invertebrates, Biotech Books, Delhi.

Course url

1. <http://b-ok.xyz/book/638104/8d1a4d>
2. <http://b-ok.xyz/book/672318/32fa64>

Objectives:

- To know the nomenclature, classification and salient features of phylum chordata.
- To understand the adaptive radiation, parental care and economic importance of vertebrates

Learning Outcomes:

The Course will provide an overview to know the Nomenclature and classification of phylum chordata, classes of chordates, adaptive radiation, structural peculiarities of mammals and comparative anatomy of vertebrates

- Understand the principles of taxonomy, nomenclature, binomial and taxonomic keys
- Classify vertebrate into divisions, classes & orders
- Describe the salient features and one example each of prochordata, cephalochordata, hemichordata and urochordata
- Identify Reptiles, Aves and Mammals according to their distinctive characters in their phylum and class & order
- Distinguish birds from glorified reptiles
- Describe the structural peculiarities of protheria, metatheria and eutheria
- Understand the comparative anatomy of vertebrates
- Understand Migration of birds & fishes and their importance
- Appreciate the parental care exhibited by fishes, amphibians, reptiles, birds & mammals; their type & need

Unit I**Overview**

Taxonomy- Principles of Taxonomy. Nomenclature: Binomial, taxonomic keys. Outline classification of Chordates up to order level.

UNIT II**Prochordata, Pisces and Amphibia**

Concept of Prochordata -Hemichordata- Balanoglossus, Urochordata - Ascidiaceans, Cephalochordata - Amphioxus - Salient features and Functions. Affinity of cephalochordata - Origin and Adaptive radiation of bony fishes. Amphibia - Adaptive radiation from water to land.

Unit III**Reptilia, Aves and Mammals**

Classification of class Reptilia, Aves and Mammals up to orders. Salient features with examples - Adaptive radiation of reptiles.

Unit IV

Adaptive Radiation

Aves- Birds as glorified reptiles, adaptive radiation in birds. Mammals - Structural peculiarities of Prototheria, Metatheria and Eutheria - Aquatic Mammals.

Unit V

Comparative Anatomy

Comparative Anatomy- Limbs, heart and brain of vertebrates. Special features like migration of birds and fishes, parental care and economic importance of vertebrates such as fishes, amphibians, reptiles, birds and mammals.

Text books

1. R.L. Kotpal-2017, Modern text book of Zoology- Vertebrate- Rastogi Publication, Meerut.
2. N. Arumugam 2002. Chordate Zoology, Sara's publication, Nagercoil.
3. Fatik Baran Mandal (2012) Chordata Zoology, PHI, Learning Private Limited, New Delhi – 110001.
4. Frank. A. Brown (2002) Chordata , Biotech Books, Delhi – 110035.
5. M.Ekabarathana Iyar and T.N.Ananthakrishnan (Recent Edition) Manual of Zoology. Vol. II. Part I & II, Visvanathan Publications, Chennai

References

1. N.C Nair, S. Leelavathy, N. Soundrapandian, T. Murugan and N. Arumugam, 2017, Animal diversity (Invertebrata& Chordata), Saras Publication, Nagercoil.
2. A. Thangamani, S. Prasanakumar, L. M. Narayanan and N. Arumugam, 2017, Chordate Zoology, Saras Publication, Nagercoil.
3. E.L.Jordan and P.S. Verma 2011 Chordate Zoology, S.Chand& Company Ltd, New Delhi.
4. Route and Solanki 2002.Learning Prochordata- Mammalia –Theory and Practice Dominant Pub. & Distributors, New Delhi.

Course url

1. <http://b-ok.xyz/book/638104/8d1a4d>
2. <http://b-ok.xyz/book/672318/32fa64>

Objectives:

- To provide fundamental environmental principles that provides an in-depth understanding of our environment.
- The scientific basis for understanding how environmental systems interfere with population and wealth of our natural resources, environmental education, pollution effects and control, monitoring and assessment of environment.

Learning Outcomes:

The Course will provide an overview of know the scope of environmental biology, fundamental principles, natural and wild life resources & their conservation strategies, remote sensing and applications, pollution, effects and control, monitoring and assessment of environment.

- Understand the scope of environmental biology & Appreciate how ecosystem works
- Appreciate how elements are cycling in the environment
- Identify the natural resources and importance of national parks, sanctuaries and biosphere reserves
- Understand remote sensing and applications
- Appreciate the importance of environmental education
- Describe the types, effects and control of pollution and importance of green house effect, acid rain and ozone depletion
- Recognise the need of environmental protection acts and laws on air and water pollution
- Realise the organisations involved in environmental protection
- Study the importance of monitoring and assessment of environment

Unit I**Ecosystem, Productivity and Biogeochemical cycles**

Scope of Environmental Biology- Structure of Ecosystem- Abiotic and Biotic components (Source: NPTEL) -Types- Terrestrial- Forest and Grassland - Aquatic- Freshwater and Marine- Food chain and food web, ecological pyramids (Source: NPTEL) -Productivity- Primary and secondary- Biogeochemical cycles- Oxygen, carbon, nitrogen, sulphur and phosphorus.

Unit II**Population and Natural Resources**

Population ecology- Natural Resources- Renewable- Food, water and forest and Non-Renewable- Land, energy and mineral- Conservation of natural resources- wildlife conservation and management- National parks, sanctuaries and biosphere reserves.

Unit III**Remote Sensing and Environmental Education**

Remote sensing- Components, types and applications- GIS and its application- Environmental Education- Objectives, goals, scope, guiding principles and Centre for Environmental Education.

Unit IV

Pollution

Pollution-Types-Air, water, soil and radio-active-sources, effect of Pollution on human health and control(Source: NPTEL)-Environmental protections acts - Air and water-Environmental Laws- Organizations involved in environmental protection.

Unit V

Environmental Assessment and Monitoring

Environmental Impact Assessment-Definition, steps, methods and problems- Public participation – Impact Analysis and Environmental Audit- Environmental Standards-Air and water- Physical, chemical and biological treatment of liquid effluents- Bio indicators and Environmental Monitoring-Bioassay –Application in Environment.

Text Books

1. P.D. Sharma 2017 Ecology and Environment- Rastogi Publication, Meerut.
2. N. Arumugam and V. Kumaresan- 2017 Environmental Biology, Saras Publication, Nagarcoil.
3. Purohit,Shammi & Agrawal 2012 Environmental Sciences – A New Approach Agrobios (India), Jodhpur.
4. Sharma, P.D. 2002 Environmental biology Rastogi and company, New Delhi
5. Metcalf and Eddy 2011 Waste water Engineering- Treatment and Reuse.Tata Mc Graw Hill Education Pvt.Ltd, New Delhi. Pp.311-1026.

References

1. P.D. Sharama 2013, Environmental Biology and Toxicology- Rastogi Publication, Meerut.
2. Pushpa Dahiya and Manisha Ahlawat 2013 Environmental Science- A New Approach,Narosa Pub. House, New Delhi.pp.2.1-2.60.
3. Agarwal, S.K. 2002 Eco – informatics. Vol I, III, IV APH pub. Company, New Delhi. Vol. I: 135 – 165 ; 265 – 311; Vol. III : 221 – 259; Vol. IV : 1-140.
4. V.S. Kulkariani, S.N. Kaw and R.K. Trivedy 2002. Environmental Impact Assessment for wetland protection. Scientific publishers (India).
5. Kaiser Jamil 2001 Bio indicators and biomarkers of Environmental pollution and Risk assessment. Oxford and IBH Pub. Co. Pvt. Ltd, New Delhi. pp.1 – 168.
6. Kailash Thakur 1997 Environmental protection law and policy in India. Deep and Deep pub. New Delhi. pp. 184-197; 210 – 248.

Course url

1. <http://nptel.ac.in/courses/122103039/40>
2. <http://b-ok.xyz/book/671429/bc900f>
3. <http://b-ok.xyz/book/2463090/f0ce34>

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18MIBP0104

MOLECULAR BIOLOGY

Credits -4

(May also offered under MOOC / NPTEL with Syllabus available online)

Objectives:

- To impart information on the historical developments in Molecular Biology
- An in-depth study on structure and organization of chromosome, replication process, transcription process, translation process and mutagenesis.
- To expose the students on the basic understanding of various techniques used in molecular studies.

Learning outcomes:

- Understand in-depth knowledge on Molecular Biology
- Know various types of Mutagenesis
- Understand in detailed mechanisms of DNA Replication
- Understand the overall concepts of Transcription
- Understand in detailed mechanisms Translation

Unit-I : Introduction to Molecular Biology

Introduction and historical development - Central dogma of Molecular biology. The Logic of molecular biology – the efficient argument, examination of models and strong inference. Molecules of life – DNA world – RNA world and protein world. Prokaryotic and Eukaryotic Chromosome organization. Genes – definition, types and functional organization. Structure of DNA - primary, secondary and different forms (A, B & Z). Gene transfer mechanism- bacterial transformation, conjugation and transduction.

Unit- II: Mutagenesis

Mutation – Types – Molecular and biochemical basis of mutation. Mutagenesis – Spontaneous and induced – Base – analog, physical agents, chemical mutagens, intercalating substances and mutator genes. Reversion – definition – Types – Mechanisms – application (Ames test). Mutants – Types and Uses – bacterial mutants, plant mutants and animal mutants.

Unit-III : DNA Replication

Basic rule. The Geometry of DNA replication – Semi conservative replication of double – stranded DNA and Circular DNA molecules. Enzymology – DNA Polymerases I and III, DNA ligase and DNA gyrase. Events in the replication fork – Continuous and discontinuous. Plasmid and ϕ 174 DNA replication. DNA damages – DNA repair mechanism – photo reactivation, excision repair, recombinant repair and DSOS function

Unit – IV : Transcription

Basic factors of RNA Synthesis - RNAPolymerases – I, II and III - Transcription Mechanisms in prokaryotes and eukaryotes – chain Initiation, elongation and termination. Significance of pribnow box, TATA box, CAAT box and enhancers in transcription initiation. Rho dependent and Rho independent termination of transcription. Classes of RNA Molecules – Messenger, ribosomal and transfer RNA. Post –transcriptional modification - RNA splicing – role of lysozyme – Spliceosomes, Group I and Group II introns Self-splicing. Capping and tailing of 5' and 3' termini of Eukaryotic mRNA molecules.

Unit – V : Translation

Genetic code – Definition, deciphering of codons – Universality of the code – Wobble hypothesis and codon degeneracy - codon dictionary. Mechanism of protein synthesis - importance of Initiation(IF), elongation(EF) and releasing factors(RF) - post translational modifications – protein splicing and folding – role of molecular chaperones. Regulation of gene expression in prokaryotes – the operon model. Lactose, galactose and tryptophan operon. Feed back inhibition and Allosteric enzymes.

Text Books

1. Lansing M. Prescott, John P. Harley and Donald A. Klein(2002). Microbiology. Mc Graw Hill companies.
2. B. Lewin 2000, Genes VII Oxford University Press.
3. David Freifelder, 1996, Molecular Biology, 4th Reprint., Narosa Publishing House, New Delhi, India.
4. H.D. Kumar, 1993, Molecular Biology & Biotechnology, Vikas publishing house Pvt. Ltd., New Delhi.
5. S.C. Rastogi, V.N. Sharma, Biology & Biotechnology, Vikas Publishing House Pvt. Ltd., New Delhi.

References

1. R.F. Weaver and P.W. Hedrick 1992, Genetics Wh.C. Brown publishers, Dubuque.
2. E.J. Gardener *et al.*, 1991 Principles of Genetics (8th Ed.,) John Wiley & Sons, New York.
3. Buchanan, Gruissum and Jones, (2000). Biochemistry and Molecular Biology of Plant; ASPP, USA.
4. David Rawn(2012). Biochemistry. Panima Publishers.
5. Richard Calendar (2005). The Bacteriophages, 2nd Edition, Oxford University Press.
6. J.E. Krebs, E.S. Goldstein, and S.T. Kilpatrick(2012). LEWINS Gene XI. Jones and Bartlett Publishers.
7. Alberts et al., Molecular Biology of the Cell, Garland Publications, (2012).

*(NPTEL) - National Programme on Technology Enhanced Learning.

18ZOOP0105 DEVELOPMENTAL ZOOLOGY AND IMMUNOLOGY Credits-3

Objectives:

- To make the students to understand the various concepts of development.
- To understand the nature and components of defence mechanism of human body.

Learning Outcome:

The Course will provide an overview of Reproductive process and Development of organs, Scope of Immunology, lymphoid organs, immune system and their functions and antigen & antibody reactions.

- Understand the mechanism of spermatogenesis
- Realize the egg interaction and sperm entry
- Know the physiological factors in fertilization process.
- Understand the mechanism of blastulation process
- Know the organogenesis and developmental process
- Understand the development of embryo and membranes
- Realize the Metamorphosis and regeneration process
- Understand the types of Immune system
- Know the types of lymphoid organs, lymph nodes and their functions
- Realize the antigen types and their functions
- Understand the types and functions of Immunoglobins
- Know the Antigen antibody reactions and invitro methods

Unit I

Gametogenesis and Fertilization

Spermatogenesis and Oogenesis – Stages – Types of eggs- Fertilization – Physiological factors and changes involved in Fertilization – Sperm – egg interaction – sperm entry in to egg - cleavage – mechanism and pattern - Blastulation

Unit II

Gastrulation and Organ Formation

Gastrulation – Morphogenetic movements & Fate map Organizer – concept – Induction process - Organogenesis of heart, brain, eye, ear & gonads.

Unit III

Development

Development of chick embryo – 24, 48, 72 & 96 hrs. Extra embryonic membranes. Placentation in mammals. .

Unit IV

Immunity

History and Scope of Immunology – Properties of immune system & adaptive, innate immune system (Source: NPTEL) -Physiology of immune response- Humoral immunity and cell mediated immunity – Primary and secondary lymphoid organs- Structure, functions and lymph nodes.

Unit V

Antigen, Antibody and Immunoglobins

Antigen – Types, properties and functions (Available NPTEL) -Immunoglobins – Types, structure and properties of immunoglobulin - Antigen – antibody reaction, In vitro methods- Agglutination- precipitation, complement fixation.

Text Books

1. K.V. Sastry and Vineeta Shukla (2018) Developmental Biology, Rastogi Publication, Meerut
2. N. Arumugam, (2017) Developmental Zoology, Saras Publication, Nagarcoil
3. Shyamasree Ghosh (2017) Immunology and Immunotechnology, Books and Allied (P) Ltd, Kolkata.
4. Ajoy Paul (2016) Textbook of Immunology, Books and Allied (P) Ltd, Kolkata.
5. Ramesh Mathur & Meenakshi Mehta (2002) Embryology, Anmol Publication Pvt.Ltd. New Delhi.

References

1. S.S. Lal and Sanjeev Kumar-2015, Immunology - Rastogi Publication, Meerut.
2. P.R. Yadav (2001) A Text Book of Embryology, Campus Books International, New Delhi.
3. T. Subramanian (2002) Developmental Biology. Narosa Publishing House, New Delhi.
4. P.M. Lydyard, A. Whelan and M.W. Fanger (2002) Instant Notes in Immunology. Viva Books Private Ltd, New Delhi.
5. C.V. Rao (2002) An Introduction to Immunology. Narosa Publishing House, New Delhi.

Course url

1. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=102103038>
2. <http://b-ok.xyz/book/463534/11604b>
3. [http://www.studocu.com/en/document/university-of-leads/animal-developmental-biology/lecture-notes/animal-developmental-biology-lecture-notes-lecture-1/60800/view](http://www.studocu.com/en/document/university-of-leeds/animal-developmental-biology/lecture-notes/animal-developmental-biology-lecture-notes-lecture-1/60800/view).
4. <http://www.studocu.com/en/document/hogeschool-van-arnhem-en-nijjmegan/immunologie/summaries/samenvatting-boek-immunologie-immunologie-sam/810272/view>.

*(NPTEL) -National Programme on Technology Enhanced Learning.

**18ZOOP0106 ANIMAL DIVERSITY I - INVERTEBRATA & II – CHORDATA
PRACTICALS Credit –1**

Objectives:

- To identify the important microscopic animals of different phyla.
- To observe crustaceans, molluscs, echinoderms and fishes through field visit to sea shore and fish farms.
- To identify teleosts, elasmobranches, amphibians, reptiles, aves & chosen Mammals.

Learning Outcomes:

By the end of this course students will be able to:

- Identify the important microscopic animals of different phyla.
- Identify earthworms, Nereis, leech, insects of different orders and arachnids
- Observation of crustaceans, molluscs, echinoderms; Gaining knowledge through field visit to sea shore and fish farms
- Identify teleosts, elasmobranches, amphibians, reptiles, aves & chosen Mammals.

EXPERIMENTS:

1. Spotters - Amoeba, Euglena, Volvox, Chlamydomonas, Trypanosoma, Paramecium, Sponges, Hydra, Jellyfish, Corals.
2. Identification of flat worms (liver fluke & tape worm).
3. Observation of nematodes (round worm, pin worm, whip worm, microfilaria, hook worm).
4. Identification of earthworms; Nereis, leech, insects of different orders and arachnids
5. Morphometrics of fish and prawns.
6. Visit to seashore and observation of crustaceans, molluscs, echinoderms and fishes.
7. Visit to fish farms.
8. Identification of teleosts, elasmobranches, amphibians, reptiles, aves & chosen Mammals.
9. Visit to aquarium and museum.
10. Observation of chick embryo of 24, 48, 72 & 96 hours.

References

1. S.S. Lal-2018, Practical Zoology- Invertebrate- Rastogi Publication, Meerut.
2. S.S. Lal-2018, Practical Zoology- Vertebrate- Rastogi Publication, Meerut.
3. Jeya surya, Dulsy Fathima, R.P. Meyyan Pillai, S. Prasanakumar, N. Arumugam, L.M. Narayanan, V. Kumaresan and, A. Marikuttikan 2017, Practical Zoology (Animal Physiology Vol.III),Saras Publication, Nagercoil.
4. Jeyasurya, N. Arumugam, N.C Nair, S. Leelavathy, N. Soundrapandian, and L. M. Narayanan 2017, Practical Zoology (Vol. 1& II), Saras Publication, Nagercoil.

Objectives:

- To estimate electrical conductivity, dissolved solids, dissolved oxygen, carbon dioxide, chloride, hardness, BOD and BOD in different water samples
- To understand how to study the population of plants.
- To understand how to design bioassay studies on industrial effluents/ pesticides using fish, aquatic insects and larvae.

Learning Outcome:

By the end of this course students will be able to:

- Understand how to estimate Electrical conductivity, Dissolved solids. Dissolved oxygen, Carbon dioxide, Chloride, hardness, BOD and BOD in different water samples
- Understand how to study on population of plants.
- Understand the Bioassay studies on industrial effluents/ pesticides using fish, aquatic insects and larvae.

EXPERIMENTS:

1. Estimation of Electrical conductivity
2. Estimation of Dissolved solids.
3. Estimation of Dissolved oxygen
4. Estimation of Carbon dioxide
5. Estimation of BOD in different water samples (Demonstration).
6. Estimation of COD in different water samples.
7. Estimation of Chloride.
8. Estimation of Total hardness.
9. Quadrant study on population.
10. Bioassay studies on industrial effluents/ pesticides using fish, aquatic insects and larvae.
11. Visit to Centre for Geology, GRI, Gandhigram for remote sensing & GIS.

References

1. P.K.Gupta 2012 Methods in Environmental Analysis Water, Soil and Air. Agrobios (India), Jodhpur.
2. APHA 2012 Standard Methods for the examination of water and waste water (20th Edition). American Public Health Association, Washington. D.C.

18ZOOPO208 BIOCHEMISTRY AND ANIMAL PHYSIOLOGY Credits – 4

Objectives:

- To study the classification, structure and properties of different biomolecules and enzymes.
- To understand the various physiological mechanisms and functioning in the animal kingdom.

Learning Outcome:

The Course will provide an overview to know the biomolecules and their function, Enzyme classification and Characteristics, Systems of organism & function and understand endocrine mechanisms, types & functions in different animals

- Learn the Classification, structure and properties of protein, carbohydrate and lipids
- Understand the classification and characteristics of enzymes
- Learn animal foods & nutritive types, feeding mechanisms in different animals and process and role of enzymes in digestion, absorption & assimilation
- Recognise the presence of different types of respiratory pigments & their functions
- Identify organs involved in respiration among aquatic amphibians and terrestrial birds & mammals
- Recognise the constituents of blood, functions and blood grouping
- Differentiate neurogenic and myogenic heart and their rhythm & regulation
- Understand osmoregulation and excretion
- Understand the structure of Mammalian kidney and the process of urine formation

Unit I

Classification, structure and properties of protein, carbohydrate and lipids

Classification of protein – Based on source, shape, composition and solubility – carbohydrates – Monosaccharide, oligosaccharides and polysaccharides – Lipids – simple, compound and derived. Structure – protein – primary, secondary, Tertiary and quaternary – Carbohydrates and lipids – Properties – physical and chemical properties of protein, carbohydrate and lipids.

Unit II

Enzymes

Enzymes - Classification – Based on substrate acted upon by the enzyme, Type of reaction catalyzed, substrate acted upon and type of reaction catalyzed, substance that is synthesized, chemical composition of the enzyme substance hydrolyzed and the group involved and over-all chemical reaction taken into consideration – Major classes of enzymes – Characteristics of enzymatic reaction (enzyme concentration, substrate concentration and Michael's – menten equation). Enzyme specificity and enzyme inhibitors.

Unit III

Nutrition, Respiration and Circulation

Nutrition - classification – Nutritive requirements of animals – Feeding mechanisms – Digestion – Digestive enzymes – absorption and assimilation of carbohydrates, proteins and lipid. Respiration – Respiratory Pigments – Blood – gas transport – Respiratory quotient- Circulation -

Blood constituents – Functions of blood – blood grouping - Types of Hearts – Neurogenic and myogenic hearts – their rhythm and regulation (Source:NPTEL).

Unit IV

Osmoregulation and Excretion

Osmoregulation and Excretion: Osmoregulation – Basic principles – Mechanism – Osmoregulation of freshwater, marine and terrestrial environment. Excretion –Nitrogenous wastes – Ammonia, Urea – Ornithine cycle – Uric acid, Organs of excretion – without special excretory tubules – Nephridia, Malpighian tubules, Vertebrate – nephron – Anatomy of mammalian kidney and urine formation.

Unit V

Muscle, Nerve and Endocrine Glands

Muscle and Nerve - Structure & Functions – Receptors – Mechanoreceptors – Chemoreceptors – Photoreceptors -Endocrine glands – pituitary, thyroid & parathyroid, pancreas, ovary & testis.(Source:NPTEL).

Text Books

1. S. Prasanakumar, A. Meena, R.P. Meyyan Pillai, DulsyFathima, L.M. Narayanan, and K Nallasingam.2017, Animal Physiology and Biochemistry, Saras Publication, Nagarcoil.
2. S. N. Gupta, 2016, A. Text Book of Biochemistry- Rastogi Publication, Meerut.
3. G.S. Sandhu 2002 Text book of biochemistry 18thEdn. Campus books International, New Delhi pp. 24-208.
4. R. Nagabhusanam Reprinted 1991 Text Book of Animal Physiology Second Edition. M.S. Kodarker R. Sarojini Oxford and IBH Publishing Company Private Limited, New Delhi.
5. William S. Hoar 1987 General and comparative Physiology Third Edition Printice - Hall International INC, Englewood cliffs, N.S. USA

References

1. K. V. Sastry& Priyanka, Mathur- 2018, Animal Physiology and Biochemistry, Rastogi Publication, Meerut.
2. J.H. Well 1997. General biochemistry. 6thEdn. New Age International (P) Ltd pub; New Delhi.
3. Eric E. Conn, Paul K. Stumpf, George Bruening and Roy H. Doi 1995. Outlines of Biochemistry. John Wiley of sons, New York. pp: 1 – 67
4. Mohan P. Arora 1989 Animal Physiology Himalaya Publishing House, New Delhi
5. Eckert and Randall Second Edition, Animal Physiology – Mechanisms and Adaptations W.B. Saunders Company, Philadelphia
6. C. Ladd Prosser (Third Edition), Comparative Animal Physiology (1973) W.N. Saunders Company, Philadelphia

Course url

1. <https://onlinecourse.nptel.ac.in/noc18bt14/preview>.
2. <https://b-ok.org/book/2595944/cab169>
3. <https://b-ok.org/book/989964/a5ob8a>

*(NPTEL) -National Programme on Technology Enhanced Learning.

Objectives:

- To understand the insects by studying of their general organisation and structure, life cycle and importance.
- To understand the plant pests of rice, legumes, sugarcane, fruits, groundnut and coconut, economic importance of insects, insect control methods and Integrated Pest Management.

Learning Outcome:

The Course will provide an overview to know the class Insecta, salient features of insects with reference to human and agriculture, economically importance of insects and Insecticidal effects & Integrated Pest Management system.

- Realise the parts of insects and their functions.
- Understand the classification and economically importance Insects
- Know the medical importance of insects
- Understand the agricultural importance of insects
- Realise the helpful insects and life cycle
- Understand the Insect Control & merits and demerits
- Know the insecticides and their effects
- Understand the importance Integrated Pest Management system

Unit I**Introduction to Entomology**

General organization and structure; types of mouth parts, sense organs, appendages and wings; metamorphosis; pheromones; reasons for the dominance of insects; reasons for insects reaching pest status; elementary classification of class Insecta; detailed study on economically important Lepidoptera, Coleoptera, Hemiptera and Thysanoptera.

Unit II**Medical Entomology**

Medical entomology - Bionomics, life cycle and control of Arthropods of medical importance: mosquitoes, sand fly, house fly, fleas, lice, ticks and mites.

Unit III**Plant Pests**

Plant pests - Leaf folder in rice; aphids in legumes; Pyrilla Perpusilla in sugarcane; fruit fly in fruits and guards; fruit borer in Pomogranate; ground nut - red hairy caterpillar in groundnut - Rhinoceros beetle in coconut - pests of stored products (any two); Apple scale.

Unit IV

Economic Importance

Productive & helpful insects: Bionomics, life cycle and economic importance - silkworm, honey bee, lac insect, pollinators and other helpful insects.

Unit V

Pest Control

Insect Control: Natural control, cultural control, applied control and legal control. Biological control of insect pests - merits and demerits; Chemical classification of insecticides; ill effects of insecticides. Integrated Pest Management (IPM) and its importance.

Text Books

1. Rajendra Singh-2016, Elements of Entomology- Rastogi Publication, Meerut.
2. K.K. Nayar, T.N. Ananthkrishnan& B.V. David (1996) General& applied entomology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3. Larry P, Pedigo (1996) Entomology and Pest management. Prentice Hall of India Ltd., New Delhi.
4. Ashok Kumar & Prem Mohan Nigam (1991) Economic & Applied Entomology Emkay Publications, Delhi.
5. H.F. Van Eenden. (1989) Pest Control 2nd edition. Cambridge University Press, Cambridge.

References

1. Lalitkumar Jha (1987) Applied Agricultural Entomology. New Central Book Agency, Calcutta.
2. A.D. Imms. (1965) A General Text Book of Entomology, 9th edition. ELBS edition, Great Brittan.
3. V.B. Wigglesworth (1965). The Principles of Insects Physiology, ELBS edition, Great Britain.

Course url

1. <http://b-ok.org/book/509727/f99f7e>
2. <http://projects.ncsu.edu/cals/course/ent425/library/tutorials>

Objectives:

To enable the students:

- To understand the structure of cell and its various organelles
- To understand the various aspects of organization of Chromosomes
- To acquire broad knowledge on basic and recent trends of genetics

Learning Outcomes:

This course outline is designed to develop awareness and interest among students on basic structure and function of cell; genetics of various levels of organisms. By the end of the course, students may be able to:

- Understand the structure and function of cell and its organelles
- Acquire combined knowledge on Cell division and cell cycle
- Analyse the various factors determining the heredity from one generation to another
- Acquire combined knowledge with special emphasis on extra chromosomal inheritance.

Unit I**Structure of Cell and cell membranes**

Ultra structure of plant and animal cell - Cell membrane: Structure and function, Structural organization and function of intracellular organelles; Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

Unit II**Organization of Chromosomes and Cell Cycle**

Organization of genes and chromosomes (operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons). Cell division and cell cycle; Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle. Biology of cancer cells – Oncogenes.

Unit III**Cell signaling**

Cell signaling; Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemo taxis and quorum sensing.

Unit IV

Mendelian genetics

Mendelian principles: Dominance, segregation, independent assortment; Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests; Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Eugenics - human betterment; Sex determination and Sex linked inheritance.

Unit V

Extra chromosomal inheritance and alterations of chromosomes

Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Cytoplasmic inheritance; Predetermination - Virus like inclusions and infective particles, milk factor, kappa particles, plastid inheritance, maternal inheritance. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Text Books

1. Benjamin A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
2. Verma, P.S. and Agarwal, V.K. 2004. Cell biology, Genetics, Molecular Biology, Evolution and Ecology. S.Chand & Company Ltd. New Delhi.
3. Sundara Rajan, S. 2003. Introduction to Cell Biology. Vikas Publishing House Pvt. Ltd., New Delhi.
4. Nair, P.K.G. and Prabhakar Achari, K. 1999. A Text Book of Cell Biology. Konark Publishers Pvt. Ltd., Delhi
5. Gupta and Jains, 1991. The Cell and Biotechnology, 1st Edition, Agro Botanical Publication, New Delhi.

Reference Books

1. Eldon J. Gardner. 2004. Principles of Genetics 8th edition, John Wiley and Sons, New York.
2. Giese, A.C. 1999. Cell Physiology. 5th Edition, W.B. Saunders Company.
3. Chariotte J. Averse. 1995. Molecular Cell Biology. Addison Wesley Publ. Co.
4. Gerald Karp, Cell Biology, II Edition – McGraw Hill International Book Co., New Delhi
5. Edmund, W. Sinnott, L.C. Dunn and Dobzhansky, T. 1990. Principles of Genetics, 5th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
6. Goodenough, U. 1984, Genetics 3rd edition CBS College Publishing, Halt, Rineshait and Winstion.

Objectives:

- Students will be able to make informed decisions based on data
- Students will be able to correctly apply a variety of statistical procedures and tests
- Students will know the uses, capabilities and limitations of various statistical procedures
- Students will be able to interpret the results of statistical procedures and tests

Learning Outcome:

On the completion of the course students should be able to:

- Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods
- Create and interpret visual representations of quantitative information, such as graphs or charts
- Understand and critically assess data collection and its representation
- Understand why biologists need a background in statistics

Unit–I Introduction to Statistics

- a) Statistics – Definition, Scope, functions and limitations; Development of Biostatistics and its applications.
- b) Sources of statistical data, Secondary and Primary sources; Statistical set up in India; Statistical organizations.
- c) Representation of data; classification and tabulation of data; frequency distribution; Diagrammatic and Graphical representation of statistical data – Bar diagrams, Pie Chart, Line graph, Pictogram, Histogram, Frequency polygon, Frequency curve, Ogive.

Unit–II Descriptive Statistics

- a) Measures of central tendency – Objects of various measures – mean, median and mode, uses, merits and demerits.
- b) Measures of Dispersion; Objects : Measures – range, quartile deviation, mean deviation standard deviation, absolute and relative measures of dispersion, uses, merits and demerits

Unit–III Sampling and Theoretical Distributions

- a) Sampling – meaning, advantages, concept of parameter and statistics, sample size, sampling error, sampling frame, types of samples – Probability samples – Simple random sample, stratified random sample, systematic sample, cluster sample, Multi stage and area sample. Non-Probability samples – purposive sampling, quota sampling, accidental sampling, volunteer sampling and snowball sampling.

- b) Introduction of probability and its applications –Theoretical Distributions – Binomial, Poisson and Normal distributions; Properties, uses and applications.

Unit-IV Correlation and Regression Analysis

Theory of correlation and regression. Definition, uses, types and correlation, Regression Lines – Properties of regression coefficients.

Unit–V Testing of Hypothesis

- a) Test of attributes, small and large sample tests.
- b) Analysis of variance – one-way and two-way classification.
- c) Non-parametric and Distribution Free Tests - Chi-Square test and Contingency coefficient

Reference Books

1. Arora P.N. Malhan P.K. Biostatistics, Delhi : Himalaya Publishing House, 1996.
2. Gupta C.B. An introduction to statistical methods New Delhi; VikasPublishers,2012.
3. Gupta, S.P. Statistical Methods, New Delhi: Sultan Chand, 2014
4. Daroga Singh, Chaundjari F.S. Theory and Analysis of Sample survey, New Delhi; Wiley Eastern Ltd., 1986.
5. Palanichamy S. and Manoharan M. 1996.Statistical methods for biologists.

Web resources

- 1.nu.libguides.com/biostatistics
- 2.<https://newonline.courses.sciences.psu.edu/>

18ZOOP0212

**BIOCHEMISTRY AND ANIMAL
PHYSIOLOGY – PRACTICALS**

Credit- 1

Objectives:

- To understand the importance of estimating protein, free amino acids, total carbohydrates, cholesterol, ammonia, urea and enzymes.
- To identify the ABO blood groups

Learning Outcome:

By the end of this course students will be able to:

- Understand the importance of estimating protein, free amino acids, total carbohydrates, cholesterol.
- Identify the ABO blood groups
- Understand the importance of estimating ammonia and urea
- Explain the estimation of enzymes

EXPERIMENTS:

1. Estimation of protein
2. Estimation of free amino acids
3. Estimation of total soluble carbohydrates
4. Estimation of total cholesterol
5. Quantitative estimation of amylase activity
6. Enzyme assay – Nitrate reductase
7. Identification of ABO blood groups
8. Estimation of glucose level in urine
9. Qualitative estimation of ammonia and urea
10. Estimation of vitamin C

18ZOOP0313

SUMMER INTERNSHIP

Credits – 2

18ZOOP0314

**INSTRUMENTATION TECHNIQUES AND
RESEARCH METHODS**

Credits – 4

Objectives:

- To understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.
- To appreciate the importance, concept of research and learn the art of thesis & paper writing and publication.

Learning Outcome:

The Course will provide an overview to know the general laboratory procedures and maintenance of research equipments, Instrumentation of equipments, concept of research and preparation of research proposal & funding agencies

- Understand general laboratory procedures and maintenance of research equipments, microscopy, pH meter and preparation of different buffers
- Describe the pH measurement in soil and water samples\
- Understand how to isolate cellular constituents
- Realise the need of centrifuges and their uses in research
- Understand how to separate amino acids and sugars using paper & thin layer chromatography
- Realise the principle and applications of gas liquid chromatography, HPLC and
- Learn the principles and applications of electrophoresis
- Realise the importance of UV-Visible.
- Understand how to estimate sugars, amino acids and sugars using spectroscopic techniques
- Describe the principle of flame photometer and bomb calorimeter
- Understand the objectives, types and importance of research
- Understand how to present research papers in seminars and conferences
- Realise the need of publication and know the importance of impact factor & citation index
- Describe the methods of writing scientific paper and components of research paper
- Understand how to prepare manuscript & methods of correcting proof
- Able to know how to prepare research proposals, identification of funding agencies and availability of research fellowships

Unit I: Microscopy, pH and Buffer

General Laboratory procedures and maintenance of research equipments- Microscopy- General principles-Confocal Microscope,SEM and TEM(Source:NPTEL) - pH basic principles and construction of pH meter- pH electrodes- Principles and application of buffers-

Mechanism of buffer action and preparation of common buffers- Citrate, acetate, tris and phosphate- Application of buffers- pH measurements of soil and water.

Unit II: Isolation, Fractionation and Separation

Isolation, fractionation and separation of cellular constituents- Isolation of chloroplasts, mitochondria, nucleic acids and enzymes- Homogenization- Manual, mechanical and sonication- Centrifugation techniques- Basic principles, Different types of Centrifuges, Analytical and preparative ultracentrifugation methods (Source:NPTEL) - Chromatography- Paper, thin layer, Ion-exchange, column, affinity - separation of amino acids and sugars- Gas liquid chromatography, HPLC.

Unit III: Electrophoresis, Colorimetry and Calorimeter

Electrophoresis- General Principles Horizontal & Vertical gel electrophoresis, Iso electric focusing, 2D, pulse field and immune electrophoresis (Source:NPTEL)Electrophoresis of proteins and nucleic acids- Spectroscopic techniques- UV-Visible and FT-IR - Flame photometer, Bomb calorimeter, AAS, Mass Spectra, NMR - Principle and applications.

Unit IV: Research and Project writing Methods

Research- Definition, objectives, types and importance-Research methods in Biological Sciences- Research process- Literature survey- sources- scientific databases- Research report writing- Parts of Thesis and Dissertation-Title, certificate, declaration, acknowledgements, contents- List of tables, figures, plates & abbreviations, Introduction, Review of literature, Materials and methods- Results- Presentation of data-Tables, figures, maps, graphs, photographs-Discussion-Summary, Bibliography/References and Appendix.

Unit V: Article Publication

Presentation in seminars and conferences- Writing scientific paper- Organization of scientific paper- Importance of title- abstract- key words, Introduction, Materials and Methods, Results, Discussion, Acknowledgements and References-Publication in research journals- Standards of Research journals- Peer- review- impact factor- citation index-Preparation of manuscript- Proof correction- proof correction marks- Method of correcting proof- Writing chapters in books- Preparation of Research proposal and funding agencies – Research fellowships.

Text Books

1. Biju Dharmapalan 2012 Scientific Research Methodology. Narosa Publishing House, New Delhi.
2. N. Gurumani 2010 Research Methodology for Biological Sciences. MJP Publishers, Chennai..
3. S. Palanichamy and M. Shunmugavelu 2009. Research methods in biological sciences. Palani paramount publications, Palani
4. Rodney Boyer 2001 Modern Experimental Biochemistry. III Ed. Addison Wesley Longman Pte. Ltd, Indian Branch, Delhi, India.
5. Sahu, P.K. 2013. Research Methodology: A Guide for Researchers in Agricultural Science, Social Science and other related fields. Springer, New Delhi.

References

1. K. Kannan 2003 Hand book of Laboratory culture media, reagents, stains and buffers Panima publishing corporation, New Delhi.
2. Keith Wilson and John Walker 2002 Practical biochemistry – Principles and techniques. Fifth edn. Cambridge Univ. Press.
3. P. Asokan 2002. Analytical biochemistry – Biochemical techniques. First dition – Chinnaa publications, Melvisharam, Vellore

Course url

1. <http://nptel.ac.in/syllabus.php?subject Id= 102107028>.
 2. <http://b-ok.xyz/book/674611/288bc3>
 3. <http://www.researchgate.net/publication/317181728>- Lecture Notes on Laboratory Instrumentation and Techniques.
 4. iiscs.wssu.edu/drupal/node/4673
 5. http://www.studocu.com/en/search/research_methodology?languages=language_en&type=document
- *(NPTEL) -National Programme on Technology Enhanced Learning.

18ZOOP0315

ECONOMIC ZOOLOGY

Credits-4

Objectives:

- To understand the aquaculture potential, kinds of aquaculture practices in India, Integrated fish culture, prawn and ornamental fish culture.
- To understand the importance of apiculture and lac culture.
- To understand the importance of sericulture.
- To know the economic importance of live stock and poultry.
- To know the vermicomposting and vermiproducs.

Learning Outcome:

The Course will provide an overview to understand the aquaculture potential, kinds of aquaculture practices in India, Integrated fish culture, prawn culture, ornamental fish culture, api culture, lac culture, sericulture, economic importance of Live stocks, poultry and vermiculture.

- Understand the aquaculture potential of India
- Learn the kinds of aquaculture practices in India
- Know the importance of integrated fish culture, prawn and ornamental fishes
- Understand the importance of api culture and lac culture.
- Recognize the importance sericulture
- Learn the importance of Live stock and poultry.
- Understand the importance of vermiculture.

Unit-I

Aquaculture Potential:

Status of aquaculture – National and International – Economics of aquaculture – Fish and Prawn. Fishery Byproducts – Fishery contribution – Fish trade & Marketing.

Unit- II

Apiculture and Lac Culture:

Apiculture- Honey bee- Types- Colonial organization and Division of Labour- Queen, worker Drone- Honey comb-Life cycle- Bee hive- Maintenance and Management- Economic Importance of Honey- Food & Medicinal value, Bee wax, Royal Jelly & bee venom- Lac Culture- Distribution- Life cycle Host plants- Cultivation of Lac- Economic importance.

Unit- III

Sericulture:

Species of silkworm- Mulberry silk moth- Life cycle- Collection of eggs- Incubation of eggs- Rearing of Larvae- Production and Recovery of cocoons- Spinning cocoons- Quality & Marketing- Post-cocoon processing- Shifting, Reeling and spinning- Diseases of silkworm and uses.

Unit- IV

Economic Importance of Live stocks and poultry:

Important live stock- Cattle, Goat, Sheep- Breeds, Management, Live stock diseases and Economics- Poultry- Types and breeds- Management, disease and economics.

Unit- V

Vermiculture:

Benefits of Earthworms- Basic Needs for working with worms- Bedding, Worm food, Moisture, Aeration, temperature- Parameters of Vermicomposting- Vermiculture- Vermicomposting systems- Methods of Worm Harvesting- Use of worms in Agriculture and Vermiproducs.

Text Books

1. G.S. Shukla and V.B. Upadhyay-2017- Economic Zoology- Rastogi Publication, Meerut.
2. Jeyasurya, N.C. Nair, N. Soundara Pandian, A. Thangamani, L.M. Narayanan, N. Arumugam, S. Leelavathi and T. Murugan- 2017- Saras Publication, Nagarcoil.
3. Q.J. Shammi and S. Bhatnagar. Applied Fisheries. Agrobios (India) 2002
4. R.P. Parihar, A text book of Fish Biology and Fisheries central Pub. House, Allahabad. 1996.
5. Arvind Kumar. Verms & Vermitechnology, APH Pub. Corporation, New Delhi,2005.

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1. V.G. Jhingran. Fish and Fisheries of India. Hindustan Publishing corporation (India) Delhi. 1997.
2. Amita Saxena. Aquarium Management. Daya Pub. House, New Delhi. 2003.
3. Manju yadav. Economic Zoology. Discovery Pub. House, New Delhi.2008.
4. N. Arumugam, T. Murugan, J. Johnson and P. Ram Prabhu, Applied Zoology- 2017- Saras Publication, Nagarcoil.
5. G.C. Banerjee. A Text book of Animal Husbandry 9thEdn. Oxford & IBH Pub. New Delhi.2010.
6. T.V. Sathe. Vermiculture and Organic Farming Daya Pub. Home, Delhi.2004

Course url

1. [gurukpo.com/applied zoology-ethology-biostatics](http://gurukpo.com/applied-zoology-ethology-biostatics)
2. [http://ia800306.us.archive.org/O/items/economic zoology. 00osbogoog/economic zoology 00osbogoog. pdf](http://ia800306.us.archive.org/O/items/economic_zoology.00osbogoog/economic_zoology.00osbogoog.pdf)

Objectives:

- To enhance the students knowledge on the historical aspects and development of microbiology
- To acquire an overall knowledge on the morphology and functions of the structures with the prokaryotes and eukaryotes.
- To make the students knowledgeable on the various techniques involved.
- To give an overview on microbial ecology-microbial habitats, their interactions and plant-microbe relationship

Learning outcomes:

By the end of this course students will be able to:

- Be impressed on the milestones of Microbiology and its present status
- Identify key components and their functions in both prokaryotes and eukaryotes.
- Be able to understand in depth the techniques used in Microbiology
- Have an insight to the interactions and characteristics of microorganisms.

Unit – I : History and Microscopy (Available NPTEL)

Historical and recent developments - Spontaneous generation, germ theory of disease and development of medical microbiology, microbial genetics, physiology, virology, plant pathology, soil microbiology, industrial microbiology and molecular biology. Microscopy: Simple, Compound, Dark field, Phase contrast, Fluorescence and Electron microscopy.

Unit – II : Prokaryotic and Eukaryotic Cell (Available NPTEL)

Ultra structure of Prokaryotic and Eukaryotic cell- The Prokaryotic Cell: Size, shape and arrangement of bacterial cells; structure of cell wall, and structures external (glycocalyx, flagella, pili, etc.) and internal (plasma membrane, cytoplasm, inclusion bodies, etc.) to the cell wall. The Eukaryotic Cell: Cilia, flagella, cytoskeleton, cytomembrane systems, mitochondria and chloroplast Comparison of Prokaryotic and Eukaryotic cell.

Unit – III : Microbiological Techniques I

Sterilization: Dry Heat, Moist Heat, Filtration, Tyndallization, Pasteurization, Radiation, Antimicrobial Chemicals- classification - mode of action - antibiotic resistance - tests for antibiosis.

Unit – IV: Microbiological Techniques II (Available NPTEL)

Cultural techniques: pure culture techniques, types of media - media preparation - preservation of cultures - aerobic and anaerobic culture techniques - growth of bacteria: batch and synchronous culture - factors influencing growth - growth curve. Methods to study microbial morphology - wet mount and hanging drop method. Staining techniques - Gram's, acid fast, spore and capsule staining.

Unit – V: Microbial Ecology

Microbial habitat- An overview, the niche, aquatic habitats (marine and fresh water)-soil habitats-subsurface and atmospheric. Microbial Interactions- neutralism, mutualisms, commensalisms, competition, amensalisms, parasitism, predation, antagonism, syntrophism and symbiotic associations. Plant-microbes interactions – Ectomycorrhizae and Endomycorrhizae- Root and stem nodules, rhizosphere and phyllosphere.

Text Books

1. Madigan, M.T., Martinko, J.M., Stahl, D.A. and Clark, D.P. 2011. Brock Biology of Microorganisms 13th Ed. Benjamin Cummings, N.Y.
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2010. Microbiology: An introduction 10th Ed, Benjamin Cummings, N.Y.
3. Wiley, J.M., Sherwood, L.M. and Woese, C.R. 2009. Prescott's principle of Microbiology, McGraw Hill, New York.
4. Dubey, R.C. and Maheswari, D.K. 2005. A text book of Microbiology, Revised Ed., S.Chand Publishers, New Delhi.
5. Pelczar, Jr., Michael, Chan E. C. S. and Kreig Noel. 2000. Microbiology. 5th Ed. Tata McGraw Hill Book Company.

References

1. Stanier, Y. Roger, John L. Ingrahm, Mark L. Wheelis and Page R. Painter. 2003. General Microbiology. V Ed. MacMillan Press Ltd. New Jersey. pp: 621-626; 655-670.
2. Sundararajan, S. 2003. Microorganisms. I Ed. Anmol Publications Pvt. Ltd. New Delhi..
3. Hans G. Schlegel. 2012 (Reprint). General Microbiology. VII Ed. Cambridge University Press. UK..
4. Salle, A. J. 2001. Fundamental and Principles of Bacteriology. 7th Ed. Tata McGraw Hill Publishing Co. Ltd.
5. John L. Ingrahm and Catherine Ingrahm.. 2000. Introduction to Microbiology. II Ed. Brooks/Cole, Thompson Learning division. USA.
6. Lansing M. Prescott, John P. Harley and Donald A. Klein. 2002. Microbiology. V Ed. WCB/McGraw Hill Company.
7. Brock, T. D., Smith, D. W. and Madigan, M. T. 1997. Biology of Microorganisms: Milestones in Microbiology. Prentice-Hall International Inc. London.
8. Talaro, K. and Talaro, A. 1996. Foundations in Microbiology, 2nd Ed., Wm. C. Brown publishers, Toronto.
9. Jeffery C. Pommerville (2016). Alcamo's Fundamentals of Microbiology (Third Edition). Jones and Bartlett Learning. LLC, Burlington, MA 01803.

*(NPTEL) - National Programme on Technology Enhanced Learning.

18ZOOP0317 INSTRUMENTATION TECHNIQUES -PRACTICALS Credit-1

Objectives:

- To know the preparation of buffers and determination of pH.
- To separate amino acids and sugars using chromatography and electrophoresis
- To estimate proteins, sugars, nucleic acids, chlorophyll, sodium, potassium, calcium and magnesium using different equipments.

Learning Outcome:

By the end of this course students will be able to:

- Know the preparation of buffers and determination of pH.
- Separate amino acids and sugars using chromatography and electrophoresis
- Estimate proteins, sugars, nucleic acids, chlorophyll, sodium, potassium, calcium and magnesium using different equipments.

EXPERIMENTS:

1. Preparation of buffers and determination of pH using pH meter
2. Separation of amino acids and sugars using paper chromatography (2D)
3. Separation of amino acids and sugars using thin layer chromatography
4. Separation of pigments by column chromatography
5. Separation of proteins using vertical gel electrophoresis.
6. Verification of Beer- Lambert's law using spectrophotometer.
7. Estimation of Protein using Spectrophotometer
8. Estimation of sodium, potassium, calcium and magnesium using Flame photometer
9. Estimation of calorific value of feed/ fire wood samples.
10. Demonstration of Biological samples using SEM.

References

1. Rodney Boyer, 2001. Modern Experimental Biochemistry. III Ed. Addison Wesley Longman Pte. Ltd, Indian Branch, Delhi, India.
2. J.Jeyaraman 1981. Laboratory Manual in Biochemistry. New Age International publishers, New Delhi.

18ZOOP0318 FUNDAMENTALS OF MICROBIOLOGY – PRACTICALS Credit-1

Objective:

- To enhance the student's knowledge and impress upon them the important aspects of microorganisms
- To provide practical knowledge and skill in the isolation and handling of microorganisms
- To understand the working procedure and principles of microscopes.
- To know pure culture techniques and methods of culturing preservation and maintenance of microorganisms
- To gain skill in isolation of microorganisms from various samples.

Learning outcomes:

By the end of this course students will be able to:

- Identify standard methods for the isolation, identification and culturing of microorganisms.
- Comprehend the ubiquitous nature of microorganisms and identify the different groups of microorganisms from different habitats and their applications
- Carry out experiments to evaluate microbial quality of food products and water

EXPERIMENTS:

1. a) Safety measures and rules of conduct to be followed in a microbiological laboratory.
b) Cleaning of Glasswares
c) Handling and Care of Microbiological Instruments.
2. a) Microscopic Examination of Living Organisms – Demonstration of motility.
b) Sample preparation and characterization of microorganisms using Scanning Electron Microscope (SEM).
c) Measurement of Microorganisms using Micrometry.
3. Staining Techniques – Gram's staining, Acid-fast staining, Endospore Staining and Capsule staining.
4. a) Basic Laboratory and Culture techniques
Preparation of Culture Media for Microorganisms. Preparation and sterilization.

- b) Demonstration of Techniques for Pure Culture of Micro-organisms by Serial Dilution Techniques and determination of Bacterial numbers.
 - i) Streak Plate method.
 - ii) Pour Plate method
 - iii) Spread Plate method
 - iv) Isolation of Anaerobic Bacteria
 - v) Isolation and maintainance of pure cultures.
 - vi) Determination of bacterial numbers
5. Isolation of Bacteriophage from Sewage.
6. Milk Analysis – Total Aerobic count and Methylene Blue Reductase Test
7. a) Standard Qualitative Analysis of Water
 - i) Presumptive Test for Coliform Group of Bacteria.
 - ii) Confirmed Test of Coliform Bacteria.
 - iii) Completed Test for Coliform Bacteria.
- b) Water Analysis for Total Bacterial Population by Standard Plate Count Method.
8. Isolation and Enumeration of selected Microorganisms such as Bacteria, Actinobacteria, Yeast, and Moulds.
9. Isolation of Protozoa from soil.
10. Isolation of AM spores from soil.

References

1. James. G. Cappucino. And Natabe Sherman, 2004. Microbiology – A Laboratory Manual, VI Ed., (I Indian Reprint). Pearson Education (Singapore) Pvt. Ltd., India.
2. Dubey, R.C and Maheswari, D.K. 2002. Practical Microbiology, I Ed., Chand and Company Ltd., India.

18ZOOP03E1

Major Elective -1 AQUACULTURE

Credits-4

Objectives:

- To understand the aquaculture potential, kinds of aquaculture practices, integrated fish culture, pond construction and management
- To study the nutritional requirements, culture of live feeds, methods of induced breeding, transportation and disease management
- To learn the culture and breeding techniques of fishes

Learning Outcome:

The Course will provide an overview of Aquaculture potential of India, kinds of aquaculture practices, integrated fish culture, pond construction and management, nutritional requirements of fishes, induced breeding, transportation, disease management and culture techniques of carps, cat fishes, murrels, prawns and ornamental fishes.

- Understand the aquaculture potential of India
- Recognise the kinds of aquaculture practised in India
- Appreciate the importance of integrated fish culture
- Learn the construction and management of fish ponds
- Differentiate stocking density and stocking rate
- Realise the nutritional requirements of fishes and culture techniques of live feeds
- Recognise the importance of induced breeding, method of transportation and management of fish diseases
- Familiarise the culture techniques of carps, cat fishes, murrels, prawns and ornamental fishes

Unit I

Overview

Aquaculture potential of India – Inland fishery resources- Riverine, Lakes and reservoir, cold-water and Estuarine – Coastal aquaculture resources – Sea farming and brackish water aquaculture – kinds of aquaculture practices – Monoculture, monosex culture, polyculture, sewage – fed fish culture, pen culture and cage culture..

UNIT II

Integrated Fish culture and Pond Construction

Integrated fish culture – Agriculture-cum fish culture- Simultaneous and Rotational – Animal husbandry – cum fish culture – Pig / Duck / cattle. Pond construction and management – Farm site – site selection – Topography, soil type, water supply – Designing – construction of fish ponds – Bunds, slope – Berm – construction of pond – Bund formation – Inlet and outlet – Types of ponds – Hatching, Nursery, Rearing and stocking- Pond management – Nursery pond management – Algal blooms – Control of algal blooms – control of predatory aquatic insects and weeds – Biological, mechanical and chemical methods – Physico – Chemical and biological characteristics of fish ponds. Liming – Fertilization of ponds – Types of fertilizers – Organic and inorganic – stocking – stocking density, stocking rate and harvesting.

UNIT III

Cultivable Fishes

Indian Major Carps – Catla, Rohu, Mrigal – Exotic carps – Silver carp, Grass carp, Common carp – Minor carps – Calbasu , Bata, White carp, Fringelipped carp Cat fishes – Singhi, Magur, Pangash – Murrel culture – Snake head murrel, Giant snake head – Prawns and Ornamental fishes - Selection criteria of cultivable fishes.

UNIT IV

Feeding

Nutritional requirements – protein, carbohydrate, lipids, minerals, vitamins-weight budgeting. Feeding Methods - Types of feeds – Live feeds (Artemia & Daphnia) and their culture techniques -artificial feeds -Feed formulation (square method). Qualities of good feed.

UNIT V

Reproduction, Transportation and Diseases

Induced breeding – stripping – Induced spawning by hypophyztion technique – selection of breeders –Rearing of breeders – Hypophyztion – Preparation of pituitary extract – Injection technique – Hatching – hatching technique – hatchery – Transport of fish seed – causes of mortality - Methods of packing and transport – open system, closed system – Transport of live fishes – Cans, Dry transport, Barrels and Vats, polythene bags – General rules for transportation– Measures of safe transport. Diseases management –bacterial, fungal, protozoan and viral diseases.

Text Books

1. Kamleshwar Pandey and J.P. Shukla, 2017- Fish and Fisheries, Rastogi Publication, Meerut.
2. N.M.Chakrabarty, P.P.Chakraborty and S.C.Mondal 2010 Biology, Breeding and Farming of Important Food Fishes.Narendra Pub. House, Delhi.
3. S.C.Agarwal 2007. A Handbook of Fish Farming. Narendra Pub. House, Delhi.
4. Amita Saxena 2003 Aquarium Management Daya pub. House, New Delhi
5. Q. J. Shammi and S. Bhatnagar 2002. Applied Fisheries. Agrobios (India)

References

1. P.C. Thomas, Suresh Ch. Rath and Kanta Das Mohapatra 2003. Breeding and seed production of Fin Fish and shell fish. Daya pub. House, New Delhi.
2. C.B.L. Srivastava 2002 Aquarium fish keeping Kitab Mahal, Allahabad
3. C.B.L. Srivastava 1999 A text book of Fishery Science and Indian Fisheries. Kitab Mahal, Allahabad.
4. V.G.Jhingram 1997. Fish and Fisheries of India, Hindustan Publishing Corporation (India), Delhi.
6. K.P. Biswas 1992 Prevention and control of fish and prawn diseases. Narendra pub.House, Delhi. pp. 43-69.

Course url

1. <http://www.studocu.com/en/document/james-cook-university/introduction-to-aquaculture/lecture-notes/lecture-notes-lecture-all-full-notes/672525/view>
2. <http://b-ok.xyz/book/614845/az7f54>.

Objectives:

- To understand the status, importance and economics of ornamental fish culture
- To know the popular fresh water ornamental fishes, their characteristics and breeding techniques

Learning Outcome:

The Course will provide an overview on the status and importance of ornamental fish culture, setting and maintenance of home aquarium, popular fresh water ornamental fishes, culture of fish food organisms, breeding techniques and economics of commercial farming

- Realise the present status and importance of ornamental fish culture
- Recognise the types, accessories needed for the construction and maintenance of home aquarium
- Understand the role of aquarium plants and their uses
- Realise the popular varieties of fresh water ornamental fishes and their characteristics
- Understand the mode of reproduction and breeding techniques of ornamental fishes
- Realise the need of artificial and live food organisms
- Recognise the economics of commercial farming

Unit I**Overview**

Present status of ornamental fish culture in India -Importance of ornamental fish culture
Design and setting up of fish tank: Types, construction, accessories and maintenance of home aquarium-Aquarium plants and their uses.

Unit II**Freshwater Ornamental Fish culture**

Popular tropical fresh water ornamental fishes and their characteristics - Live bearers – guppy, molly, platy and swordtail - Egg layers- Gold fish, fighter, gourami, angelfish, koi carp, zebrafish.

Unit III**Food and Feeding**

Artificial feeds-making pelleted feed – quantity and time of feeding. Live feed organisms: Daphnia, tubifex & Artemia.

Unit IV**Breeding of Aquarium Fishes**

Mode of reproduction: breeding of egg layers-gold fish, fighter, angel fish and barbs and breeding of live bearers: guppy, molly, platy and swordtail - Care of the fry

Unit V

Commercial Farming

Economics of Commercial farming: Construction and Management of commercial ornamental fish farm: types; costs and returns up of an exporting unit.

Text Books

1. Amita Saxena 2003 Aquarium Management Daya pub. House, New Delhi
2. C.B.L. Srivastava 2002 Aquarium fish keeping Kitab Mahal, Allahabad
3. Cliff W. Emmens 1987 A complete guide to Tropical fish , T.F.H. Publishing.

References

Course url

1. <http://b-ok.xyz/book/1240495/OeeO8e>
2. <http://b-ok.xyz/book/2872234/Oa56ed>

Objectives:

- To impart information on the historical aspects development of Biotechnology and Genetic Engineering
- To provide knowledge and in-depth study on plant & animal tissue culture techniques, Biosensors, Bio-energy, Concepts & Scope in Genetic Engineering and Applications of Genetic engineering
- To expose the students on the basic understanding of various techniques used in Biotechnology and Genetic Engineering in plant, animal and microbial system.

Learning outcomes:

- Understand in-depth knowledge on the history and concepts and scope in bio-technology
- Gain knowledge on biotransformation & production of useful compounds and uses of biosensors
- Know the alternate energy sources and generation of energy from biomass energy
- Understand the concepts and methods in Genetic Engineering
- Acquire knowledge on applications of genetic engineering in plant, animal and microbial system.

Unit – I : Concepts and Scope in bio-technology

Historical development - Plant cell and tissue culture techniques – Culture medium - Culture techniques — Anther and pollen culture. Animal tissue cultures techniques - primary culture, cell strains and cell lines – culture medias - Small scale and large scale culture techniques – Animal bioreactors. Protoplast culture technique and its applications. Germplasm and cryopreservation. Immobilization of microbial cells / enzymes – Adsorption, entrapping, ionic bonding, cross linking, encapsulation and microencapsulation. Application of immobilized microbial cells & enzymes.

Unit-II : Biotransformation and Biosensors (*Source NPTEL course*)

Biotransformation and production of useful compounds – Glycerol, butanol, acetons, alkene oxide, Poly hydroxy butyrate and valerate(PHBV), Xanthangum and Microbial Leaching. Biosensors – definition and outline design- types of electrode systems – Oxygen electrode system, Fuel cell type electrode, Potentiostatic, Piezoelectric membrane and Dye-coupled electrode membrane filter systems –Biosensors for nutrients (glucose sensors). Sensor for cell population (Lactate sensor) - Biosensor for products (alcohol sensor, formic acid sensor and methane sensor) - Biosensor for environmental control (BOD sensor, Ammonia sensor, Nitrite sensor and Sulfite Ion sensor).

Unit-III : Biomass and Bio-energy

Energy sources – nuclear energy, fossil fuel energy and non-fossil and non-nuclear energy. Biomass energy – Composition of biomass-wastes as sources of renewable source of energy – Composition wastes – sources of wastes (Industrial, agricultural, forestry, municipal sources). Biomass conversion – non-biological process, direct combustion (Pyrolysis, Gasification, liquefaction); biological process (enzymatic digestion, anaerotic digestion, aerobic digestion). Bioenergy products – ethanol, biogas and Hydrogen.

Unit – IV : Genetic Engineering (Source NPTEL course)

Definition and outline strategy: Enzymology – Restrict enzymes, DNA ligases, reverse transcriptase, klenow fragment, Alkaline phosphatase, Polynucleotide kinase, terminal transferase, Dnase and Rnase. Cloning vehicles- Plasmids – pBR 322 & pUC; phage vector, cosmid vector, shuttle vector, expression vector and YAC vector. Gene cloning strategy – Isolation of foreign DNA and recombinant DNA construct – Transformation – Screening and selection. Expression of cloned genes in prokaryotic and eukaryotic systems – minicell, maxicell, Fused and unfused gene expressions.

Unit-V : Applications of Genetic engineering (Source NPTEL course)

GMOS – transgenic plants – role of *Agrobacterium* - development of transgenic crops for disease resistance, salt tolerances, drought tolerance, herbicide tolerance and nutritional quality – Brief outline on Bt Cotton & golden rice. Transgenic animals -development of Transgenic animals for disease resistance, improved milk content and expression of antibodies. Brief outline on transgenic mice and Cattle. Genetically modified Microorganisms (GMOs) and its applications for antibiotic production, expressing hGH, interferon and human insulin (Humulin). Brief outline on Superbug bacteria. Rules and regulation in biotechnology – biosafety, bioethics, hazards of environmental engineering and intellectual property rights (IPR) and protection (IIP).

Text Books

1. Dubey R.C., 2014. Advanced Biotechnology 1st Edition. S.Chand&Company Ltd., New Delhi.
2. S.B. Primrose, R.M. Twyman, and R.W. Old (2012). Principles of Gene Manipulations; 6th Edn. Blackwell Science.
3. Chhatoval G.R., 1995. Text book of Biotechnology, 1st Ed, Anmol Publications Pvt. Ltd., New Delhi.
4. Kumar H.D., 1991. A text book on Biotechnology 2nd Ed, East-west Press Private Ltd., New Delhi. Pg.1-250; 411-472; 534-555.
5. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.

Reference Books

1. Dubey R.C., 2001. A text book of Biotechnology 1st Edition. S.Chand&Company Ltd., New Delhi.
2. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
3. Kumar, H.D. 1993. Molecular Biology & Biotechnology, Vikas Publishing House Pvt., Ltd., New Delhi.
4. Kumar, H.D. 1991 Biotechnology, 2nd Ed., East – West Press Private Ltd., New Delhi.
5. Trevan, M.D, Boffey, S., Goulding, K.H. and Stanbury, P. 1990. Biotechnology- The basic Principles. Tata McGraw Hill, New Delhi.
6. Demain, A.L., Solomon, N.A. 1986. "Manual of Industrial Microbiology and Biotechnology", ASM Press, Washington.

7. Robert F. Weaver, 2012 Molecular Biology; McGraw Hill
8. Keith Wilson and John Walker 2010 Principles and Techniques of Biochemistry and Molecular Biology; 7th Edn.
9. T. A. Brown 2006 Gene Cloning and DNA analysis- An Introduction;, 5th Edition, Wiley Blackwell Publishing

Web resources

1. <https://www.edx.org/learn/biotechnology>
2. <https://biog.feedspot.com/genetics-blogs/>
3. learn.genetics.utah.edu/
4. <http://bmc.biotechnol.biomedcentral.com>

COURSE
18ZOOP03M1 ADVANCED MOLECULAR TECHNIQUES Credits -2

Objectives:

- To impart knowledge on advanced biological and molecular techniques
- To provide hands on experience to various advanced Instruments used for biological and molecular studies

Learning Outcome:

- Understand in-depth knowledge on Electrophoretic techniques
- Realize Molecular Sequencing techniques
- Know the principle and applications of PCR techniques
- Familiar with Chromatographic and Spectrophotometric techniques
- Distinguish Genome sequencing and Physical mapping of genome analysis

Unit-I: Electrophoresis

Principle and application: paper electrophoresis, agarose gel electrophoresis, polyacrylamide gel electrophoresis (Native PAGE and SDS- PAGE) and Immuno-electrophoresis.

Unit-II: Molecular Sequencing

Amino acid sequencing and analysis -MALDI-TOF, DNA sequencing –Enzymatic & chemical methods and new generation sequencing. Blotting techniques – Southern, northern, western and Dot blots. Microarray techniques – oligonucleotide array and cDNA array and its applications.

Unit-III: PCR techniques

Principle and applications- types of PCR - enzymology- primer types-methods. PCR amplification for Detection of mutation, monitoring cancer therapy, detect bacterial & viral infections, sex determination of prenatal cells, linkage analysis in sperm cells and studies on molecular evolution.

Unit-IV: Chromatographic and Spectrophotometric techniques

Principle and applications of Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC). Principle and applications of Atomic Absorbance Spectra (AAS), Infra-red (IR) Spectra and LC-MS technique.

Unit-V: Genome sequencing and Physical mapping of genome analysis

Restriction fragment Length Polymorphism (RFLP) technique, Random Amplified polymorphic DNA (RAPD) technique and 16 S rRNA sequencing. Methods and applications of Chromosome walking & Chromosome jumping.

Text Books:

1. James .D.Watson, Michael Gilman, Jan Wit Koeski and Mark Zuller, 2001. Recombinant DNA. IInd Ed. Scientific American Book, New York.
2. B. Lewin 2000. Genes VII Oxford University Press.
3. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
4. E.J. Gardener *et al.*,.1991. Principles of Genetics 8th Ed., John Wiley & Sons, New York.

MODULAR COURSE
18ZOOP03M2 BIOINFORMATICS-MICROBIAL GENOMICS AND PROTEOMICS
Credits - 2

Objectives:

- An- in depth study on Bioinformatics, microbial genomics and proteomics
- To make the students to understand genome analysis, sequence analysis and protein analysis
- To make the students to know the tools used in Bioinformatics

Learning Outcomes:

- Understand whole genome analysis methods
- Know the computational tools used for sequence analysis tools
- Know the use of internet in data analysis
- Acquire knowledge on DNA microarray techniques
- Know the different methods of protein analysis

Unit –I : Whole genome analysis

Preparation of ordered cosmid libraries, bacterial artificial chromosome libraries, shotgun libraries and sequencing, conventional sequencing (Sanger, Maxam and Gilbert methods), automated sequencing.

Unit–II : Sequence analysis

Computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotations of genes conserved protein motifs related structure/function (PROSITE, PEAM, Profile Scan). DNA analysis for repeats (direct and inverted), palindromes, folding programmes.

Unit–III : Databases Analysis

Use of internet, public domain databases for nucleic acid and protein sequences (EMBL, GenBank), database for protein structures (PDB).

Unit-IV : DNA microarray and general Analysis

DNA microarray printing or oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for global patterns of gene expressions using fluorescent labeled DNA or end labeled RNA probes. Analysis of single nucleotide polymorphisms using DNA chips.

Unit-V : Protein analysis and Proteomics

Two-dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy. Protein microarray. Advantages and disadvantages of DNA and protein microarrays. Introduction to docking.

Text Books

1. Read, TD., Nelson, KE., Fraser, CH. 2004. Microbial Genomics. Humana Press Inc., USA.
2. Rashidi, H.H. and Buchler, L.K. 2002 Bioinformatics Basics :Applications in Biological Science and Medicines, CRC Press, London
3. Stephen P. Hont and Rick Liveey (OUP) 2000. Functional Genomics, A practical Approach.
4. Perysju, Jr. and Peruski 1997. The Internet and the New Biology: Tools for Genomic and molecular Research.
5. Mark Schena (OUP). DNA Microarrays, A practical approach.

Objectives:

- To impart knowledge on various biotechnological commercial processes and their usefulness.
- To provide hands on experience to various biotechnological commercial processes such as biogas production, composting methods, mushroom production, spirulina cultivation and ornamental fish cultures.

Learning Outcome:

- Understand in-depth understanding on biogas technology and its uses
- Understand composting technology and its applications
- Realise the cultivation and uses of mushrooms
- Know the cultivation and uses spirulina
- Understand the value of Ornamental Fish culture

Unit-I:Biogas technology:

Introduction and history – anaerobic digestion – microbes involved – factors influencing methane production – Stages of methanogenesis – Wastes used in methanogenesis – various bioreactors used for methane generation – Advantages and disadvantages. Visit to biogas production units with field demonstration.

Unit-II:Composting technology:

Historical background – waste availability – factors influencing – methods- biomaturity-enrichment of Compost and crop productivity. Vermiculture Technologies: History – species – life cycles – methods – different types of waste suitable for vermicomposting. Utilization of vermicompost for crop production. Visit to vermicompost industries with field demonstration.

Unit-III:Mushroom technology:

Bioconversion of organic wastes into protein - Oyster mushroom technology, paddy mushroom technology, milky mushroom and button mushroom technology, post harvest technology. Mushroom farming and prospects. Visit to mushroom farms with field demonstration.

Unit -IV:Spirulina cultivation technology:

Biology of *Spirulina* - cultivation methods, post harvest technology and single cell protein formulation. Visit to *spirulina* industries with field demonstration.

Unit -V: Ornamental Fish culture: Present status and importance – popular varieties – artificial and live feeds – breeding techniques of egg layers – gold fish, angel fish, fighter and barbs – live bearers – guppy, molly, platy and sword tail – economics. Visit to ornamental fish farms with field demonstration.

Text Books:

1. Tripathi, G. 2003. Vermireources technology, 1st Ed., Discovery Publication House, New Delhi.
2. Anita Saxena, 2003. Aquarium management. Daya Pub. House, New Delhi.
3. Kaul, T.N. 1999. Introduction to mushroom science, Oxford & IBH Co., Pvt. Ltd., New Delhi.
4. Kumar, H.D., 1991. A Textbook on Biotechnology, II Edition, East-west Press Pvt. Ltd., New Delhi.
5. Chawla O.P. 1986. Advances in Biogas Technology, ICAR, New Delhi.

References

1. Srivastava, C.B.L, 2002. Aquarium fish keeping. Kitab Mahal, Allhabad.
2. Gaur, A.C., 1999. Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.
3. Subba Rao, N.S., 1999. Soil Microbiology, 4th Ed., Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Philip G. Miles, Shu-Ting Chang, 1997. Mushroom biology, World Scientific, Singapore.
5. Chatwal, G.R., 1995. Textbook of Biotechnology, Anmol Publications Pvt. Ltd., New Delhi
6. Bahl, N. 1988. Handbook on mushrooms. Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.

Objectives:

- To understand the parasitology and human welfare
- To understand the life cycle and control of protozoan, platyhelminthes, nematode and arthropod parasites

Learning Outcomes:

The Course will provide an overview to know the parasitic mechanism and reproduction of Protozoan, Platyhelminthes and Nematodes, lifecycle and control.

- Understand the parasitology and interference with human welfare
- Describe the parasitic adaptations and defence mechanisms.
- Know the parasitic relationship and reproduction
- Understand the Protozoan, Platyhelminthes & Nematode parasites and lifecycle
- Realise the structure of various parasites and their functions
- Learn the systematic position of parasites

Unit I**Overview**

Introduction to parasitology - parasitology and human welfare; definitions, symbiosis, mutualism, commensalism, parasitism, hosts; parasitic reproduction; parasitic adaptations; susceptibility and resistance; defence mechanisms.

Unit II**Protozoan Parasites**

Protozoan parasites: Bionomics, life cycle and control - *Trypanosoma*, *Leishmania*, *Giardia*, *Trichomonas*, *Opalina*, *Entamoeba*, *Plasmodium* and *Balantidium*.

Unit III**Platyhelminthes Parasites**

Platyhelminthes parasites: Bionomics, life cycle and control - tape worm (*Taenia solium* & *T. saginata*), liver fluke, blood fluke, *Echinococcus granulosus*, *Hymenolepis diminuta*, *Fasciola psisbuski*, *Diphyllobothrium latum*.

Unit IV**Nematode Parasites**

Nematode parasites of Animals: Bionomics, life cycle and control – *Ascaris lumbricoides*, *Trichuris trichuria*, *Trichinella spiralis*, *Ancylostoma duodenale*, *Enterobius vermicularis*, *Wuchereria bancrofti*, *Loa loa*, *Dracunculus medinensis*. Nematode parasites of plants: Bionomics, life cycle and control – *Meloidogyne*, *Aphelenchoides* and *Heterodera*.

Unit V**Arthropod Parasites**

Arthropod parasites: Bionomics, life cycle and control - *Phthirus pubis*, *Cimex species* Reduvids, black fly, *Glossina*, *Pulex irritans*, *Tabanus* and *Sarcoptes scabiei*.

Text Books

1. H.S. Singh-2018- Parasitology, Rastogi Publication, Meerut.
2. G.Rathanasamy 2017 Text book of Medical Entomology and Parasitology. Viswanathan & Co., Publications, Chennai.
3. J. Park and Park 2013 Social and preventive medicine 22th Edition.
4. Thomas C. Cheng 2006 General Parasitology, Academic Press, USA
5. C.K. Jayaram Paniker (1997). Text book of Medical Parasitology. Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.

References

1. M.Rahmatullah 2013 Modern Parasitology , Axis Books Pvt. Ltd. New Delhi
2. K.N.Sachdev 1983 Medical Parasitology, Jaypee Brothers Medical Pub. New Delhi
3. Sowlstry, E.J.L. (1965) Text book of Veterinary Clinical Parasitology. F.A. Davis Co. Philadelphia.
4. Asa C. Chandler, (1952) Introduction to Parasitology 8th edition. John Wiley & Sons, Inc. New York.
5. Larry S. Roberts & John Janovy Jr. Foundations of Parasitology 5th edition. Wm.C. Brown Publishers.