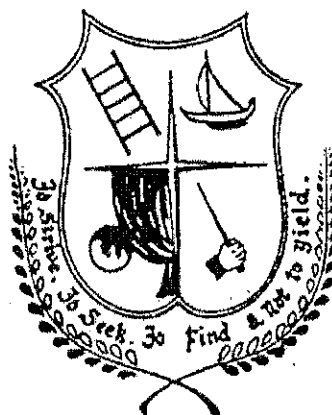


**ETHIRAJ COLLEGE FOR WOMEN
(AUTONOMOUS)
CHENNAI – 600 008**



**BRANCH VI A –ADVANCED ZOOLOGY AND
BIOTECHNOLOGY**

**REVISED SYLLABUS FOLLOWING CHOICE BASED CREDIT
SYSTEM (CBCS)
M.Sc., ZOOLOGY SYLLABUS 2015 - 2016 ONWARDS**

ETHIRAJ COLLEGE FOR WOMEN, CHENNAI 08
POST GRADUATE AND RESEARCH DEPARTMENT OF ZOOLOGY
M.Sc., DEGREE IN ZOOLOGY
(EFFECTIVE FROM THE ACADEMIC YEAR 2015 – 2016)

Department of ZOOLOGY is revising syllabi with effect from the academic year 2015 -2015, with 90 credits for core and elective subjects.

Every academic year is divided into two semester sessions. Each semester will have a minimum of 90 working days and each day will have 5 working hours. Teaching is organized into a modular pattern of credit courses. Credit is normally related to the number of hours a teacher teaches a particular subject. It is also related to the number of hours a student spends learning a subject or carrying out an activity.

REGULATIONS

1. ELIGIBILITY FOR ADMISSION

A candidate who has passed the B.Sc., degree examination in branch VI and VIa Zoology Main of this University or an examination of some other University accepted by the syndicate as equivalent there to shall be admitted and permitted to appear and qualify for the M.Sc., Degree examination of the University after a course of two academic year (4 semester).

2. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study for a period of not less than two academic years, passed the examinations of all the four semesters prescribed.

3. EXAMINATION

There shall be four examinations; one at the end of each semester. A candidate who does not pass the examination in any subject of the first semester will be permitted to appear in such failed subject or subjects along with the second, third and fourth semester examinations.

COURSE OF STUDY - CBCS FOR PG

SUBJECT	NO OF COURSES	CREDIT PER COURSE	TOTAL CREDITS
SUBJECT (INCLUDING PRACTICALS)	16	4	74
ELECTIVES (MAJOR NON-MAJOR)	5	4	16
		TOTAL	90

4. PASSING MINIMUM

A candidate shall be declared to have passed in each paper / practical of the main subject of study wherever prescribed, if she secured NOT LESS THAN 50% of the marks prescribed for the examination.

5. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Successful candidates passing the examination and securing the marks (i) 60 percent and above (ii) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND class respectively.

Candidate who pass all the examination prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for ranking.

6. QUESTION PAPER PATTERN

Unless and otherwise specified in the syllabus for each paper, the pattern of question paper shall be as follows:

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
Part A	Descriptions	5X8= 40
Part B	Application/ Analysis / Synthesis / Evaluation	3 x 20 = 60

Part A : 5 questions have to be answered out of 8 covering all 5 units.

Part B: 3 questions have to be answered out of 5 questions covering all the five units.

PREAMBLE

Zoology at the M. Sc., level offers a broad base for the future courses of teaching and Research careers in Biochemistry, Microbiology, Biotechnology, Genetics, Molecular Biology, Aquaculture, Toxicology, Forensic Science, Environmental Science, Marine Biology etc., M. Sc., course in Zoology enable the students to opt for teaching career in schools and Colleges. There is great demand for Zoology student in Medical transcription as they have a solid base in Physiology, Immunology, Laboratory Techniques, Genetics, Cytology, Biochemistry and Embryology.

**PG COURSE PROFILE
2015-2016**

SEM	COURSE CODE	TITLE OF THE PAPER	HRS / WK	CREDITS	C	S	TOTAL
I	5P15/1C/FMI	PAPER-I-Functional Morphology and Systematics of Invertebrates	5	4	4	6	100
I	5P15/1C/GEN	PAPER-II Genetics	5	4	4	6	100
I	5P15/1C/MBB	PAPER-III-Molecular Biology and Biotechnology	5	4	4	6	100
I	5P15/1E/MIC	ELECTIVE-I- Microbiology	5	3	4	6	100
I		SOFT SKILL- Personality Development	2	2			100
II	5P15/2C/FMC	PAPER-IV- Functional Morphology and Systematics of Chordates	4	4	4	6	100
II	5P15/2C/BBB	PAPER-V- Biophysics, Biostatistics and Bioinformatics	5	4	4	6	100
II	5P15/2E/EAB	ELECTIVE-II Evolution and Animal Behaviour	4	3	4	6	100
II	5P15/2E/PIS	ELECTIVE-III- Pisciculture	4	3	4	6	100
I & II	5P15/2C/MP1	PRACTICAL I- Invertebrata, Chordata and Microbiology	4	4	4	6	100
I & II	5P15/2C/MP2	PRACTICAL II- Molecular Biology, Biotechnology, Genetics, Biophysics and Biostatistics	4	4	4	6	100
II	5P15/2D/INS	INTERNSHIP	--	2	-	-	100
II		SOFT SKILL-II-Other languages	2	2			100
III	5P15/3C/APY	PAPER-VI- Animal Physiology	4	4	4	6	100
III	5P15/3C/EBC	PAPER-VII- Environmental Biology and Biodiversity conservation	4	4	4	6	100
III	5P15/3C/IMM	PAPER-VIII- Immunology	4	4	4	6	100
III	5P15/3E/RDT	ELECTIVE-IV- rDNA Technology	4	3	4	6	100
III		Soft skill - III	2	2			50
IV	5P15/4C/DBY	PAPER-IX- Developmental Biology	5	4	4	6	100
IV	5P15/4C/BIO	PAPER-X- Biochemistry	5	4	4	6	100
IV	5P15/4C/AQU	PAPER-XI- Aquaculture	5	4	4	6	100

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IV	5P15/4E/RMY	ELECTIVE-V Research Methodology	5	3	4	6	100
IV		Soft Skill- IV	2	2			50
III & IV	5P15/4C/MP3	PRACTICAL III- Animal Physiology, Biochemistry, Immunology and Recombinant- DNA Technology	4	4	4	6	100
III & IV	5P15/4C/MP4	PRACTICAL IV- Developmental Biology, Environmental Biology and Aquaculture and Research Methodology	4	4	4	6	100

NON-MAJOR ELECTIVE

SEM	PAPER CODE	TITLE OF THE PAPER	HRS/ WK	CREDITS	CA	SE	TOTAL
II	5P15/2N/MCC	Maternity and Child Care	4	3	40	60	100
III	5P15/3N/AQF	Aquarium Fishes	4	3	40	60	100
TOTAL CREDITS: 91							

SOFT SKILL

EVALUATION COMPONENT OF SOFT SKILL

SEMESTER	COURSE CODE	TITLE OF THE PAPER	CA MARKS	END SEMESTER MARKS	TOTAL
III	5P15/3S/DFG	Dairy Farming	-	50	50
IV	5P15/4S/PFM	Poultry Farming	-	50	50

The above highlighted courses of PG programme enrich the skills in employability / skill development / Entrepreneurship which caters to the needs of the student.

EVALUATION PATTERN – THEORY

Sem	Course code	Title of the paper	CA							End sem marks	Total
			Test		Assignment		Seminar		Total		
			No	Marks	No	Marks	No	Marks			
1	5P15/1C/FMI	PAPER-I- Functional Morphology and Systematics of Invertebrates	2	20	2	10	2	10	40	60	100
1	5P15/1C/GEN	PAPER-II- Genetics	2	20	2	10	2	10	40	60	100
1	5P15/1C/MBB	PAPER-III- Molecular Biology and Biotechnology	2	20	2	10	2	10	40	60	100
1	5P15/1E/MIC	ELECTIVE-I- Microbiology	2	20	2	10	2	10	40	60	100
2		SOFT SKILL- Personality Development	2	20	2	10	2	10	40	60	100
2	5P15/2C/FMC	PAPER-IV- Functional Morphology and Systematics of Chordates	2	20	2	10	2	10	40	60	100
2	5P15/2C/BBB	PAPER-V- Biophysics, Biostatistics and Bioinformatics	2	20	2	10	2	10	40	60	100
3	5P15/2E/PIS	ELECTIVE-II- Pisciculture	2	20	2	10	2	10	40	60	100
3	5P15/2E/EAB	ELECTIVE-III- Evolution and Animal Behaviour	2	20	2	10	2	10	40	60	100
3	5P15/2D/INS	INTERNSHIP	2	20	2	10	2	10	40	60	100
4		SOFT SKILL- 2- Other languages	2	20	2	10	2	10	40	60	100
4	5P15/3C/APY	PAPER-VI- Animal Physiology	2	20	2	10	2	10	40	60	100
4	5P15/3C/EBC	PAPER-VII- Environmental Biology, Biodiversity conservation.	2	20	2	10	2	10	40	60	100
4	5P15/3C/IMM	PAPER-VIII- Immunology	2	20	2	10	2	10	40	60	100
4	5P15/3E/RDT	ELECTIVE-IV- RDNA Technology	2	20	2	10	2	10	40	60	100

4	5P15/4C/DBY	PAPER-IX- Developmental Biology	2	20	2	10	2	10	40	60	100
4	5P15/4C/BIO	PAPER-X- Biochemistry	2	20	2	10	2	10	40	60	100
4	5P15/4C/AQU	PAPER-XI- Aquaculture	2	20	2	10	2	10	40	60	100
4	5P15/4E/RMY	ELECTIVE-V- Research Methodology	2	20	2	10	2	10	40	60	100

EVALUATION PATTERN - PRACTICALS

Sem	Course code	Course title	CA							End sem marks	Total
			Test		Assignment		Observation		Total		
			No	Marks	No	Marks	No	Marks			
1&2	5P15/2C/MP1	PRACTICAL I- Invertebrate, Chordate and Microbiology	2	20	2	10	2	10	40	60	100
1&2	5P15/2C/MP2	PRACTICAL II- Molecular biology, biotechnology , Genetics, Biophysics and Biostatistics	2	20	2	10	2	10	40	60	100
3&4	5P15/4C/MP3	PRACTICAL III- Animal Physiology, Biochemistry and Immunology	2	20	2	10	2	10	40	60	100
3&4	5P15/4C/MP4	PRACTICAL IV- Developmenta l biology, Environmenta l Biology and Aquaculture	2	20	2	10	2	10	40	60	100

SEMESTER-I
PAPER I –FUNCTIONAL MORPHOLOGY AND SYSTEMATICS OF
INVERTEBRATES

TEACHING HOURS: 6

COURSE CODE:5P15/1C/FMI
CREDITS: 4

UNIT I

- Origin of metazoan-organization of coelom : acoelomates, pseudocoelomates, coelomates. Origin of Bilateria
- Locomotion- amoeboid, flagellar and ciliary movements in Protozoan. Hydrostatic movements in Coelenterata, Annelida and Echinodermata.

UNIT II

- Filter feeding in Polychaets.
- Nutrition and digestion – patterns of feeding and digestion in lower Mollusca, Echinodermata.
- Respiration- Organs of respiration: gills, lungs and tracheae. Respiratory pigments. Mechanism of respiration

UNIT III

- Excretion in lower invertebrates, excretion in higher vertebrates.
- Mechanism of osmoregulation in invertebrates.
- Nervous system- 1. Primitive nervous system- Coelenterata and Echinodermata .
2. Advanced nervous system – Annelida ,Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)

UNIT IV

- Invertebrate larval forms and their evolutionary significance- Trematoda, Cestoda, Crustacea, Mollusca, Echinodermata
- Sedentary invertebrates, Regeneration in invertebrates, reproduction in insects and crustaceans.

UNIT V

- Structures affinities and life history of the following minor phyla- Rotifer, Entoprocta, Phoronida and Ectoprocta. Acanthocephala, Gastrotricha, Chaetognatha.
- Fossil records of important trilobites, ammonite and cephalopods.

SUGGESTED READING:

1. Hyman, L.H. The invertebrates, Protozoa through Ctenophora, McGraw Hill Co.,
2. NYKardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and Evolution. IV Edition. Mc Grawhill Higher Education.
3. Kent, G.C. And Carr R.K. (2000). Comparative Anatomy of the Vertebrates. Ix Edition. The McGraw-Hill Companies.
4. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
5. Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
6. Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
7. Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.

8. Russel-Hunter, W.D. A biology of higher invertbrates, the Macmillan Co. Ltd., London.
9. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol. V. Mc.Graw Hill Co., NY
10. Read, C.P. Animal Parasitism. Parasitism. prentice Hall Inc., New Jersey.
11. Parker, T.J., haswell W.A. Text book of Zoology, Macmillan Co., London.

Web link : <https://archive.org/details/zoologyofinverte00ship>

**SEMESTER-I
PAPER II- GENETICS**

TEACHING HOURS: 5

**COURSE CODE:5P15/1C/GEN
CREDITS: 4**

UNIT I

- Organisation of genes and chromosomes,
- Organization of chromatin – nucleosome
- Molecular anatomy of eukaryotic chromosomes
- Structure and organization of telomere, centromere and kinetochore,
- Unique and repetitive DNA.

UNIT II

- Basic ideas of prokaryote genome, eukaryotic genome
- Sex-determination and dosage compensation in C.elegans, drosophila and human
- Transposable elements in prokaryote and eukaryotes
- Genetic imprinting
- Epigenetic regulation by DNA methylation.

UNIT III

- Somatic cell genetics
- Cell fusion and technology
- Heterokaryon selecting hybrids and chromosome mapping, hybridoma
- Microbial genetics
- Bacterial conjugation, transformation and transduction.

UNIT IV

- Genetics of cell cycle
- Genetic regulation of cell division in yeast and eukaryotes
- Regulation of CDK-cyclin activities
- Molecular basis of cellular check points
- Molecular basis of neoplasia.

UNIT V

- Recombination and repair

- Recombination : homologous and non-homologous recombination
- Site-specific and transpositional recombination
- DNA repair mechanism in prokaryotes and eukaryotes

SUGGESTED READING:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Viii Ed. Principles of Genetics. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts Of Genetics. XI Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Igenetics- A Molecular Approach. Iii Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications Of Recombinant Dna. Asm Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. And Carroll, S.B. IX Edition. Introduction To Genetic Analysis. W. H. Freeman And Co.
8. Immanuel,C And Vincent ,S., Applied Genetics. Mjp Publishers.

Web links: 1. <http://www.genetics.org/> 2. <http://www.nature.com/subjects/genetics>

SEMESTER-I
PAPER III-MOLECULAR BIOLOGY AND BIOTECHNOLOGY

TEACHING HOURS: 5

COURSE CODE:5P15/IC/MBB
CREDITS: 4

UNIT I

- Genome organization – C value paradox, genome size, Cot curves, repetitive and non repetitive DNA sequences , Cot ½ and Rot ½ values, pseudo- genes, gene families, gene clusters, organelle genome, chromosomal structure , chromatin organization and remodelling, DNA structure, forms of DNA.
- DNA damage and repair – types of DNA damages, excision repair system, mismatch repair, recombination repair, double strand break repair, and transcription coupled repair.
- Recombination- homologous and non homologous recombination.

UNIT II

- DNA replication – molecular mechanisms of prokaryotic and eukaryotic DNA replication, regulation of replication.
- Transcription- prokaryotic and eukaryotic transcription, RNA polymerases, transcriptional unit, initiation, elongation, termination, transcriptional factors.
- Regulation of transcription – Operon, positive and negative control, attenuation phage strategies, anti-termination, response elements and inducible elements.

UNIT III

- Translation - prokaryotic and eukaryotic translation, genetic code, altered code in elongation, termination factors, fidelity of translation, post translational modifications.
- Mobile DNA elements – transposable elements, IS elements, P elements, retroviruses, retrotansposons.
- Antisense and ribozyme technology – initiation of splicing, polyadenylation, molecular mechanisms of antisense molecules, miRNA , siRNA. gene silencing

UNIT IV

- Isolation and sequencing of DNA, gene amplification, PCR, RAPD, RFLP, Maxim-Gilbert, Sanger's dideoxy methods.
- Splicing and Cloning – Cloning vectors for recombinant DNA technology , plasmids, cosmids, phagemids, YACS, gene replacement, restriction enzymes.
- Hybridization techniques – Southern- Northern hybridization, microarray.

UNIT V

- Medical biotechnology-Application of restriction fragment length polymorphism (RFLP) in forensic science, disease prognosis and genetic counselling.
- Agricultural biotechnology— bio fertilizers, bio insecticides, biogas
- Immunobiotechnology- Hybridoma technology and monoclonal antibodies.
- Industrial and Environmental biotechnology-microbial production of fermentation products, enzymes, antibiotics, single Cell proteins and biosensors.

SUGGESTED READING :

1. Harper's Review of Biochemistry, Prentice Hall.
2. Principles of Biochemistry by Lehninger and Nelson, CBS publications.

3. The Biochemistry "Students companion" by Allen J. Scism, Prentice Hall.
4. Fundamentals of Biochemistry by Jain J. L., S. Chand Publication.
5. Principles of Biochemistry by Zubay J. L., WM. C. Brown Publishers.
6. Principles of Biochemistry by Horton, Prentice Hall.
7. Concept of Biochemistry by Boyer R., Coel publication co.
8. Harper's Biochemistry eds. Murray, R. K. P. and Granner, D. K. Prentice Hall.
9. Cell and Molecular Biology by De Robertis- E. D. P., I. S. E. publication.
10. Molecular Biology by Turner P. C. and Mc Lennan , Viva Books Pvt. Ltd.
11. Advanced Molecular Biology by Twyman R. M., Viva Books Pvt. Ltd.
12. Molecular Biology by Freifelder D., narosa publication House.

Web links : 1. http://www.sciencedaily.com/terms/molecular_biology.htm
2. <http://www.nature.com/subjects/biotechnology>

SEMESTER-I
ELECTIVE I- MICROBIOLOGY

TEACHING HOURS: 60 hrs

COURSE CODE: SP15/IE/MIC

L T P : 3 1 0

CREDITS: 3

UNIT I:

Introduction to Microbiology –Discovery of microorganisms –Classification, approaches to microbial classification – outline classification – Bergey's manual –Domain and Kingdom

UNIT II

Main group of microorganisms, general characters - The prokaryotic cell envelope, peptidoglycan structure - Gram positive and negative cell walls - components outside the cell wall: capsules, slime layers and S-layers, pili and fimbriae, flagella and motility

UNIT III

Microbial metabolism – energy acquisition by chemotrophs and phototrophs – Fermentation, anaerobic oxidations, chemosynthesis – photosynthesis, carbon assimilation – regulation of metabolism – Nutrition and growth – common nutrient requirements, nutritional types, growth factors, uptake of nutrients by the cell – culture media – Reproduction and exponential growth – the growth curve – Physical requirements for bacterial growth and influence of environmental factors on growth

UNIT IV

Microbial interactions and microbial Ecology- symbiosis, commensalism – Mutualism between microbes, microbes and plants, microbes and animals – Cooperation, competition, predation, antagonism – Parasitism, animal parasites -

UNIT V

Applied Microbiology – Bacteria of air, water and soil – Microbes associated with food production and spoilage, microbiology of milk and dairy products – Control of microorganisms – physical, chemical and antimicrobial agents – Biological weapons and bioterrorism

SUGGESTED READING:

1. Arora, D.R. and Arora, B. 2008. Text Book of Microbiology. CBS Publishers and Distributors, New Delhi
2. Chakraborty, P.A. 2009. Text Book of Microbiology. New Central Book Agency. New Delhi
3. Harma and Kanika. 2009. Manual of Microbiology Tools and Techniques. Ane Books Pvt. Ltd. New Delhi
4. Ingraham, J.L. and Ingraham, C.A. 2000. Microbiology (2nd edn). Brooks/Cole – Thomson Learning, MA, USA
5. Laning, M. Prescott, John, P. Harley and Donald A. Klein. 2008. Microbiology (7th edn). McGraw Hill International, NJ, USA
6. Talaro, Park, Kathelee, N and Talaro, Arthur. 2002. Foundations of Microbiology. McGraw Hill Higher Education, NY
7. Wheelis, Mark. 2010. Principles of Modern Microbiology. Jones and Bartlett Publishers, NY, USA.

Web Links: 1. <http://www.nature.com/subjects/microbiology>

2. <http://www.sgm.ac.uk/all/microbio/each/bsc/careers/index.cfm>

Question Paper Template

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
Part A	Descriptions - Contains 5 questions to be answered out of 8 covering all 5 units.	5X3= 15
Part B	Application, Analysis / Synthesis / Evaluation - Contains 3 questions to be answered out of 5 questions covering all the five units.	3X3= 9

SEMESTER-II
PAPER IV – FUNCTIONAL MORPHOLOGY AND SYSTEMATICS OF
CHORDATES

TEACHING HOURS: 6

COURSE CODE:5P15/2C/FMC
CREDITS: 4

UNIT I

- Origin and ancestry of Chordata, General organization and affinities of Cephalochordata.
- Origin of Fishes. General organisation and characters of Fishes. General characters and affinities of Dipnoi.
- Origin of Amphibia. General organisation and characters of Amphibians.

UNIT II

- Origin of Reptiles. General organisation and characters of Reptiles. General body organization and classification in Sphenodon and Chelonia.
- Origin of Birds. General organisation and characters of Aves.
- Origin of Mammals. General organisation and characters of Mammals General characters and adaptations of Cetacea.

UNIT III

- Comparative anatomy of the brain in vertebrates (teleost, frog, lizard, fowl and rat).
- Autonomous nervous system in vertebrates: structure and functions.
- Structure, development and metamorphosis of Ammonoetes.
- Evolution of heart in vertebrates.
- Sense organs in vertebrates: lateral line system and electroreception in fishes.

UNIT IV

- Appendicular skeleton (Limbs and girdles) in Amphibia, Reptilia, Aves and Mammals.
- Vertebrate integument and its derivatives.
- Organs and mechanism of respiration in Pisces and Amphibia, reptiles, birds, mammals.
- Evolution of urinogenital organs in vertebrates.

UNIT V

- Biological and cultural Evolution of Man. Evolution of Horse.

SUGGESTED READING:

1. Alexander R.N., The Chordata, Cambridge University Press London.
2. Barrington EJW, The Biology of Hemichordates and Protochordates, Oliver and Boyd Edinberg.
3. Bourne G.H., The structure and function of nervous tissue Academic press New York.

4. Honyelli A.R. The Chordates Cambridge University Press, London
5. Smith H.S. Evolution of Chordate structure, Hold Rinehart and Winton Inc. New York
6. Walter H.A. and Sayles L.D. Biology of Vertebrates Macmillan and co. New York
7. Romer A.S. Vertebrate body W.P. Sanders co., Philadelphia.
8. Young J.Z. Life of Vertebrates Oxford University Press, London.
9. Young J.Z. Life of Mammals Oxford University Press, London.
10. Colbert E.H. Evolution of Vertebrates John Wiley and sons Inc. New York.
11. Kent C.J. Comparative anatomy of Vertebrates.
12. Waterman A.J. Chordate Structure and Functions Macmillan Co. New York.
13. Lovettrup S. The phylogeny of Vertebrates John Wiley and sons Inc., London.
14. Joysey K.A. and Kemp T.S. Vertebrate Evolution Oliver and Boyd, Edinberg.
15. Romer A.S. Vertebrate Paleontology University of Chicago Press, Chicago.

Web links: <http://www.ucmp.berkeley.edu/chordata/chordata.html>

SEMSESTER- II

CORE PAPER-V-BIOPHYSICS, BIOSTATISTICS AND BIOINFORMATICS

TEACHING HOURS: 6

COUSE CODE:5P15/2C/BBB

CREDITS: 4

UNIT I

Microscopy- principle and applications- light microscope, phase contrast, electron microscope and fluorescence microscope. Histological techniques- principles of tissue fixation- microtomy- staining and mounting.

UNIT II

Separation techniques- chromatography-principle, types and applications- TLC and ion exchange electrophoresis- principle, types and applications- agarose gel electrophoresis and PAGE. General principles and applications of colorimeter and spectrophotometer, Beer and Lambert's law.

UNIT III

Radiation biophysics- ionizing radiation units of radio activity- exposure and dose biological effects of radiation: effect on nucleic acid, proteins, enzymes and carbohydrates. Cellular effects of radiation- somatic and genetic. Autoradiography.

UNIT IV

General principle of biostatistics- frequency distribution. Central tendency, correlation and regression. Sampling and analysis. Sampling theory- analysis of variance. Non parametric tests (any 2).

UNIT V

Biology and bioinformatics. Genomics and proteomics, biological databases- National center for biotechnology and informatics (NCBI); European bioinformatics institute (EBI) sequence alignment and database searching. Sequencing similarity search tools- BLAST and FASTA. Computational tools for DNA sequencing analysis.

SUGGESTED BOOKS:

1. Biometry. 3rd Edition (2001). R. R. Sokal And F. J. Rohlf. W. H. Publisher-Freeman And Company.
2. Biostatistical Analysis. 5th Edition (2008). J. H. Zar. Publisher-Pearson Education Inc. And Dorling Kindersley Publishing Inc.
3. Statistical Methods. 6th Edition (1967). G. W. Snedecor And W. G. Cochran. Publisher-Oxford Andibh Publishing Co.
4. Practical Statistics - S.P. Gupta
5. Jerold H. Zar Bio Statical Analysis (2nd Edition) Printice Hail Of International Edition, 1984 (Relevant Portions)
6. Rangaswamy R.A Text Book Of Agriculture Statistics, New Age International Publishers, 1995

7. Atwood And Parry-Smith. 2001. Introduction To Bioinformatics. Pearson Education Asia, New Delhi. Baxevanis & Ouellette. 2001.
 8. A. Upadhyaya, K. Upathyaya And N. Nath, (2003) Biophysical Chemistry, Principles And Techniques, 3rd Ed, Himalaya Publishing House.
 9. H.B. Bull, F.H. Davis, An Introduction To Physical Biochemistry 2nd Ed, Philadelphia 1971
 10. Gurumani.N. 2006. Research Methodology For Biological Sciences Mjp Publ. Chennai.
- Web Links :<http://www.biophysics.org/education/whatisbiophysics/tabid/2287/default.aspx>
www.ncbi.nlm.nih.gov

SEMESTER-II
ELECTIVE- II- PISCI CULTURE

TEACHING HOURS: 4

COURSE CODE: 5P15/2E/PIS
CREDITS: 3

UNIT I

Fisheries resources of Tamil Nadu, Riverine fisheries, Coastal fisheries in India, Offshore and deep sea fisheries in India

UNIT II

Collection of fish seed from natural resources, Types of ponds required for fish culture farms, Management of hatcheries, nurseries and rearing ponds, Management of stocking ponds.

UNIT III

Composite fish culture, Sewage fed fisheries Prawn culture and pearl industries in India.

UNIT IV

Hypophysation and breeding of Indian major carps, Drugs useful in induced breeding of fish.

UNIT V

Role of fisheries in rural development, Methods of fish preservation, Marketing of fish in India, Economic importance and by product of fishes, Shark liver oil industry in India Transport of live fish and fish seed.

SUGGESTED BOOKS :

1. JR. Norman - The History of fishes
2. Nagaraja Rao - An introduction to fisheries
3. Lagler Ichthyology
4. Herclen Jones Fish migration
5. Marshal The life of fishes
6. Thomas - Diseases of fish
7. Greenwood - Inter relationship of fishes
8. Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar
9. Brown -Physiology of fishes Vol. I & II
10. Hoar and Randall -Fish physiology of fishes Vol. I & IX
11. Gunther Sterba C.N.H.-Freshwater fishes of the world
12. W. Lanharn -The Fishes
13. G.V. Nikolsky -The Ecology of Fishes
14. Borgstram -Fish as food Vol. I & II
15. Nilsson -Fish physiology -Recent Advances
16. P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology

17. Carl E. Bond -Biology of fishes
18. M. Jobling -Environmental Biology of fishes.
19. Santosh Kumar & Manju Ternbhre -Fish and Fisheries
20. S.K. Gupta -Fish and Fisheries
21. K.P. Vishwas -Fish and Fishries
22. Jhingaran -Fish and Fisheries

SEMESTER-II
ELECTIVE – III EVOLUTION AND ANIMAL BEHAVIOUR

TEACHING HOURS: Hrs

COURSE CODE : 5P15/2E/EAB

CREDITS: 3

UNIT –I

- Arguments of evolutionary ideas and evolutionary theories since Darwin
- Evolutionary process
- Evidences for evolution- fossils and stratification
- Mechanisms producing genetic diversity
- Natural selection and adaptation

UNIT – II

- Gene frequencies in population
- The hardy-Weinberg principle and analysis of gene frequencies in natural population
- Major factors influencing gene frequencies
- Effects of selection and mutation on gene frequencies.
- Genetic drift
- Patterns and trends in evolution

UNIT –III

- The origin and evolution of primates
- Evolution of anthropoid primates
- The first hominids and origin of modern man.

UNIT - IV

- Principles and mechanisms of animal behaviour
- Four propositions of Tinbergen
- Individual vs group selection
- Genotype and environment interaction
- Phenotypic plasticity
- Cooperation and conflict
- Male-male competition and sexual selection
- Elaborate ornaments: fisher's hypothesis and handicap hypothesis
- Parent-offspring conflict

UNIT – V

- Territoriality and group foraging
- Aggression
- Aggressive behaviour

- Sensory system and communication
- Signal content and structure

SUGGESTED BOOKS:

EVOLUTION

1. Darwin, C. The Origin Of Species, 6e. Oup. Desmond Morris, 1990. Animal Watching (Field Guide), Crown Pub Co., London.
2. Dobzhansky, Th.: Genetics And The Origin Of Species 1951, Columbia Uty. Press.
3. Dobzhansky, Th. Et Al: Evolution, Surjeet Pubn., Delhi. Prakash M. Et Al.
4. Organic Evolution – N. Armugam
5. Evolution – M. P. Arora
6. Dodson, Evolution – Process And Product
7. Moody, Introduction To Evolutionsuggested Books:

Animal Behaviour

8. Recent Advances In Animal Behaviour. 1994, 7 Vols., Anmol.
9. Reena Mathur: Animal Behaviour, Rastogi & Co., Meerut.

SEMESTER-II

PRACTICAL I – INVERTEBRATA, CHORDATA AND MICROBIOLOGY

TEACHING HOURS: 3

COURSE CODE: 5P15/2C/MP1

CREDITS : 4

INVERTEBRATA

1. Identification and study of selected Protozoans and Helminthes of medical importance.
2. Identification and study of sections of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.
3. Identification and study of larval forms from all major phyla of invertebrates.
4. Identification and study of invertebrate fossils (specimens).
5. Dissection of digestive, nervous and reproductive systems in
 1. Scorpion ,
 2. Gryllotalpa
6. Dissection of the Nervous system in 1. Pila 2. Prawn
7. Mounting of Pedicellariae, Aristotle lantern in Sea Urchin and mounting of the sting of honey bee..

CHORDATA

1. Identification of important Prochordates, South Indian fishes, Amphibians, Reptiles, Birds and Mammals.
2. Dissection of internal ear in Shark.
3. Dissection of aortic arches in Shark and Mullet.
4. Dissection and Display of portal system in Calotes.
Aortic arches in Calotes.
5. Mounting of Hyoid of Calotes

MICROBIOLOGY

1. Microscopic observation for identification and characterization of micro organisms relevant to theory syllabus.
 - a. *Staphylococcus aureus*
 - b. *Escherischia coli*
 - c. *Rhizopus*
 - d. *Aspergillus niger*
 - e. *Aspergillus flavus*
 - f. *Penicillium*
 - g. *Nostoc*
 - h. *Oscillatoria*
 - i. *Volvox*
2. Culture medium and preparation.
 - i. Preparation of peptone water
 - ii. Preparation of nutrient broth
 - iii. Preparation of solid media.
 1. Slant
 2. Stab
 3. Plate.
3. Simple and Differential staining of bacteria.
4. Identification of bacteria in Milk – Gram staining (*Lactobacillilus* and *Streptococcus*)
5. Identification of Algae present in pond water – *Oscillatoria*, *Chlorella*, *Nostoc*.

SEMESTER-II
**PRACTICAL II -MOLECULAR BIOLOGY, BIOTECHNOLOGY, GENETICS,
BIOPHYSICS AND BIOSTATISTICS**

TEACHING HOURS: 4 HRS

COURSE CODE: 5P15/2C/MP2
CREDITS: 4

MOLECULAR BIOLOGY

1. Cytological techniques

Micrometry: Microscopic calibration and Measurements of cell size using ocular and stage micrometers.

2. Study of different types of cells

Blood cells –Differential count in man and fish.

1. Histochemical techniques

Demonstration: Fixation, Dehydration, Embedding, staining (vital staining) and Mounting.

Histochemical localisation of

- a. Lipids
- b. Proteins

BIOTECHNOLOGY

Demonstration:

- a. PCR
- b. Agarose gel Electrophoresis of DNA.

BIOPHYSICS

Demonstration :

1. Spectrophotometry: Principle and application
2. Electrophoresis: Description and applications.

Genetics

1. Preparation of culture medium for Drosophila.
2. Observation of Drosophila in culture medium.
3. Identification of sex in Drosophila. Development and life cycle.
4. Identification of Drosophila mutants.
1. Yellow body 2. White eye 3. Vestigial wing 4. cut wing 5. Rotated abdomen
6. Curled wing 7. bi-thorax 8. bar eyes 9. Cinnabar.
5. Preparation of human karyotypes. Analysis of normal and abnormal karyotypes.
Down's syndrome and Klinefelter's syndrome.
6. Genomic imprinting analysis- Prader Willi syndrome.
7. Mitochondrial diseases and modes of inheritance.

8. Gene Therapy – ADA deficiency and CFTR.

Biophysics

1. Principle and application of Spectrophotometer
-Determination of proteins
2. Principle and application of Electrophoresis

Biostatistics

1. Construction of bar diagram - simple, component and percentage
2. Construction of histogram and pie diagram
4. Measures of central tendency
 - a) Calculation of mean for continuous series -direct method.
 - b) Calculation of median for continuous series.
 - c) Calculation of mode for continuous series.
5. Measures of dispersion: calculation of standard deviation – direct method.

SEMESTER III

PAPER VI- ANIMAL PHYSIOLOGY

TEACHING HOURS : 90Hrs

PAPER CODE : 5P15/3C/APY

CREDIT: 4

UNIT- I

Introduction - Fields of physiology- Classification – metabolism- glycogenesis, glycogenolysis, glycolysis, TCA cycle electrontransport system and oxidative phosphorylation of carbohydrate - protein Classification – metabolism classification and metabolism- oxidative deamination, decarboxylation and, trans-amination of amino acids, arginine-ornithine cycle.- lipid classification - metabolism- oxidation of fatty acids - cholesterol metabolism

UNIT- II

Respiratory pigments- types – distribution – properties – structure of haemoglobin – mechanism of O₂ transport - myogenic – neurogenic heart – cardiac cycle – phases of cardiac cycle – ECG – pace maker and heart valves

UNIT- III

Neurotransmitters – chemical nature – biosynthesis – mechanism of synaptic transmission - Bioluminescence : light producing organs – in invertebrates and chordates – colour change mechanism – chromophores – melanophores – physiology and significance. - Cerebrospinal fluid: Chemistry and functions, Mechanism of reflex action, Physiology of environmental stress and strain- tolerance, avoidance, resistance and, physiological adaptations.

UNIT - IV

Enzyme classification – mechanism of enzyme action. Factors affecting enzyme action – regulation of enzyme activity – activators – inhibitors.

UNIT- V

Thermoregulation – poikilotherms – homeotherms – adaptations – regulatory mechanisms – osmoregulation: pisces, amphibian – mechanism of salt and water transport by gills and kidney.

SUGESSTED READING

1. Textbook of Medical Physiology: Guyton, A.G. (1968). 7th Edn. Saunders Pub
2. General & Comparative Animal Physiology : W.S. Hoar.
3. Medical Physiology : W.F. Ganong (1981) : 10th Edn. Lange Medical Publications.
4. Animal Physiology : Mechanism & Application, R. Eckert, W.H. Freeman & Company.
5. Mineral Metabolism : Comar, C.L. & Felix Bronner (1961) Acad Press, New York & London
6. Comparative Animal Physiology C.L. Prosser, W.B. Saunders & Company.
7. Reproductive Physiology of Vertebrates: Van Tienhoven, A. (1983): 2nd Edn

SEMESTER III

PAPER VII- ENVIRONMENTAL BIOLOGY AND BIODIVERSITY CONSERVATION

TEACHING HOURS: 90Hrs

COURSE CODE: 5P15/3C/EBC

CREDITS: 4

UNIT- I

Basic concept and Scope of Environmental Biology, Biosphere and Biogeochemical cycles, Environmental monitoring and impact assessment. Environmental and sustainable development. Water conservation, rain water harvesting, water shed management.

UNIT- II

Cause, effects and remedial measure of Air pollution, Water pollution. Noise, radioactive and thermal pollution. Agriculture pollution, Basic concepts of Bioaccumulation, Solid waste management, Global warming and disaster management, Cause of global warming, Impact of global warming – acid rains and ozone depletion, green house effect, Control measures of global warming, Afforestation, Reduction in the use of CFCS.

UNIT- III

Disaster management -floods, earthquake, Cyclones landslides, Environmental legislation. Natural Resource, Forests of India, Use and over exploitation of forests, Timber extraction. Land degradation, Landslides, Soil-erosion and desertification, Use and over utilization of surface and ground water, Floods. Drought dams- benefits and problems.

UNIT- IV

Mineral Use and exploitation, Environmental effect of extracting and using mineral resources, World food problem, Effects of modern agriculture and overgrazing, Conventional and non- conventional energy resources, alternate energy source, Equitable use of resources for sustainable life.

UNIT- V

Biodiversity crisis – habitat degradation , poaching of wild life, Socio economic and political causes of loss of biodiversity, Conservation of Biodiversity, In situ and ex situ conservation of biodiversity, Hot spots of Biodiversity.

SUGGESTED READING

1. Kormondy : Concepts of ecology
2. May : Model ecosystems
3. Odum : Ecology
4. Perkins : Ecology
5. Arora : Fundamentals of environmental biology
6. Anathakrishnan : Bioresources ecology
7. Bottain : Environmental studies
8. Bouhey : Ecology of populations
9. Clark : Elements of ecology
10. Dowdoswell : An introduction to animal ecology

SEMESTER III
PAPER VIII – IMMUNOLOGY

TEACHING HOURS: 90Hrs

COURSE CODE: 5P15/3C/IMM
CREDITS 5

UNIT- I

Immune system - innate and adaptive immunity. Cells and organs of immune system – hematopoiesis, primary and secondary lymphoid organs. Antigens and antibodies – antigenicity, immunogenicity, antigen – antibody interactions, superantigens, antibody diversity.

UNIT- II

Organization of immunoglobulin genes – antibody structure, heavy, light, kappa, lambda; chain gene rearrangements. Complement system – classical, alternative and lectin pathways, regulation of complement system, biological consequences of complement activation. Major Histocompatibility Complex (MHC) - general organization and inheritance of the MHC, MHC molecules and genes, cellular distribution and regulation of MHC expression.

UNIT- III

T cells - maturation, activation and differentiation, T cell receptors. B cells - maturation, activation and differentiation, B cell receptors. Cytokines - properties of cytokines, cytokine receptors, cytokine-related diseases, therapeutic uses of cytokines and their receptors. Cell mediated cytotoxic responses – effector mechanisms, leukocyte activation and migration.

UNIT- IV

Hypersensitivity reactions – types, prevalence, factors, mechanisms of type I to IV hypersensitivity reactions. Immune tolerance and Autoimmunity – organ specific autoimmune diseases, animal models, treatment of autoimmune diseases. Transplantation immunology – blood antigens, transplantation rejection, graft rejection, familial grafting, tissue typing, cross matching, immune suppression.

UNIT- V

Immune response to infectious diseases– bacterial, fungal, viral, parasitic diseases and Immune deficiency - AIDS. Vaccine production - immune therapies, immunization. Applications of immunology and immune techniques –, ELISA, precipitation reaction, agglutination reaction, radioimmunoassay

SUGGESTED READING

1. Immunology – R. C. Kubly et al..
2. Immunology - Tizzard.
3. Immunology -. Roitt, Brostoff and D. Male.
4. Microbiology- M. T. Pelzer. Jr. E. C. S. Chan and N. R. Krieg. Tata McGraw –Hill

SEMESTER III
ELECTIVE PAPER-IV-RECOMBINANT DNA TECHNOLOGY
TEACHING HOURS:60Hrs **COURSE CODE: 5P15/3E/RDT**
CREDITS : 3

UNIT- I

Introduction to recombinant DNA technology, General strategy of recombinant DNA technology and gene cloning, Genomic libraries, c-DNA libraries, Single gene cloning Isolation, identification and characterization of DNA fragments to be cloned.

UNIT- II

Preparation of cDNA, Vectors in gene cloning, Types of vectors and choice of vectors Plasmids, cosmids, lambda phage vectors, shuttle vectors, YACS, BACS, other advanced vectors, DNA modifying and degrading enzymes used in recombinant DNA technology.

UNIT- III

Methods of transferring recombinant DNA to different host cells, Screening for transformants, Characterisation of transformants, Different hybridization techniques, Probe preparation using radioactive and nonradioactive ligands detection of hybrids

UNIT- IV

DNA sequencing, Site directed mutagenesis, Genetic manipulation of animals Gene transfer to plants.

UNIT-V

Various expression vectors in bacteria and eukaryotes, Choice of appropriate hosts Induced expression, Expression of industrially important products.

SUGGESTED BOOKS

1. Primrose S., Twyman R., Old D., Sixth Edition (2001) Principles of Gene Manipulation, Blackwell Science Ltd.
2. Prirose S., Twyman R., Third Edition (2003) Principles of Genome Analysis And Genomics., Blackwell Science Ltd.
3. Alcamo I. Second Edition (2001) DNA Technology, The Awesome Skill, Harcourt Academic Press
4. Brown T.A., Third Edition (2007) Genomes 3, Garland Science , Taylor And Francis Group

SEMESTER III

PAPER-IX- DEVELOPMENTAL BIOLOGY

TEACHING HOURS : 90Hrs

PAPER CODE : 5P15/4C/DBY
CREDIT:5

UNIT- I

Various methods of asexual and sexual reproduction in Protozoa - Morphogenesis and hormonal control. -Metamorphosis in insects: Partial and complete metamorphosis, metamorphic forms nymph, larvae and pupae - Mechanism of vitellogenesis in insects. Metamorphosis in Amphibia: morphogenetic and biochemical mechanism, hormonal control.

UNIT- II

Hormonal control and ultra-structure of human spermatozoa -Semen-biochemical composition and sperm abnormality -Sperm capacitation and decapacitation- molecular mechanism and significance - Mechanism of oogenesis, biochemical events, hormonal regulation.

UNIT- III

Cytological and molecular events of fertilization - Implantation in Mammals Foetal membranes- types, structure and functions - Pheromones and sexual behavior in mammals -Neurohormonal control of fish reproduction and mechanism of vitellogenesis. Molecular induction (Morphogenetic gradients) and organizer concept.

UNIT- IV

Cryopreservation of gametes, embryo and test-tube baby - In vitro fertilization (IVF) and its significance - Multiple ovulation and embryo transfer technology (MOET) - Application of embryonic stem cells, clinical and economic significance. Embryonic sexing, cloning, screening for genetic disorder diagnosis (ICSI, GIFT etc.) Cloning of animals by nuclear transfer.

UNIT- V

Immunocontraception- fertilization, inhibition and pregnancy termination - Classical contraceptive techniques: Physical, chemical, surgical and IUCD devices. Anti-androgen and anti-spermiogenic compounds (LDH-CY and SP-10)

SUGGESTED READING

1. Developmental Biology. 2nd Edition. Leon W. Browwer Saunders College publishing.
2. Current Topics in Developmental Biology eds. R. A. Pedersen and G. P. Schatten.
3. Developmental Biology, S.F. Gilbert. 4th Edn. Sinauer Associates Inc. Publishers.
5. Principles of developmental: Paul Weiss edited by Hafner publishers , New York.
6. Cells into organs. 2nd Edn. The forces that shape the Embryo. Philip, Trinkaus

7. Principles of development: Lewis Wolpert et al. 1998. Oxford University Press.
8. Foundations of Embryology. B. M. Patten & B. M. Carlson. Tata McGraw Hill Publishing Company Ltd., New Delhi.
9. An Introduction to Embryology: Balinsky (1981) 5th Ed. (CBS College Publishing).
10. Marshall's Physiology of Reproduction Longmont, Green & Co. London Vol. 1 & 2. Flamming 1984, 2000.

IV SEMESTER

PAPER X- BIOCHEMISTRY

TEACHING HOURS: 90Hrs

COURSE CODE : 5P15/4C/BIO

CREDITS: 4

UNIT- I

Chemical foundation of biology, Biomolecules, pH, pK, acids bases, buffers ,
Enzymes: Nomenclature, classification and basics of enzyme kinetics, Mechanism of
enzyme catalysis
Regulation of enzyme reaction

UNIT- II

Carbohydrates-Classification, Glycolysis and Gluconeogenesis
Citric acid cycle, Basic concepts of metabolism: Coupled and interconnecting reactions of
metabolism

UNIT- III

Proteins –Classification of Aminoacids- Primary, Secondary, tertiary and quaternary,
structures of proteins, protein folding and denaturation- Oxidative phosphorylation :
Protein and its regulation, DNA & RNA: Double helical structure of DNA, Structure of
RNA, RNA synthesis and splicing, Biosynthesis of nucleotides, Protein synthesis.

UNIT- IV

Lipids - Biosynthesis of membrane lipids and steroids, Functional importance of lipid
storage and membrane lipids, Membrane channels and pumps, Fatty acid metabolism:
Synthesis and degradation of fatty acids.

UNIT- V

Thermodynamics-. Concept of free energy and thermodynamic principals in biology,
Metabolism of Xenobiotics-detoxification – definition –Phase I oxidation, Reduction,,
Hydrolysis – Phase II conjugation reaction – Glucuronic acid, Glutathione sulphahte,
acetate and methyl group.

SUGGESTED READING

1. Voet, D. and J.G. Voet. Biochemistry John Wiley & Sons.
2. Freifelder, D. Physical Biochemistry W.H. Freeman & Co.
3. Segal, I.H. Biochemical calculations John Wiley and Sons
4. Creighton, T.E. Protein Structure and Molecular Properties W.H. Freeman & Co.
5. Freifelder, D. Essentials of Molecular Biology
6. Wilson, K. and K.H. Goulding A Biologists Guide to Principals and Techniques of
Practical Biochemistry
7. Cooper, T.G. Tools of Biochemistry
8. Hawk, Practical Physiological Chemistry
9. Garret, R.H. and C.M. Grisham. Biochemistry. Saunders college Publishers.

SEMESTER IV

PAPER XI- AQUACULTURE

TEACHING HOURS: 90 Hrs

COURSE CODE : 5P15/4C/AQU

CREDITS: 4

UNIT- I

Aquaculture: history, definition, scope and importance, Fishery resources of India in general and Tamil Nadu in particular, Abiotic and biotic factors of water necessary for fish life. Ecological characteristics of lakes and rivers, General ecological characteristics of reservoirs of India.

UNIT- II

Fresh water fish farm: selection of site, construction of fish farm and soil chemistry, Designing, layout and construction of different types of fish ponds, Setting and management of fresh water aquarium, Water pollution, its effects on fisheries and methods of its abatement. Common fish diseases & their control.

UNIT- III

Fish culture :- Mono, Poly, mixed and composite Fish culture, Fresh water prawn culture and its prospects in India, Culture of Mussels, clams, oysters and pearl culture, Sewage fed fish culture, paddy cum fish culture, Frog culture, Sea Weed Culture.

UNIT- IV

Fish breeding in natural conditions, bundh breeding, hypophysation & stripping, Transport of live fish and seed, Different types of crafts and gears used for fish catching, Plankton- its definition, culture & identification, Common weeds of fish ponds and methods of their eradication. Polyploidy and hybridization, sex determination in fishes, super males and super females, transgenic fishes.

UNIT- V

Preservation and processing of fish, By products of fish Industry and their utility, Biochemical composition and nutritional value of fish, Fisheries economics and marketing, Fisheries managements and extension.

SUGGESTED READING:

1. C.B.L. Shrivastava : Fishes of India
2. Jhingaran : Fish and fisheries of India
3. S.S. Khanna : An Introduction to fishes
4. R.S. Rath : Fresh water Aquaculture
5. Gopalji Shrivastava : Fishes of U.P. & Bihar
6. H.D. Kumar : Sustainability & Management of Aquaculture & Fisheries
7. A.J.K. Mainan : Identification of fishes
8. R. Sanatam : A Manual of fresh water Aquaculture
9. S.K. Gupta : Fish & Fisheries

SEMESTER IV
ELECTIVE-V - RESEARCH METHODOLOGY
TEACHING HOURS: 60 Hrs **COURSE CODE: 5P15/4E/RMY**
CREDITS : 3

UNIT-I

Basic concepts - Knowledge, Information and Data - Science, Pseudoscience, Life Science - Definition, Laws, Characteristics, Scientific temper, Empiricism, Rationalism. Units of measurements, Concepts of Research -Meaning, Objectives, Motivation and Approaches, Types of Research (Descriptive/Analytical, Applied/ Fundamental, Quantitative/Qualitative, Conceptual/ Empirical, Research methods versus Methodology, Research and scientific method, Research Process.

UNIT-II

Research Formulation-Observation and Facts, Prediction and explanation, Induction, Deduction. Defining and formulating the research problem. Selecting the problem and necessity of defining the problem, Literature review -Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review, Hypothesis -Null and alternate hypothesis and testing of hypothesis -Theory, Principle, Law and Canon.

UNIT-III

Research Designs-Basic principles, Meaning, Need and features of good design, Important concepts, Types of research designs, Development of a research plan -Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs, Data collection techniques, Scientific Documentation and Communication.

UNIT-IV

Project proposal writing, Research report writing (Thesis and dissertations, Research articles, Oral communications). Presentation techniques - Assignment, Seminar, Debate, Workshop, Colloquium, Conference, Information Science, Extension and Ethics, Sources of Information -Primary and secondary sources, Library - books, journals, periodicals, reference sources, Abstracting and indexing sources, Reviews, Treatise, Monographs, Patents, Internet - Search engines and software, Online libraries, e-Books, e-Encyclopedia, TED Talk, Institutional Websites.

UNIT-V

Intellectual Property Rights - Copy right, Designs, Patents, Trademarks, Geographical indications. Safety and precaution - ISO standards for safety, Lab protocols, Lab animal use, care and welfare, animal houses, radiation hazards. Extension: Lab to Field, Extension communication, Extension tools, Bioethics: Laws in India, Working with man and animals, Consent, Animal Ethical, Committees and Constitution.

SUGGESTED READING

1. Ahuja, V.K. 2010. Law of Copy Rights and Neighbouring Rights : National and International Perspectives..Lexis Nexis- Butterworths Wadhwa, Nagpur Ahuja, V.K. 2007.
2. Law Relating to Intellectual Property Rights. Lexis Nexis-Butterworths Wadhwa, Nagpur. Anitha Goel.2010
3. An Introduction to Scientific Research. Dover Publications. NY. Chap T.Le.2003.Introductory Biostatistics. John Wiley & Sons, NJ, USA. Clough, P. and C. Nutbrown.2002.
4. A Student's Guide to Methodology: Justifying Enquiry. Sage, London. Daniel, W.W. 2006. Biostatistics: A Foundation for Analysis in the Health Sciences (7th edn). John Wiley & Sons, New York. Dharmapalan, Biju. 2012.
5. Scientific Research Methodology. Narosa Publishing House, New Delhi Finney, D.J. 1980. Statistics for Biologists. Chapman and Hall, London Frank, Harry and Steven C. Althoen, 1995.
6. Advice to Young Scientist. Harper and Row, London. Phillippe Cullet.2005.
7. Intellectual Property Protection and Sustainable Development. Lexis Nexis Butterworths Wadhwa, Nagpur Prabhakara, G.N. 2006. Biostatistics. Jaypee Bro. New Delhi Pradeep Sinha and Priti Sinha.2010.
8. Introduction to Biostatistics and Research Methods (4th edn). Prentice Hall, New Delhi.
9. WHO.2011. Laboratory Quality Standards and Their Implementation. WHO Regional Office. New Delhi.

SEMESTER – IV

PRACTICAL III- ANIMAL PHYSIOLOGY, BIOCHEMISTRY AND IMMUNOLOGY

TEACHING HOURS: 60HRS

COURSE CODE: 5P15/4C/MP3

CREDITS: 4

ANIMAL PHYSIOLOGY

1. Estimation of RQ in fish with reference to temperature
2. Oxygen consumption in terrestrial animal (cockroach)
3. Salt loss and Salt gain in Fish
4. Estimation of carbohydrates in the tissues –Anthrone Method
5. Determination of aminoacids in the tissues (paper chromatography)
6. Estimation of Blood glucose level – Glucose oxidase peroxidise method
7. Principles and applications of the following instruments: Kymograph, spectrophotometer, Sphygmomanometer, Electrophoretic unit
8. Study of fauna in their natural habitats by visiting places of zoological interest

BIOCHEMISTRY

1. Blood: Clotting time, bleeding time.
2. Estimation of haemoglobin
3. Erythrocyte Sedimentation Rate (ESR)-Chick Blood
4. Estimation of Blood Urea (DAM Method)
5. Estimation of Blood creatinine (Jaffe's method)
6. Estimation of Blood Cholesterol (Zaks method)

IMMUNOLOGY

1. Histology of Lymphoid organs- Thymus, spleen, Bone marrow, Lymph nodes
2. Isolation of lymphocytes and enumeration – DC
3. Immunodiffusion

4. Determination of antigenic determinants.

SEMESTER IV

PRACTICAL IV- DEVELOPMENTAL BIOLOGY, ENVIRONMENTAL BIOLOGY & AQUACULTURE

TEACHING HOURS: 120Hrs

COURSE CODE: 5P15/4C/MP4

CREDITS: 4

DEVELOPMENTAL BIOLOGY

1. Histological studies in a mammal: (i) T.S of mammalian Ovary (ii) T.S of mammalian Testes
2. Development in chick embryo-Observation of live chick embryo using vital stain
3. Developmental stages of Frog metamorphosis.
4. Induced ovulation in fish using hormone (Demonstration)
5. Observation of maturity stages of ovary and testes
6. Determination of gonadosomatic index and fecundity

ENVIRONMENTAL BIOLOGY

1. Identification of

i. Marine plankton

2. Study of

i. Rocky shore fauna

ii. Sandy shore fauna

iii. Muddy shore fauna

3. Determination of hydrobiological features of different samples (tap water, sea water, brackish water and polluted water)

i. pH

ii. Salinity

iii. Free carbon dioxide

iv. Dissolved oxygen

v. Calcium

4. Animal association- Parasitism, Mutualism and Commensalism

5. Analysis of industrial effluent for TDS and BOD – Visit to sewage treatment plant

6. Study of fauna in their natural habitats by visiting places of zoological interest.

AQUACULTURE

i. Fish morphology-Morphometric characters – Head structure

ii. Types of scales in fishes

iii. Identification of Marine fishes (5 nos) up to species level.

iv. Commercially important invertebrates: Crab, Lobsters, Pearl Oyster, Edible Oyster, Mytilus, Sepia and Loligo- their importance.

v. Observation of Gears and Crafts.

vi. Observation of Larvivorous fishes.

vii. Identification of commercially important fresh water fishes (2 nos) and estuarine fishes (1 no) belonging to different families using Day volumes.

viii. Identification of cultivable Prawns.

ix. Identification of Sea weeds – their economic importance.

x. Observation of fish farm implements- Sacchi's disc, pH meter, Aerator and Plankton net.

xi. Observation of fish parasites.

xii. Identification of 5 common ornamental fishes.

xiii. Study of different types of Formulated feeds and live feeds (Artemia, Rotifers and Diatoms)

xiv. Visit to hatchery, Fish landing and Fishery institutes.

xv. Field report to be submitted.

**IMSC ELECTIVE (OFFERED TO OTHER DEPARTMENT STUDENTS)
SEMESTER - II**

TITLE OF THE PAPER: MATERNITY AND CHILD CARE
TEACHING HOURS : 60 HRS **COURSE CODE : SP15/2N/MCC**
L T P : 3 1 0 **CREDITS : 3**

- UNIT I:** Structure and functions of Reproductive organs in male and female – Structure of a mammalian sperm – longevity – Morphology and cyclic changes of ovary – uterus – vagina and mammary glands during menstrual cycle – hormonal changes– puberty – menarche – menopause.
- UNIT II:** Formation of gametes – spermatogenesis– spermiogenesis – oogenesis – structure of human ovum – Ovulation – Role of hormones.
- UNIT III:** Fertilization – types – mechanism – chemotaxis – capacitation – Acrosomal reaction – activation of ovum – cortical reaction – amphimixis – monospermy, polyspermy – implantation – development of foetus – Birth of identical and non- identical twins-siamese twins.
- UNIT IV:** Pregnancy – maternal body changes –Test for pregnancy – parturition – Role of hormones – Birth control – necessity for birth control – contraceptive devices – Infertility – causes – Male and female infertility – Artificial insemination – test tube babies – amniocentesis.
- UNIT V:** Prenatal – postnatal care – Rh factor – erythroblastosis foetalis Immunoprophylaxis – immunization schedule – typhoid, cholera, diphtheria, tetanus, polio, plague, pertussis, Tuberculosis, MMR vaccine.

RECOMMENDED TEXT BOOK:

- Inderbir Singh and Pal, G.P, 2005. Human Embryology, 7th Ed.

REFERENCE BOOKS:

- Arumugam N, A Text book of Chordate Embryology – Saras Publication - 420pp.
- Gerard, J. Tortora and Sandra Reynolds Grabowski, 2003. Principles of Anatomy and Physiology, 10th Ed, Mac Millan. John Wiley and Sons, IMC.
- K.V. Sastry and Dr. Vineeta Shukal, 2004. Developmental Biology, 1st Ed. Rastogi publications.
- Verma P.S., V.K.Agarwal and Tyagi, 1995. Chordate Embryology, S.Chand & Co New Delhi 110 055, 420 pp.

Question Paper Template

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
Part A	Descriptions - Contains 5 questions to be answered out of 8 covering all 5 units.	5X8= 40
Part B	Application/ Analysis / Synthesis / Evaluation - Contains 3 questions to be answered out of 5 questions covering all the five units.	20X3 = 60

SEMESTER - III
ELECTIVE - II (OFFERED TO OTHER DEPARTMENT STUDENTS)
TITLE OF THE PAPER : AQUARIUM FISHES

TEACHING HOURS: 60 hrs
L T P : 3 1 0

COURSE CODE : SP15/3N/AQF
CREDITS : 3

Course Outline:

- UNIT I Introduction: Taxonomy and biology of some common fresh water and marine ornamental fishes - *Carassius auratus*; *Betta splendens*; *Poecilia reticulata*; *Colisa lalia*; *Pterophyllum*; *Scleropages*; *Amphiprion percula*; *Macropharyngodon negrosensis*; *Paracanthurus hepatus*; *Chaelodon vergobundus*; *Pterois voltans*
- UNIT II Food and Feeding Management: Live feed organisms (*Daphnia*, *Tubifex*, *Cyclops*, *Brachionus*, *Chlorella*, etc.) - Formulated feed (Freeze dried tubifex, liver, vegetable food, etc.) - Method of preparation of commercial feed and quality assessment of feed.
- UNIT III Aquarium Keeping and Management: Setting up of an aquarium tank - selection of stone and gravel - Decors - aquarium plants - water quality management - aeration - Illumination devices - salinity - pH - temperature maintenance - filtration (mechanical and biological filters). Safety measures and devices for maintenances.
- UNIT IV Breeding techniques and Health assessment: Development of brood stocks - Selection of brood fishes - Breeding of Egg layers and Live bearers - Induced breeding - Common diseases of aquarium fishes and their control - Microbial: Bacterial, Viral and Fungal diseases; non - microbial - Protozoans, Trematodes, Cestodes, Nematodes and Crustaceans.
- UNIT V Prospects of ornamental fishes: Export and industrial importance - Hobby and household industry - Tips for hobbyists - List of fresh water and marine ornamental fishes available in India for export with its indicative prices - Role of women in ornamental fish culture.

RECOMMENDED TEXT BOOK:

Donald Wilkie, 1985. Aquarium fish Pelhem Book, Ltd.

REFERENCE BOOKS:

1. Boulenger, E.G, 1939. Keep an Aquarium.
2. Dey V.K., Ornamental fishes-MPEDA Hand book of Aquafarming.
3. Gregory C. Bateman, 1921. Fresh water Aquaria - 7th edition. Revised by Jack Hen.
4. Harvey Jack Hims. Georg, F, 1973. A guide to fresh water Aquarium fishes. Hamylnn publications.
5. John G. Shedd, 1933. Aquarium.
6. Robert Goldstein, 1971. Diseases of aquarium fishes T.F.H. Publication.
7. Stephen Spotte, 1973. Marine Aquarium keeping. The Science, Animals and Art. John Wiley & Sons.

Question Paper Template

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
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Part B	Application/ Analysis / Synthesis / Evaluation - Contains 3 questions to be answered out of 5 questions covering all the five units.	20X3 = 60

soft skill

SEMESTER	Paper Code	Title of the Paper	Hrs/Wk	Credits	CA Marks	End Semester Marks	Total
III	SP15/4S/DFG	Dairy Farming	2	2		50	50
IV	SP15/4S/PFM	Poultry Farming	2	2		50	50

Soft Skill

Evaluation Component for Soft Skill

Semester	Course Code	Title of the Paper	CA Marks	End Semester Marks	Total
III	5P15/3S/DFG	Dairy Farming		50	50
IV	5P15/4S/PPM	Poultry Farming		50	50

Soft skill – III Dairy Farming

Teaching Hours: 30 Hrs

Paper Code: 5P15/3S/DFG

L T P : 2 0 0

Credit : 2

Unit – I

Dairy breeds, breeding, feeding and nutrition: Scope of Dairy farming – Dairy breeds of India- both cows and buffaloes-exotic cow breeds. Systems of breeding-hybrid vigour-grading- pure breeding – merits and demerits of Inbreeding and Outbreeding. Feeding and Nutrition – Structure of digestive system and physiology of digestion. Common cattle feed- their nutritive value- minerals, feed additives and silage preparation.

Unit – II

Live stock diseases: Viral diseases- rinderpest, foot and mouth disease and cowpox. Bacterial diseases- Mastitis, Anthrax, Tuberculosis, Haemorrhagic septicaemia, Brucellosis – Fungal diseases, Protozoan and Helminth diseases – Control measures.

Unit – III

Dairy technology, Marketing and Farm management: Milk – Composition and nutritive value- techniques to detect milk adulteration- spoilage of milk- pasteurization of milk- preparation of dahi, butter, ghee and milk products. Role of Co-operative societies in milk production and marketing. Technique of producing quality milk – artificial insemination- semen collection, storage and insemination techniques.

Books for reference:

1. G.C. Banerjee- A textbook of Animal Husbandry – Oxford & IBH publication, New Delhi.
2. KAR – Handbook of Animal Husbandry, 1990.
3. G.H Schmidt & T.D Van Vleck – Principles of dairy science- Surget Pvt. Ltd., 1982.
4. N.S.R. Sasting & C.K. Thomas - Farm Animal Management – Vikas Publishing House. Pvt. Ltd., 1976.
5. Dr. A.K. Sacheti – Animal reproduction and Artificial insemination: NCERT, 1989.
6. M.M. Rai – Dairy Chemistry and Animal Nutrition – Kalrant Publishers, 1985

Question Paper Template

Component	Nature of the question	Maximum marks
Part A	3 Questions to be answered out of 4 covering all 3 units	3 x 10 = 30
Part B	1 Question to be answered out of 2 from 3 units	1 x 20 = 20

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Soft Skill - IV Poultry Farming

Teaching Hours: 30 Hrs

Paper Code: SP15/45/PP/31

L.T.P.: 20:0

Credits: 4

Unit - I

External features of fowls - Sexual dimorphism - Maturity and egg laying capacity - different types of egg (Black fowl) - Nutritive value of eggs. Genetics of fowls - Inheritance of morphological characters - List of autosomal and sex-linked characters. Breeds of fowls. Breeding methods - systems of breeding - modern methods of breeding.

Unit - II

Poultry industry in India a survey - Choosing commercial layers and broilers - Poultry housing - Deep litter system - cage rearing - poultry - poultry methods. Practical aspects of layer rearing - management of growers - Management of layers and broilers - lighting, sanitation and winter management - debunking.

Unit - III

Poultry Nutrition Energy and Diseases - Protein and amino acids - Vitamins - essential organic elements - Non-nutrition feed additives - feed stuffs for poultry - feed formulation. Diseases - Virus, bacterial, fungal and parasitic diseases - vaccination programme - Poultry products making.

Books for reference:

1. Veterinary books and Journals.

2. The Poultry Science: The Selection Rearing and General Treatment of Poultry By: L.C.R. Norris, Flye.

3. Poultry Farming and Keeping By: W. Powell Owen.

4. Poultry Breeds and Management: An Introductory Guide By: David Serivaner.

Question Paper Template

Component	Nature of the question	Maximum marks
Part A	3 Questions to be answered out of 4 covering all 3 units	3 × 10 = 30
Part B	1 Question to be answered out of 2 from 3 units	1 × 20 = 20