

Ph.D. ZOOLOGY COURSE WORK

(With effect from the Academic Year 2017-18)

Department of Biology
The Gandhigram Rural Institute Deemed University
(MHRD, Govt. of India)
Accredited by NAAC with ‘ A’ Grade (3rd Cycle)
Gandhigram- 624 302
Dindigul District, Tamil Nadu

Ph.D ZOOLOGY SCHEME

FIRST SEMESTER							
	Course Code	Course title	C	L	E	ESE	Total
Core Courses	17ZOOR0101	Recent Trends in Zoology	4	4	3	100	100
	17ZOOR0102	Animal Ecology and Conservation	4	4	3	100	100
	17ZOOR0103	Applied Zoology	4	4	3	100	100
Supportive Course	17ZOOR0104	Research Methodology	4	4	3	100	100
Total Credits			16				

SECOND SEMESTER							
	Course Code	Course title	C	L	E	ESE	Total
Supportive Course	17ZOOR0205	Quantitative Techniques – Advanced Biostatistics	4	4	3	100	100
Core Course	17ZOOR02SX	Area of Specialization on Thrust Areas*	4	4	3	100	100
Seminars		Seminar -1	1	2	-	-	-
		Seminar -2	1	2	-	-	-
		Seminar -3	1	2	-	-	-
		Term paper on Topical Research	1	2	-	-	-
Total Credits			12				

Research Credits			
	Course Code	Course title	C
		a) Project Planning including literature collection, finalization of objectives and methodology	4
		b) Field/ Lab Studies, Data Collection, compilation of results, statistical analysis, results and final conclusion	32
		c) Synopsis and thesis submission, final viva	6
Total Credits			42
OVERALL CREDITS - 70			

	List of Area of Specialization on Thrust Areas*
17ZOOR02S-1	1. Aquaculture
17ZOOR02S-2	2. Environmental Management
17ZOOR02S-3	3. Nanobiotechnology
17ZOOR02S-4	4. Toxicology

C- Credits
L- Lecture Hours
E- Exam Hours
ESE- End Semester Examinations

***Detailed Syllabus for Area of Specialization may be prepared by the respective Doctoral Committee.**

Objectives:

- To acquire broad knowledge on basic and recent trends in genetic engineering
- To understand the comprehensive overview of all major aspects of nanotechnology and its applications in various fields
- To understand the threats and uses animal diversity in India
- To understand the nature and components of defence mechanism of human body.
- To know the tools used in bioinformatics

Learning Outcomes:

The Course will provide an overview to know the recent trends in genetic engineering, scope and current scenario of nanotechnology, treats, issues, approaches, values and uses of biodiversity and threatened species, immune system and their functions, databases and types of Sequences used in Bioinformatics.

- Understand cloning, gene therapy, genetic disorders
- Understand Human Genome Project and the importance of transgenic animals
- Appreciate the importance, scope and current scenario of nanotechnology and its applications in medicine, agriculture, live-stock and environment
- Understand the threats of animal diversity in India
- Understand the issues, approaches, values and uses of biodiversity and threatened species
- Understand the antigen structure and function
- Understand the different classes of immunoglobulins
- To know the types of databases, sequences, information sources and Use of Bioinformatics Tools in analysis

Unit I: Genetic Engineering

Cloning- Cloning vectors- Cloning strategies and DNA Libraries, cDNA cloning & cDNA libraries- Gene therapy- Pharmaceutical products of DNA technology- Human therapies- Vaccines- Treatment of genetic disorders- Alzheimer, Thalassemia & Phenylketonuria- Human Genome project- Current status, ethical and Legal issues- Transgenic animals and their importance.

Unit II: Nanotechnology

Importance of Nanoscience and Nanotechnology- Milestones in Nanotechnology- Scope and Current Scenario of Nanotechnology- Types and applications of Nanoscience in the field of Medical, agriculture, livestock and aquaculture.

Unit III: Biodiversity

Treats to animal diversity in India- Issues, approaches, values and uses of biodiversity and threatened species- Measuring status of species in the wild- IUCN Red list- status of Indian animals.

Unit IV: Immunology

Antigen, structure and functions - Different classes of immunoglobulins and generation of immunological diversity; Humoral and cell- mediated immunity, Primary and Secondary immune response- lymphocytes and accessory cells; MHC, Complement Fixation.

Unit V: Bioinformatics

Historical background- Databases- types of database- primary, secondary and composite- Data structure- Database management- Sequences- Types of Sequences used in Bioinformatics- Information Sources- NCBI, MGD- Date Retrieval Tools- Entrez, OMIM Pubmed, Locus Link- Use of Bioinformatics Tools in analysis.

References:

1. Vinay Sharma.Ashok Munjal and Ashish Shanker(2017) Bioinformatics, Rastogi Publications, Meerut.
2. Ajoy Paul (2016) Text book of Immunology, Books and Allied (P) Ltd, Kolkata.
3. Bandyopadhyay, A.K (2007) Nanomaterials. New Age International Publishers, New Delhi.
4. Dubey, R.C (2004) Advances Biotechnology S. Chand Publishing, New Delhi.
5. George Pinchuk (2004) Immunology. Tata McGraw- Hill pub. Company Ltd, New Delhi.
6. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C., Gelbart W.M and J.H. Miller (2003) Intorduction to genetic analysis. W.H.Freeman and Company, New York.
7. Ratner. M and D. Ratner (2002) Nanotechnology: A Gentle Introduction to the Next Big Idea. Wiley.
8. Brown, T.A (2001) Gene Cloning and DNA analysis. 5th Edn. Black Well Science Ltd.
9. Old, R.W and Primrose, S.B (2001) Principles of gene Manipulation, 6th Edn. Black Well Scientific publications.
10. Reka, M.L, D.E.Wilson and E.O.Wilson (1997) Biodiversity II: understanding and protecting our Biological Resources. Joseph Henry Press, Washington, D.C.

Web resources:

<https://www.researchgate.net/publication/264934129>
booksc.org/dl/10142905/205224
booksc.org/book/14846478/28220b

LECTURE SCHEDULE: RECENT TRENDS IN ZOOLOGY

Unit	Lecture No.	Topic	Lecture Delivery Mechanism
I	1	Cloning –Introduction	Lecture
	2	Cloning vectors	PPT
	3	Cloning strategies and DNA Libraries	PPT
	4	cDNA cloning & cDNA libraries	PPT
	5	Gene therapy	PPT
	6	Pharmaceutical products of DNA technology	PPT
	7	Human therapies	Video + Lecture
	8	Vaccines- Treatment of genetics disorders- Alzheimer, Thalassaemia & Phenylketonuria	Lecture
	9	Human Genome Project- Current status, ethical and Legal issues	PPT
	10	Transgenic animals and their importance	Self Study
II	11	Importance of Nanoscience and Nanotechnology	Lecture
	12	Milestones in Nanotechnology	Lecture
	13	Scope of Nanotechnology	Lecture
	14	Current Scenario of Nanotechnology	Lecture
	15	Types –Nanoscience	Lecture
	16	Application of Nanoscience in Medicine	PPT
	17	Application of Nanoscience in Agriculture	PPT
	18	Application of Nanoscience in Live Stock	PPT
III	19	Application of Nanoscience in Aquaculture	PPT
	20	Treats to animal diversity in India	Lecture
	21	Issues, approaches, values and uses of biodiversity and threatened species	PPT
IV	22	Measuring status of species in the wild- IUCN Red list- status of Indian animals.	PPT
	23	Antigen, structure and functions	PPT
	24	Different classes of immunoglobulins and generation of immunological diversity	Assignment
	25	Humoral and cell- mediated immunity	Lecture
V	26	Primary and Secondary immune response- lymphocytes and accessory cells; MHC, Complement Fixation	PPT
	27	Historical background of Bioinformatics	Lecture
	28	Databases- types of database- primary, secondary and composite	PPT
	29	Data structure- Database management-	PPT
	30	Sequences- Types of Sequences used in Bioinformatics	PPT
	31	Information Sources- NCBI, MGD- Date Retrieval Tools- Entrez, OMIM Pubmed, Locus Link-	Invited Lecture and Exposure visit
	32	Use of Bioinformatics Tools in analysis.	PPT

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, cycling of elements, Causes of urban growth and recycling of solid wastes, Tools in conservation of animals, GIS & Remote sensing and Animal laws and policies in India .

Learning Outcomes:

The Course will provide an overview to know the Types, structure and function of Ecosystem, Renewable and non-renewable resources, Biogeochemical cycles, recycling of solid wastes, Conservation of animals through people participation, GIS & Remote sensing and Animal laws and policies in India.

- Understand the types of various ecosystems & appreciate how ecosystem works
- Identify the Renewable and non-renewable resources, Conventional and Nonconventional source of energy and their importance
- Appreciate how elements are cycling in the environment
- Understand In-situ and Ex-situ conservation of animals, GIS & Remote sensing and its applications
- Recognise the need of Animal laws and policies in India
- To study Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves

Unit I

Introduction-scope of Ecology-Major Ecosystem-Types structure and function of Ecosystem. Types –Ocean, Estuaries; Mangroves and coral reefs; streams and rivers; Lakes and ponds; forest; deserts; Grass lands and Agro ecosystems.

Unit II

Resource Ecology – Concept- Classification - Renewable and non-renewable resources – Conventional and Nonconventional source of energy - Biogeochemical cycles - Hydrological cycle, Carbon, Nitrogen, phosphorus

Unit III

Urbanization-Causes of urban growth- Urban problems-Solid Waste-production and disposal – composting-Energy from waste-Rescue and recycling of solid wastes

Unit IV

Conservation Tools – Insitu and Ex-situ conservation of animals- people participation in conservation- Tools in conservation: GIS, Remote sensing – Landscape model- PVA, Vortex- Red listing process

Unit V

Animal laws and policies in India-Protected Area network - forest policy – Prevention of cruelty to Animal Act - International Trade in endangered species -Zoo policy-Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves - World wildlife fund (WWF) -Indian Board for Wildlife (IBWL).

References :

1. Benu Singh(2006) Ecology and Environment.Vista International Publishing House, Delhi.
2. K.A.Siddigu (2002) Pollution Conservation and Forestry.Kitab Mahal Agencies, New Delhi
3. A.B.Caudhuri and D.D.Sarkar (2002) Biodiversity Endangered. Scientific Publishers (India), Jodhpur.
4. S.K.Agarwal (2002) Eco-informatics.Vol.II Green Management, A.P.H.Publishing Corporation,New Delhi.
5. William P.Cunningham and Barbara Wood Worth Saigo (1999) Environmental Science. Fifth Edn.Mc Graw-Hill, New Delhi
6. P.R.Trivedi (1998) Encyclopaedia of Environment, Pollution,Planning and Conservation Natural Resources Conservation.Vol.3 A.P.H Publishing Corporation,New Delhi.
7. Eugene P.Odum (1996) Ecology.Sinauer Associates,Inc .Publishers. Sunderland, Massachusetts,USA.

Web resources:

b-ok.org/book/995833/1da1fa

b-ok.org/book/823625/625d23

b-ok.org/book/888217/4e21aa

LECTURE SCHEDULE: ANIMAL ECOLOGY AND CONSERVATION

Unit	Lecture No.	Topic	Lecture Delivery Mechanism
I	1	Introduction	Lecture
	2	Scope of Ecology	PPT
	3	Ecosystem - Structure and function	Assignment
	4	Ecosystem -Types – Ocean & Estuaries	PPT +Lecture
	5	Ecosystem - Mangroves and coral reefs	PPT +Lecture
	6	Ecosystem - Streams and rivers	PPT +Lecture
	7	Ecosystem - Lakes and ponds	Field visit
	8	Ecosystem - Forest and deserts	PPT +Lecture
	9	Ecosystem- Grass lands and Agro ecosystems	PPT +Lecture

II	10	Resource Ecology- Concept	Lecture
	11	Classification -Renewable and non-renewable resources	PPT
	12	Conventional and Nonconventional source of energy	PPT
	13	Biogeochemical cycles - Hydrological cycle	PPT
	14	Biogeochemical cycles - Carbon, Nitrogen, phosphorus	PPT
III	15	Urbanization-Causes of urban growth	PPT
	17	Urban problems	PPT
	18	Solid Waste Production and disposal	Team Teaching
	19	Composting	PPT
	20	Energy from waste	Assignment
	21	Rescue and recycling of solid wastes	Exposure visit
IV	22	Conservation Tools – Insitu conservation of animals	PPT
	23	Ex-situ conservation of animals	PPT
	24	People participation in conservation	Assignment
	25	Tools in conservation: GIS	PPT
	26	Tools in conservation: Remote sensing	PPT
	27	Landscape model- PVA, Vortex- Red listing process	Lecture + Exposure visit
V	28	Animal laws and policies in India	PPT
	29	Protected Area network - forest policy	PPT
	30	Prevention of cruelty to Animal Act	PPT
	31	International Trade in endangered species -	PPT
	32	Zoo policy-Laws and their applications in Zoological parks,	PPT
	33	Wildlife sanctuaries and Biosphere reserves	Exposure visit
	34	World wildlife fund (WWF) -Indian Board for Wildlife (IBWL).	Lecture

Objectives:

- To understand the aquaculture potential, cultivable fish and prawn, culture methods, types of fish ponds and pond construction and management
- To understand the beneficial and harmful effects of insects and economic importance of rodents, snakes, bats.
- To understand Infectious and communicable diseases
- To know important live stock, diseases, parasites, dairy and poultry industries
- To understand the importance of api culture, sericulture and vermiculture

Learning Outcomes:

The Course will provide an overview to understand the aquaculture potential, cultivable fish and prawn, culture methods, types of fish ponds and pond construction and management, beneficial and harmful effects of insects and economic importance of rodents, snakes, bats, Infectious and communicable diseases, important live stock, diseases, parasites, dairy and poultry industries and the importance of api culture, sericulture and vermiculture.

- Describe the aquaculture potential of India
- Understand the types of cultivable fish and prawn, culture methods and types of fish ponds
- Learn the construction and management of fish ponds
- Recognize the importance beneficial and harmful effects of insects
- Appreciate the economic importance of rodents, snakes and bats.
- Understand the importance Infectious and communicable diseases
- Learn the important Live stock, diseases, parasites
- Understand Dairy and Poultry industries.
- Understand the importance of api culture, sericulture and vermiculture.

Unit I: Aquaculture

Aquaculture potential of India- Cultivable fishes of India- Indian major carps, Exotic carps, cat fishes and murrels- Culture methods- pond construction and Management- Type of fish ponds - Prawn culture and Management.

Unit II: Agricultural Zoology

Beneficial insects: spiders, mantis, ladybird beetle, damsel fly- Harmful insects: migratory locust, rhinoceros beetle, aphids, mosquitoes and cockroach- Economic importance of rodents, snakes, bats.

Unit III: Medical Zoology

Infectious / Communicable diseases: Small pox, hepatitis, AIDS, influenza, tuberculosis, plaque, cholera, amoebiasis, malaria, dengue, chikungunya, trypanosomiasis and Elephantiasis.

Unit IV: Veterinary Zoology

Important Live stock- Cattle, goat, sheep & rabbit Live- Stock diseases- tetanus, anthrax, ranikhet- Live- Stock parasites- helminthes, flies, ticks, lice and mites- Dairy and Poultry industries.

Unit V: Apiculture, Sericulture and Vermiculture

Apiculture- Honey bees- bee hive, management of bees hive, swarming, diseases and honey. Sericulture- Silk moth, Silk farming- Processing Cocoons for raw silk- Other farms of silk- Tussar silk, Muga silk and Erisilk- Diseases- Vermiculture- Important Species of Earthworms.

References:

1. Shukla, G.S and V.B. Upandhyay (2017) Economic Zoology 5th Rev. Edn. Rastogi Publications, Meerut.
2. Gupta, S.K and P.C.Gupta (2006) General and Applied Ichthyology (Fish and Fisheries). S.Chand & Company, New Delhi.
3. Q.J. Shamni and S. Bhatnagar (2002) Applied Fisheries, Agrobios (India)
4. Parihar, R.P (1996) A Text book of Fish Biology and Indian Fisheries. Central pub. House, Allahabad.
5. Pillay, T.V.R (2005) Aquaculture principles and practices. Fishing News Books, USA.
6. Kotpal, R. L (2000) Modern Text book of Zoology. Rastogi publications.
7. Ashok Kumar (2009) Text book of Animal Diseases Sonali publication.
8. Pradip. V. Jabde (2005) Text book of Applied Zoology.
9. Banerjee, G.C (2010) A Text book of Animal Husbandry Oxford & IBH pub. New Delhi.
10. Ashok Kumar and Prem Mohan Nigam (1991) Economic & Applied Entamology. Emkay Publications, New Delhi.

Web resources:

b-ok.org/book/610091/eb7967
b-ok.org/book/2141454/b57379

LECTURE SCHEDULE: APPLIED ZOOLOGY

Unit	Lecture No.	Topic	Lecture Delivery Mechanism
I	1	Aquaculture potential of India	Lecture
	2	Indian major carps	PPT
	3	Exotic carps	PPT
	4	Cat fishes	PPT +Lecture
	5	Murrels	PPT +Lecture
	6	Culture methods	Assignment
	7	Type of fish ponds	Exposure Visit
	8	Pond construction and Management	PPT +Lecture
	9	Prawn culture and Management	PPT +Lecture
II	10	Beneficial insects: spiders, mantis, ladybird beetle, damsel fly	PPT +Lecture
	11	Harmful insects: migratory locust, rhinoceros beetle, aphids, mosquitoes and cockroach	PPT +Lecture
	12	Economic importance of rodents, snakes, bats.	PPT
III	15	Infectious/ communicable diseases: Small pox, hepatitis	PPT
	17	AIDS, influenza, tuberculosis,	PPT
	18	Plaque, cholera, amoebiasis, malaria, dengue	Team Teaching
	19	Chikungunya, trypanosomiasis and Elephantiasis.	PPT
IV	20	Important Live stock- Cattle, goat, sheep & rabbit	PPT + Exposure visit
	21	Live-Stock diseases -Tetanus, anthrax, ranikhet	PPT
	22	Live- Stock parasites- helminthes, flies, ticks, lice and mites	PPT
	23	Dairy and Poultry industries.	Exposure visit
V	24	Apiculture- Honey bees and bee hive	PPT
	25	Management of bees hive & swarming	PPT
	26	Diseases and honey.	PPT
	27	Sericulture- Silk moth, Silk farming- Processing Cocoons for raw silk-	PPT + Exposure visit
	30	Other farms of silk- Tussar silk, Muga silk and Erisilk	PPT
	31	Diseases	PPT
	32	Vermiculture- Important Species of Earthworms.	Lecture + Exposure visit

Objectives:

To enable the students:

- To understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.
- To expose the students on the basic understanding of research concepts and learn the art of thesis & paper writing, publication and scientific ethics.

Learning outcomes:

- The students are be able to understand the working principle, operation system and importance of pH meter and various Microscopes.
- The students are be able to understand the working principle, operation system and importance of centrifuge, photometers and chromatography.
- The students are be able to understand the working principle, operation system and importance of molecular techniques.
- The students are be able to understand the overall concepts of Research and art of writing Thesis
- The students are be able to understand art of writing research articles, publication and scientific ethics.

Unit I : pH meter, microscopic and polarimetric techniques:

pH meter - types, basic principle, operation and application; Buffers-principle, standards and preparation of buffer; pH determination & pH indicators. Microscopy – Principle, operation and application - simple, compound, light-field, dark-field, phase-contrast, fluorescence, confocal and electron microscopy. Micrometry-principle and application. Polarimetry -principle and application. Experiments on buffer preparation and pH determination. Exposure to various microscopes.

Unit II : Centrifuge, Photometric and Chromatographic techniques:

Centrifugation-types, principle and application. Photometry - Principle, operation and application-colorimeter, spectrophotometer, flame photometer, bomb calorimeter, UV-Visible spectroscopy, atomic absorption spectroscopy, mass spectroscopy and FTIR spectroscopy. Chromatography– types, principle and application: paper chromatography, thin layer chromatography, column chromatography, Ion Exchange, GC-MS and HPLC. Demonstration on differential and gradient centrifugation Demonstration on verification of Beer-Lamberts law. Demonstration on chromatographic separation of amino acids and sugars. Experiment on ARA.

Unit III: Molecular techniques:

Electrophoresis - Principle and applications, paper electrophoresis, agarose gel-Polyacrylamide gel electrophoresis (PAGE and SDS- PAGE) and immuno electrophoresis. Molecular techniques- Microarray, MALDI-TOF, Amino acid sequencing-DNA sequencing (Enzymatic & Chemical methods) Blotting techniques-southern, northern and western blottings and PCR techniques. RAPD, RFLP and ARDRA techniques. Demonstration/experiments on isolation, separation of DNA and Protein molecules by electrophoresis techniques.

Unit IV : Research and Thesis writings:

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 : Research Publication and Project writing:

Writing scientific paper: Importance of title – abstract – key words, Introduction, Materials and Methods, Results, Discussion, Acknowledgements and References – Publication on research journals – Standards of research journals – peer review – impact factor –citation index. Proof correction – proof correction marks –Method of correction proof. Writing chapters in books. – Preparation of Research proposal and funding agencies – Research fellowships. Ethics in science reporting – Reproduction of published materials – Plagiarism & Anti – Plagiarism check – citation and acknowledgement. Biosafety levels – IBC – Institutional ethical committees – IPR & IPP.

References:

1. David.T Plummer (2009). An Introduction to Practical Biochemistry, Tata Mc Graw Hill Pub.Co.Ltd, New Delhi.
2. N.Gurumani (2006).Research Methodology for Biological Sciences. MJP Publishers, Chennai.
3. K.Kannan (2003). Hand book of Laboratory Culture media, reagents, stains and buffers. Panima Publishing Corporation, New Delhi
4. Glick, B.R and Pasternak.J.J.,(2003). Molecular Biotechnology, ASM Press, Washington.DC.
5. P.Asokan (2002).Analytical biochemistry-Biochemical techniques. First Edn. China Publications, Melvishoram, Vellore.
6. Rajbir Singh (2002).Chromatography 1st Edition Mittal Publications, New Delhi.
7. Keith Wilson and John Walker (2002). Practical Biochemistry-Principles and techniques. 5thEd.Cambridge Univ.Press, London.
8. James.D.Watson, Michael Gilman,JanWit Koeski and Mark Zuller(2001). Recombinant DNA. IInd Ed.Scientific American Book. New York.
9. S.Palanichamy and M.Shanmugavelu.(1997). Research methods in biological sciences. Palani Paramount Publications, Palani.
10. Jeyaraman.J.(1981).Laboratory Manual in Biochemistry. New Age International Publishers, New Delhi.

Web resources:

PubMed search engine for database of references and abstracts on life sciences and biomedical topics: <https://en.wikipedia.org/wiki/PubMed>.

Plagiarism Software: Online plagiarism checker for checking articles: <https://www.plagiarismsoftware.net/> and www.urkund.com/en/

LECTURE SCHEDULE: RESEARCH METHODOLOGY

Unit	Lecture No.	Topics	Lecture delivery Mechanism
I	1	pH meter - types, basic principle, operation and application	Lecture +PPT
	2	Buffers-principle, standards and preparation of buffer; pH determination & pH indicators.	Lecture +PPT
	3	Principle, Operation and application of simple, compound, light-field microscopes	Lecture +PPT
	4	Principle, Operation and application of dark-field, phase-contrast, fluorescence microscopes	Lecture Exposure visit
	5	Principle, Operation and application of confocal and electron microscopy.	Lecture Exposure visit
	6	Micrometry-principle and application.	Lecture +PPT
	7	Polarimetry -principle and application	Lecture +PPT
	8	Experiments on buffer preparation and pH determination. Exposure to various microscopes.	Practical Demo
II	9	Centrifugation-types, principle and application	Lecture +PPT
	10	Principle, Operation and application of colorimeter, spectrophotometer, flame photometer, bomb calorimeter,	Lecture +PPT
	11	Principle, Operation and application of UV-Visible spectroscopy, atomic absorption spectroscopy, mass spectroscopy and FTIR spectroscopy.	Lecture Exposure visit
	12	Chromatography– types, principle and application: paper chromatography, thin layer chromatography, column chromatography & Ion Exchange	Lecture +PPT
	13	Principle, Operation and application of GC-MS and HPLC.	Lecture Exposure visit
	14	Demonstration on differential and gradient centrifugation	Practical Demo
	15	Demonstration on verification of Beer-Lamberts law.	Practical Demo
	16	Demonstration on chromatographic separation of amino acids and sugars & Experiment on ARA.	Practical Demo
	17	Electrophoresis- Principle and applications	Lecture
	18	Paper and agarose gel electrophoresis,	Lecture Exposure visit

III	19	Polyacrylamide gel electrophoresis (PAGE and SDS-PAGE) and immuno electrophoresis.	Lecture Exposure visit
	20	Microarray, MALDI-TOF and Amino acid sequencing	Lecture Exposure visit
	21	DNA sequencing (Enzymatic & Chemical methods)	Lecture Exposure visit
	22	Blotting techniques-southern, northern and western blottings and their applications	Lecture Exposure visit
	23	PCR, RAPD, RFLP and ARDRA techniques and their applications	Lecture Exposure visit
	24	Demonstration/experiments on isolation, separation of DNA and Protein molecules by electrophoresis techniques.	Practical Demo
IV	25	Research- Definition, objectives, types and importance	Lecture +PPT
	26	Research methods in Biological Sciences- Research process	Lecture +PPT
	27	Literature survey- sources- scientific databases	Lecture + Library visit
	28	Research report writing – Parts of thesis and Dissertation – Title, certificate, declaration, acknowledgements, and contents – list of tables, figures, plates & abbreviations.	Invited Lecture
	29	Parts of thesis: Introduction, Review of literature, Materials and methods	Invited Lecture
		Parts of thesis: Results – Presentation of data - Tables, figures, maps, graphs, photographs – Discussion – Summary, bibliography / References and Appendix	Invited Lecture
V	30	Writing scientific paper – Importance of title – abstract – key words, Introduction, Materials and Methods, Results, Discussion, Acknowledgements and References	Invited Lecture
	31	Publication on research journals – Standards of research journals – peer review – impact factor –citation index	Invited Lecture
	32	Writing chapters in books	Invited Lecture
	33	Proof correction – proof correction marks –Method of correction proof	Invited Lecture
	34	Preparation of Research proposal and funding agencies – Research fellowships	Invited Lecture
	35	Ethics in science reporting – Reproduction of published materials – Plagiarism & Anti –Plagiarism check – citation and acknowledgement.	Invited Lecture
	36	Biosafety levels – IBC – Institutional ethical committees – IPR & IPP.	Class Room Discussion

Objective:

To provide students with a basic understanding of the principles of statistical methods and techniques as applied to biological Sciences.

Learning Outcomes:

Upon completion of the course, the students will be able to perform the following:

- Choose appropriate statistical measures to analyze biological data.
- Students may try a few “Bio- Statistics tutorial” available in the internet.
- Select an appropriate measure, test and make interpretation of the results in biological experiments.
- Create and interpret visual representation of quantitative data in biological research.
- Understand different rates, ratios and Odds ratio required to interpret biological data.

UNIT- I:

Descriptive Statistics: Types of data; Measures of central value; Variability Measures, Skewness measures; Computational Tools: SPSS, MATLAB, DMRT; Origin Software; NCBI online Tools on sequence alignment and physiological tree analysis

UNIT- II:

Sampling and sample Designs: Census VS Sample methods- Laws of sampling; Sampling Techniques, Determination of Sample size; Merits and Demerits of Sampling and Non- Sampling errors; Reliability of samples.

UNIT- III:

Probability and Theoretical distributions: Basic concepts in probability, Definition of Probability, Approaches to probability; Theoretical Distributions- Simple problems in Binomial, Poisson and Normal Distributions with biological applications.

UNIT- IV:

Correlation Techniques: Simple Correlation and Regression problems; Multiple Correlation and Regression Analysis; Logistic Regression Analysis, Factor Analysis; Discriminant Analysis; Cluster Analysis; Illustration with SPSS; Bio- assays and odds ratios.

UNIT- V:

Inferential Statistics; Basic concepts; Type- I and Type- II errors; Steps in Hypothesis Testing; Different Test procedures; Analysis of variance and Design of Experiments; Multiple comparisons Least significant difference Test; Analysis of Covariance.

References:

1. Vijayalakshmi. G and C. Sivapragasam (2009)Research methods; Tips and Techniques, MJP publishers, Chennai
2. Sinha, B.L (2006) Statistics in Psychology and Education. Anmol publications, New Delhi
3. Gurumani, N(2004)An Introduction to Biostatistics, MJP publishers, Chennai
4. Stevens, J.P (2002) Applied Multivariate Statistics for the Social Sciences, 4th Edition, New Jersey, Lawrence, Erlbaum Associates
5. Aneshensel, C.S(2002)Theory- Based Data Analysis for the Social Sciences, Thousand Oaks, CA: Sage publications.
6. Sampath Kumar V.S(1997)Bio-Statistics, Manonmaniam Sundaranar University, University publication, Tirunelveli
7. Arora, P.N and P.K. Mathan(1996)Bio- Statistics, Himalaya publishing House, NewDelhi
8. Kline, P(1994)An Easy Guide to Factor Analysis, London: Routledge
9. Gupta, S.P(1992)Statistical methods, Sultan Chand, New Delhi
10. Milton J.S(1992)Statistical methods in Biological and Health Sciences, McGraw Hill, Inc., New York

Webliography:

1. Data analysis: Online manuals and guides to software packages, SSPS product file:
<http://www.spss.com/statistics>.
2. Practical examples for the analysis of Surveys -
<http://www2.napier.ac.UK/depts/fhls/peas/index.htm>
3. Research methods and Statistics arena - [http://www.researchmethodsarena.com/resources/resources .asp](http://www.researchmethodsarena.com/resources/resources.asp)
4. Analysis of statistics and quantitative data analysis - website: www.data-archive.ac.UK
5. Resource for methods in evaluation in Social research -<http://gsociology.icaap.org/methods/>.

LECTURE SCHEDULE: QUANTITATIVE TECHNIQUES- ADVANCED BIOSTATISTICS

Unit	Lecture	Topic	Delivery Mechanism
I	1 to 12	Introduction and Types of data, Central measures, Variability Measures and Skewness Computational Tools	Lecture Practical Practical Lecture + Practical
II	1 to 12	Introduction; Census VS Sample. Laws of Sampling and Sampling Techniques Determination of Sample size Merits and Demerits of sampling Sampling and Non- sampling errors	Lecture Self study Lecture Self study Self study
III	1 to 12	Probability- Basic concepts Approaches in Probability Computation of Probability- Simple problems in Binomial, Poisson and Normal Distributions	Lecture Lecture Lecture and Practical Lecture+ Practical
IV	1 to 14	Correlation and Regression- concepts Simple problems Multiple Correlation and Regression Analysis Logistic Regression Factor Analysis Discriminant Analysis, Cluster Analysis Bio-assays and odds ratios	Self study Lecture+Practical Lecture+Practical Lecture+Practical Lecture+Practical Lecture+Practical Lecture+Practical Lecture+ Practical
V	1 to 14	Basic concepts Type I and Type II errors Steps in Hypothesis Testing Test procedure Design of Experiments, Analysis of Variance Multiple comparisons, Least significance difference Test; Analysis of Covariance	Lecture Lecture Lecture Lecture Lecture+Practical Lecture+Practical Lecture+Practical Lecture+Practical