GONDWANA UNIVERSITY, GADCHIROLI

DIRECTION RELATING TO THE EXAMINATION LEADING TO THE TWO YEAR / ONE YEAR MASTER OF SCIENCE DEGREE WITH SEMESTER PATTERN

AS PER NEP 2020

FACULTY- SCIENCE AND TECHNOLOGY

SUBJECT-ZOOLOGY

M.Sc. Semester III and IV

Session - 2024-25

M. Sc. Semester III

1. Details of Eligibility for M.Sc. Semester III Admission

Subject to their compliance with the provisions of this direction and of other ordinances in force from time to time, the following applicant candidates shall be eligible for the admission to Master of Science in Zoology and examinations their of

Table1: Eligibility for M.Sc. Semester III Admission

A	For M.Sc. (Zoology) Semester-III	For admission to the M. Sc. Semester III in Zoology, a candidate shall have pass Two subjects each of Semester I and Semester II

2. Duration of the Program, Student Progression Path and Provisions for Multiple Exit

Duration of the M.Sc. shall be TWO years with the provision for exit at the end of first year/semester II

Exit Option:

Students will have the flexibility to enter a program in odd semesters and exit a program after the successful completion of even semester as per their future career needs:

a. A student can exit the program after successful completion of semester I & II having earned requisite number of credits as mentioned in the scheme of examination. Such a student shall be eligible for the award of **'PG Diploma in Zoology'** by the affiliated colleges of Gondwana University OR a student can continue the program for 2nd year.

b. A student, on successful completion of all the 4 semesters and having earned requisite number of credits as mentioned in the scheme of examination shall be eligible for the award of **'Master of Science Degree in Zoology'**.

Table 2: Eligibility for Award of Certificate/Diploma/Degree/Honours or Research Degree

Qualification Title	Credits Earned	Semester	Year
PG Diploma in Zoology	44	2	1
Master of Science Degree In Zoology	88	4	2

3. Credit Specifications :

a. Theory Courses: One hour/credit/week (a minimum of 15 hours of teaching per credit is required in a semester.

b. Laboratory/Performance Based Courses: A minimum of 30 hours in laboratory or Performance Based activities is required in a semester. Performance based activities include Workshop based activities, internship, Apprenticeship, Field based learning, community engagement learning, etc.

c. Each semester will consist of at least 15 weeks of Academic Work equivalent to 90 actual teaching days.

4. Assessment

Assessment Plan will consist of Continuous Internal Evaluation (CIE) and End Semester Evaluation (ESE) for each course/subject taken together.

(A) Continuous Internal Evaluation (CIE) will be based on prescribed syllabus

(a) Attendance of the student during a particular semester

(b) An assignment (min. two) based on curriculum to be assessed by the teacher concerned

(c) Subject wise class test (min. two) or activities conducted by the teacher concerned with proper rubrics.

(B) Expected classroom activities shall consist of Group Discussion, Seminars, Power Point Presentations, Elocution, Debate, Role Play, Case Studies, Educational Games etc. The teacher is expected to undertake a minimum of four of the aforesaid activity.

(C) The CIE marks will be communicated to the examination cell at the end of each semester, but before the semester end examinations / as instructed by the Examination Cell. These marks will be considered for the declaration of the results.

(D) The record of internal marks, evaluation & results should be maintained for a min. period of three years by the respective department for verification by the competent authority.

5. Standard of Passing

The scope of the course, percentage of passing in Theory and Project and Internal Assessment will be governed as per following rules:

(i) In order to pass the Master of Science (M.Sc.) 1st, 2nd, 3rd, and 4th Semester Examinations, an examinee shall obtain not less than 40% (Grade 4) marks in each theory course/paper, taking CIE & SEE together. Whereas, for practical/performance-based examination an examinee shall obtain not less than 50% marks in each practical, taking CIE & SEE together.

(ii) An examinee who is unsuccessful at the examination shall be eligible for admission to the subsequent examinations on payment of a fee prescribed for the examination together with the conditions of the ordinance in force from time to time.

6. General Guidelines

a. With effect from Academic Year 2023-24, Two years Master's Degree Program will be

revamped as per the Illustrative Credit Distribution given in the above Table.

b. Under the One-year PG Diploma program, and two-year master's Degree program, the students must complete on-the-job training/internship of 04 credits during summer break, after completion of the second semester of the first year in the respective Major Subject.

c. The 04 Credits Research Methodology Component is mandatory in the First Year.

d. Electives selected in the PG program may be Relevant to OR Supportive of the Major Subject chosen.

e. The students will have to undertake a research project of 04 credits in Semester III and a research project of 06 credits in Semester IV in the second year of the two-year master's degree program. This is also applicable to the students admitted to one year PG program after completion of four years UG Program.

f. The exit option at the end of one year of the Master's degree program will commence from AY 2024-25. Students who have joined a two-year Master's degree program may opt for exit at the end of the first year and earn a PG Diploma.

g. The PG Diploma may be awarded to a student provided they have earned the requisite credits in one year including on-the-job training of 04 credits during summer break, after completion of the second semester of the first year in the respective Major Subject.

h. Successful examinees at the M.Sc. Sem I, II, III and IV Examinations shall be entitled to receive a grade card signed by the Controller of Examination and Evaluation of Gondwana University Gadchiroli and successful examinees opting for the exit at the end M.Sc. Sem II and IV Examinations shall, on payment of prescribed fees, receive a Degree certificate in the prescribed format from Gondwana University.

M.SC. SEMESTER III & IV

Model Question Paper

Zoology Core Course/Elective Course

Time: 3 Hrs Maximum Marks: 80

Instructions to Candidates:

1. All sections/parts are compulsory.
2. Draw neat labeled diagrams wherever necessary.
3. There will be five descriptive questions, each carrying16 marks.

Qu. I. Long Question from Unit1 (16x1=16)

OR

A)Short Question from Unit1 (8x2=16)

B)Short Question from Unit1

Qu.2. Long Question from Unit II (16x1=16)

OR

A)Short Question from Unit II (8x2=16)

B)Short Question from Unit II

Qu.3. Long Question from Unit III (16x1=16)

OR

A)Short Question from Unit III (8x2=16)

B)Short Question from Unit III

Qu.4.Long Question from Unit IV (16x1=16)

OR

A)Short Question from Unit IV (8x2=16)

B)Short Question from Unit IV

Qu. 5. Attempt to the following (4x4=16)

1. Unit I
2. Unit II
3. Unit III
4. Unit IV

M.SC. SEMESTER III

Model Question Paper

Zoology Elective Course

Time: 2 Hrs Maximum Marks: 40

Instructions to Candidates:

4. All sections/parts are compulsory.
5. Draw neat labeled diagrams wherever necessary.
6. There will be five descriptive questions, each carrying16 marks.

Qu. I. Long Question from Unit1 (8x1=8)

OR

A)Short Question from Unit1 (4x2=8)

B)Short Question from Unit1

Qu.2. Long Question from Unit II (8x1=8)

OR

A)Short Question from Unit II (4x2=8)

B)Short Question from Unit II

Qu.3. Long Question from Unit III (8x1=8)

OR

A)Short Question from Unit III (4x2=8)

B)Short Question from Unit III

Qu.4.Long Question from Unit IV (8x1=8)

OR

A)Short Question from Unit IV (4x2=8)

B)Short Question from Unit IV

Qu. 5. Attempt to the following (2x4=8)

3. Unit I
4. Unit II
5. Unit III
6. Unit IV

2. Practical Examination Assessment (2 Credits Each)

a. Practical I based on CC1, CC2 and CC3 of 50 marks- (20 Marks for Practical CA+30 marks for Practical UA)

b. Research Project (50 Marks of CA + 50 Marks of UA)

Total Credits:

Cumulative Credits required for PG in Major Subject (One Year PG Degree) = 44 Credits

Cumulative Credits required for PG in Major Subject (Two Year PG Degree) = 88 Credits

Teaching and Examination Schemes:

Teaching and Examination Schemes Two Year M.Sc. (of four semesters) programme is as follows.

Gondwana University, Gadchiroli
NEP 2020 P.G. PROGRAMME SESSION 2024-25
Faculty of Science and Technology
Program Name - M.Sc. Sem-III (Zoology)

Sr. No.	Course Category	Name of the course (Title of the Paper)	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
							Theory					Practical				
				Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	DSC	**Paper 1:-** Parasitology and Immunology (03MSCZO01)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
2		**Paper 2:-** Animal Physiology (03MSCZO02)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
3		**Paper 3:-** Ecology and Environmental Biology (03MSCZO03)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
4		Practical (C_1+C_2+C_3)	02	-	04	04	-	-	-	-	-	30	20	50	25	50
5	Major (Elective)	(Any one from elective basket) **Paper 1:-** Fish and Fisheries- I **Paper 2:-** Mammalian Reproductive Physiology- I **Paper 3:-** Fresh Water Zoology-I **Paper 4:-** Industrial Entomology-I **Paper 5:-** Applied Fresh Water Fisheries-I (03MSCZO04)	02	02	--	02	40	10	50	20	02	--	--	50	25	50
6		Practical for respective elective paper	02	-	04	04	-	-	-	-	-	30	20	50	25	50
7		Research Project	04	--	08	08	--	--	--	--	--	60	40	100	50	100
Total			22	14	16	26	280	70	350	-	-	120	80	250	125	550

Gondwana University, Gadchiroli

NEP 2020 P.G. PROGRAMME SESSION 2024-25

Faculty of Science and Technology

Programme Name - M.Sc. Sem IV (Zoology)

Sr. No.	Course Category	Subject name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
							Theory					Practical				
				Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	DSC	**Paper 1:-** Evolution and Genetics (04 ZOO001)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
2		**Paper 2:-** Developmental Biology (04 ZOO002)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
3		Pract-I Evolution and Genetics	02	-	04	04	-	-	-	-	-	30	20	50	25	50
4		Prac-II Developmental Biology	02	-	04	04	-	-	-	-	-	30	20	50	25	50
5	DSE Elective (Any one)	Any one from Elective basket **Paper 1:-** Fish and Fisheries-II **Paper 2:-** Mammalian Reproductive Physiology- II **Paper 3:-** Fresh Water Zoology-II **Paper 4:-** Industrial Entomology-II **Paper 5:-** Applied Fresh Water Fisheries-II (04ZOO003)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
7		Research Project	06	--	12	12	--	--	--	--	--	90	60	150	75	150
Total			22	12	20	32	240	60	300	-	-	150	100	250	125	550

M.Sc. Part II Semester – III Zoology

Paper-I, Parasitology and Immunology (03MSCZ001)

NEP-2020 **(Core DSC)** **Credits-4** **Marks–80**

Unit-I

(15Hrs)

1.1 *Vibrio cholera* and *Clostridium titani*- Life cycle, mode of transmission, infection, and treatment

1.2 Yersinia pestis- Life cycle, mode of transmission, infection and treatment

1.3 Influenza and H1 N1 viruses- Life cycle, mode of transmission, infection and treatment.

1.4 Dengue and Hepatitis- Life cycle, mode of transmission, infection and treatment

Unit-II

(15 Hrs)

2.1*Trypanosoma cruzi* and *Entomoeba histolytica*- Life cycle, mode of transmission, infection, and treatment

2.2 *Leishmania donavani* and *Plasmodium vivax*- Life cycle, mode of transmission, infection, and treatment

2.3 *Wuchereria bancrofti* and *Trichinella spiralis*- Life cycle, mode of transmission, infection, and treatment

2.4 Toxins and antitoxins

Unit-III

(15 Hrs)

3.1 Structure and functions of primary and secondary lymphoid organs.

3.2 Immune system- innate and adaptive immunity; Antigens and antibodies and its interaction

3.3. Cells and organs of immune system; T cells and B cells - maturation, activation and differentiation, T cell receptors

3.4 Major Histocompatibility Complex (MHC)- General organization and inheritance of the MHC, MHC molecules and genes

Unit-IV **(15Hrs)**

4.1 Cytokine receptors- properties of cytokines, cytokine receptors, cytokine secretion by TH1 and TH2 subsets; Cell mediated cytotoxic responses- effector mechanisms, leukocyte activation and migration.

4.2 Hypersensitivity reactions- types, mechanisms of type I to IV hypersensitivity reactions; Autoimmunity- Organ specific autoimmune disease and treatment.

4.3 Transplantation immunology- blood antigens, transplantation rejection, graft rejection, familial grafting, tissue typing, cross matching, immunosuppression.

4.4 Tumor immunology- Types and roles of tumor antigens, immune response to tumor; Immuno techniques- RIA and ELISA

Books Recommended

Parasitology

1. Brock Biology of Microorganisms (Ed. IX) M. T. Madigan J. M. Martinko and J.Parker. Prentice Hall International Publication.

2. The Nematode Parasite in Vertebrate, W. Youle and Maplestone.

3. General Parasitology, V. A. Dogiel.

4. Helminthology, E. C. Fausy.

5. Platyhelminthes and Parasitisium, D.R.Birt.

6. Animal Parasite- O.W. Aisen

7. Parasitic Protozoa, J.P. Kreier and J.R. Baker. Allen and Unwin Press.

8. Medical and Veterinary Protozoalogy M. G. Kathering , A. James paul and V. Zaman. Churchill Livingstone.

Immunology

1. Immunology – R. C. Kuby 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

5. Immunology - Abbas

M.Sc. Part II Semester – III Zoology

Paper-II, Animal Physiology (03MSCZ002)

NEP-2020 (Core DSC) Credits-4 Marks –80

Unit-I (15Hrs)

1.1 **Nutrition and Digestion:** Salivary glands, stomach and Intestine (Histology, mechanism of secretion, composition and functions), Neural and endocrine regulation of gastro-intestinal movements

1.2 Pancreas, Liver (Histology, mechanism of secretion, composition and functions) Gastro-intestinal hormones: role in digestion.

1.3 **Excretion:** Nephron; Mechanism of urine formation; counter current mechanism, Normal and abnormal constituents of Urine, Dietary influence on nitrogen excretion.

1.4 Regulation of urine formation: role of rennin-angiotensin, ADH, aldosterone. Regulation of water, electrolytes and acid base, renal clearance, Physiology of nitrogen excretion.

Unit-II (15Hrs)

2.1 Respiration: Respiratory system, Mechanism and regulation of breathing; Respiratory capacities and volumes. Neural control of respiration.

2.2 Transport of oxygen and carbon dioxide; Respiratory quotient. Factors affecting oxygen dissociation, Respiratory disorders

2.3 Circulation: Internal structure of Heart, Major types of body fluids, blood composition, Haemopoiesis, homeostasis, Angiography and Angioplasty.

2.4 Blood coagulating factors, Cascade of biochemical reactions involved in coagulation of blood, blood groups and blood transfusion, blood pressure and factors affecting blood pressure

Unit-III **(15Hrs)**

3.1 Nervous System: Organization, neuron and glial cells- types and structure; Synapses – types and transmission, initiation and conduction of nerve impulse.

3.2 Vision: Structure of eye, retinal components, and photoreceptors, Hearing: Structure of ear, mechanoreceptor, ionic basis of potential generation.

3.3 **Muscles:** Types, Ultra structure of skeletal, smooth and cardiac muscles, chemical composition of muscle; Neuromuscular junction.

3.4 Molecular and chemical basis of muscle contraction; theories of muscle contraction Characteristics of muscle twitch, tetanus and fatigue, isotonic and isometric contractions.

Unit-IV **(15Hrs)**

4.1 Lymph – composition, formation and functions, causes and control of blood sugar and lipids

4.2 Animal calorimetry, Basal metabolism, Caloric requirement.

4.3 Inborn errors of metabolism, Organelle malfunction, metabolic disorders.

4.4 Physiology of Ageing: Ageing at cellular and molecular level, Immunological surveillance and ageing, theories of ageing

Books Recommended

1. Text Book of Physiology & Biochemistry: Bell, G.E. & Davidson, J.N. &Emslie D.Smith, 1922.
2. Medical Physiology: AWiley Medical Publication, John Wiley & Sons, New York.
3. Mineral Metabolism: Comar, C.L. & Felix Bronner (1961) Acad Press, New York &London.
4. A Text Book of General Physiology: Dayson (1964): Little Brown & Co. Boston.10
5. Animal Physiology: R. Eckert &D.Randall(1983)2ndEdn.,W.H.Rexeman&Co.
6. Biochemistry & Physiology of the Cell: (2nd Edn.), M.A. Edwards & K.A. Hassall (1980) Mc. Graw Hill Co.
7. The Physiology of Cells: Cuthe F. (1968): The Macmillan Co.
8. Text book of MedicalPhysiology: Guyton,A.G.(1968).7thEdn.SaundersPub.
9. Samson Wrights Applied Physiology: OxfordUniversityPress.
10. ComparativeAnimal PhysiologyC.L.Prosser,W.B.Saunders&Company.
11. Animal Physiology: Mechanism & Application, R. Eckert,W.H.Freeman&Company.
12. General & Comparative Animal Physiology: W.S. Hoar.
13. MedicalPhysiology:W.F.Ganong(1981):10thEdn.LangeMedicalPublications.
14. Principles of Anatomy and Physiology: Tortora Grabowski, 9th Edn. John Willey &Sons.
15. Reproductive Physiology of Vertebrates: Van Tienhoven, A. (1983): 2nd Edn. CornellUniv.Press, New York.

M.Sc. Part II Semester –III Zoology

Paper-III, Ecology and Environmental Biology (03MSCZ003)

NEP-2020 (Core DSC) Credits-4 Marks –80

Unit-I (15Hrs)

1.1 Basic concepts of ecology, climatic and topographic factors(light, Temperature, rainfall and atmosphere)

1.2 Edaphic factors: formation of soil, Soil profile, classification and components of soil.

1.3 Biotic components: structure of biotic community, stratification and periodicity, ecotone and edge effect, Nature and Classification of Community, Ecological succession.

1.4 Biogeography: Patterns of distribution, chief vegetational belts of Earth, Descriptive Zoogeography, Dynamic biogeography.

Unit-II (15Hrs)

2.1 Plankton: classification, collection, preservation and importance of plankton (phytoplankton and zooplankton).

2.2 Nekton: types, collection, preservation and importance of nekton.

2.3 Benthos and periphyton: Classification, methods of collection, preservation and importance.

2.4 Productivity: concept, Primary and secondary productivity, measurement of productivity by light and dark bottle method, factors affecting primary and secondary productivity.

Unit-III (15Hrs)

3.1 Environmental pollution: Air pollutants, their sources and harmful effects. Acid rain, greenhouse effect, photochemical smog aerosols.

3.2 Water pollution: sources and effects of water pollution, water quality management, water quality indices, sewage treatment.

3.3 Land pollution: sources and types of land pollutants, Biomedical waste, Ecotoxicology.

3.4 Bioremediation: merits and scope of bioremediation, phytoremediation, ecotechnology and of bioremediation.

Unit –IV (15Hrs)

4.1 Intraspecific interaction: types of association, colonization, aggregation, social organization and behaviour.

4.2 Intersepecific relationship: mutualism, commensalism, parasitism, synergism, antagonism and competition. Prey and predator relationship

4.3 Animal adaptation: Echolocation, osmoregulation, thermoregulation, Batesion and Mullerian mimicry and significance.

4.4 Biometeorology: scope and factors, Water and soil as essential factors for the meteorological studies.

Books Recommended

1. The Science of Ecology: Brewer, A. (1998), Sanders Pub. New York.
2. The Science of Ecology: Ehrlich, P. R. &Roughsrden, J. (1987) McMillan Pub. Co. New York.
3. Population Biology: Emlein, J. M. (1984). McMillan Pub. London.
4. Current Ecology: Pattern & Progress: Killawa, J. & Anderson, G.J. (1986), Blackwell Science Publication, Oxford.
5. Basic Ecology: Odum, E. P. (1983), Sanders Pub. New York.
6. Systems of Ecology: Odum, H. T. (1983), John Wiley & Sons, New York.
7. Ecology with Special Reference to Animals and Man: Kendelgh, Prentice Hall Co.
8. National Resources & Conservation: Owen, O. S. (1985) McMillan Pub. New York.
9. Elements of Ecology: Smith, R. L. (1986), Harper & Row Pub. New York.
10. Environmental Physiology: Sonim, N. B. (1974), C. V. Mosby Pub. St. Louis, USA.
11. Environmental Physiology: Philips, J. G. (1975), Blackwell Science Publication, Oxford.
12. Ecology: Ricklefts, R. E. (1973), Thomas Nelson & Sons Ltd.
13. Threatened Animals of India: Tikader, B. K. ZSI Calcultta.
14. Ecology & Field Biology: Smith, R. L. Harper &Rw Pub. New York.
15. Wildlife in India: Sharin, V. B. (1985), Natraj Pub. Dehradun.
16. Fresh Water in India: Kulkarni, K. H. (1957), ICAR, New Delhi.
17. Marine Fishes: Bal, D. V. & Rao, K.V. (1989), Tata McGraw Hill, New York.
18. Textbook of Marine Ecology: Balkrishnan, N. A. &Thumpy, D. N. (1980), McMillan Co.
19. Marine Ecology & Fishes: Cushly, B. H. (1980), Cambridge University Press.
20. Treatise on Limnology: Hutchinson, G.E., (1967), John Willy Pub. New York.
21. Methods of Soil Analysis: De, S. K. (1962), Narayan Pub. House, Allahabad.
22. Fish & Fishes of India: Jhingran, V. G. (1985)
23. Aquatic Pollution: Edward A. (2000) Laws. 3rd edition**. John Wiley** and **Sons**, NewYork.
24. A Manual of Fresh Water Ecology: Santhanam, R., Velayntan, P. &Jagathesan, G. (1989), Daya Pub. House, Delhi.
25. Limnology: Welch, P. S. (1957), McGrall& Hill Co. New York.
26. Air Pollution: Perkins, H.C., (1974) McGraw-Hill, New York.

Semester-III, Practical, of C1+C2+C3 (CREDIT - 2)

Paper I- C1 - Parasitology, and Immunology

1. Study of different types of parasitic protozoan's with the help of already available permanent slides/ ICT tools/ Models/ Charts/ Photographs etc.
2. Study of different types of parasitic helminthes with the help of already available specimens, permanent slides/ ICT tools/ models/ charts/ photographs etc.
3. Study of different types of insect vectors with the help of already available specimens, permanent slides/ ICT tools/ models/ charts/ photographs etc.
4. Preparation of tissue sections of thymus, spleen, and lymph nodes. (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)

5. Identification and study of T and B cells with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

Paper 2 -C2 - Animal Physiology

I. Physiology Experiments

1 Effect of pH, temperature, and incubation on human salivary amylase activity.

2 Determination of protein, glucose in Urine.

3 Total leukocyte count and differential leukocyte count.

4 Total erythrocyte count.

5 Quantitative Estimation of blood Glucose (Source of blood: Local recognized pathology laboratory)

6. Quantitative Estimation of blood proteins (Source of blood: Local recognized pathology laboratory)

II. Histological Study of Stomach, Liver, Small intestine, Large intestine, Pancreas, Kidney, Thyroid, Pituitary, Blood smear, Heart, T.S. Vein, T.S. Artery with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

Paper 3-C3 _ **Ecology and Environmental Biology**

1. Plankton study and analysis of zooplankton.
2. Identification of benthic and periphytonic organisms
3. Determination of primary productivity by light and dark bottle method.
4. Analysis of organic, inorganic contents and pH of the soil.
5. Identification of Plankton, Nekton, periphyton and benthos (Four each)

Distribution of Marks:		**Marks**
1.	Major Expt.	10
2.	Minor Expt.	5
3.	Identification and comment on spots (1-5)	5
4.	Practical Record	5
5.	Viva-voce	5
	Total marks	30

M.Sc. Part II Semester –III Zoology

Paper-IV, Fish and Fisheries -I (03MSCZ004)

NEP-2020 (Core DSE) Credits-2 Marks – 40

Unit-I (6 Hrs)

1.1 Origin and Evolution of fishes: Fossil record, classification, cyclostoms, ostracoderms, placoderms, Shark like fishes, Bony fishes

1.2 Development of jaws and limbs in fishes.

1.3 Classification and general characters of Placoderms: Acanthodii, Coccostei,

Pterychthyes, Stegoselachii, Palaeospondyli.

1.4 Affinities of Placoderms and fossil record.

Unit-II (6 Hrs)

2.1 Classification and general characters of Elasmobranch/Chondrichthyes: Sharks and Rays, Holocephali

2.2 Affinities of Elasmobranchs, specialized characters of Elasmobranchs.

2.3 Classification and general characters of Actinopterygii/Ray finned fishes:Palaeonisciformes,Polypteriformes, Acipenseriformes, Amiiformes, Teleostea (Osteoglossomorpha, Elopomorpha, Clupeomorpha, Euteleostei)

2.4 Affinities of Actinopterygiians.

Unit-III (6 Hrs)

3.1 Dipnoi: General characters, classification, origin, fossil Dipnoians and distribution of Dipnoians.

3.2 Specialized characters of Dipnoi, Blood vascular system of Protopterus and affinities of Dipnoians.

3.3 Respiratory system: Structure of gills in fishes, gill histology

3.4 Blood supply and mode of respiration and gaseous exchange in teleosts.

Unit-IV (6Hrs)

4.1 Accessary respiratory organs: Origin of air breathing organs; skin, buccopharynxopercular cavity, air bladder

4.2 Mechanism of air breathing, function of accessory respiratory organ.

4.3 Air bladder: Origin, Development, types of air bladder; physostomous, physoclists, structure of gas secreating complex

4.4 Blood supply to air bladder and functions of air bladder

Semester-III, Practical, DSE -Fish and Fisheries – I (Credits -2/ 4 Hrs / Week)

1.Identification of local fishes upto species.

2.Anatomical observations, demonstration and detailed explanation of fish in general, reproduction and urino genital system, Endocrine glands with the help of ICT tools/ models/ charts/ photographs etc.

3.Study of Accessary Respiratory organs in locally available fishes/with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

4.Identification of various stages of fry and fingerlings of major carps with the help of already available preserved material, permanent slides/ charts/ models / photographs/ ICT tools etc.

5.Permanent preparation of various scales using wastes from recognized fish markets.

6.Estimation of dissolve oxygen in water sample.

7.Estimation of CO2 in water sample.

8.Estimation of chloride sample in water.

9.Estimation of protein in blood of fish (Source of fish blood: Local recognized fish markets).

Distribution of Marks:		**Marks**
1	Major Experiment Any one	10
2	Minor Experiment Any one	05
3	Identification of spots (1-5)	05
4	Practical Record	03
5	Viva voce	02
	Total marks	30

Books Recommended

1. Fish Physiology Vol. 1 to 13: Hoar H.S. & Randall (Eds.) (1964-1994) Academic press London, New York.
2. The physiology of fishes Vol. 1&2: Brown M.E.(1957) Academic press, New York.
3. Natural history of fishes & systematic of fresh water fishes:PDattaMunshi, J.S. &Shrivastva, M.P.(1988): Narendra pub. House, Delhi.
4. Air breathing fishes of India- Their structure, function and life history: Dutta Munshi, J. S., Hunghes G.M. (1992) .Oxford and JBH publication Co. New Delhi.
5. The freshwater fishes of India, Pakistan, Bangladesh, Burma and Shri Lanka Handbook: Jayaram, K.C. (1981): Zoological Survey of India, Calcutta.
6. Fish migration: Jones, F.R. S. (1968), E.Arnold, London
7. Aquaculture, Bardach, Ryther and Mc Lamy
8. Marine fisheries: D. K. Dal, K. V. Rao
9. Ichthyology: Lagler, K. F., Bardach, J. and Miller, R.(1977) John Wileys and sons.
10. Fish Endocrinology: Matty, A. J. (1985), Chapman and Hall, London.
11. An aid to the identification of common commercial fishes of India and Pakistan: Mishra K. S. (1982).
12. Aquaculture: The farming and husbandry of freshwater and marine organism: Bardach J.E. (1974). Narendra Publication House, New Delhi.
13. Handbook of breeding of Indian Major Carps by pituitary hormone injection: Chonder

M.Sc. Part II Semester –III Zoology

Paper-IV, Mammalian Reproductive Physiology (MRP)-I (03MSCZ004)

NEP-2020 (Core DSE) Credits-2 Marks –40

Unit-I **(6 Hrs.)**

1.1 Development, descent and structure of the testis.
1.2 Spermatogenesis: Molecular changes, hormonal regulation, and spermiogenesis.
1.3 Sertoli cells: Structure, functions, blood testis barrier.
1.4 Leydig cells: Structure, functions and interaction with peritubular and Sertoli cells.

Unit-II **(6 Hrs.)**

2.1 Epididymis: Structure and function.
2.2 Structure of spermatozoa and anomalies.
2.3 Sperm capacitation: molecular and biochemical changes, decapacitation.
2.4 Vas deferens: Structure and function.

Unit-III **(6 Hrs.)**

3.1 Seminal Vesicle: Structure, function and regulation.
3.2 Prostate gland: Structure, function and prostatic cancer.
3.3 Cowpers gland: Structure, function and anomalies.
3.4 Penis: Structure and mechanism of erection.

Unit-IV **(6 Hrs.)**

4.1 Male reproductive behaviour: Mating system, neural and hormonal control.
4.2 Pheromones: types, structure and function.
4.3 Infertility: causes and remedy.
4.4 Andrologically relevant diseases in advanced age.

Semester-III, Practical, DSE-Mammalian Reproductive Physiology (MRP) I
(Credits -2/ 4 Hrs / Week)

1. Demonstration of surgical operation in rat/ mice Orchidectomy or Vasectomy or Epididymoctomy with the help of ICT tools
2. Anatomical observations, demonstration and detailed explanation of the male reproductive system of rat/ mice with the help of ICT tools/ models/ charts/ photographs etc.
3. Sperm count for the assessment of fertility (Source of semen: Government artificial insemination centre).
4. Study of spermatogenesis and identification of its various stages with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
5. Estimation of fructose/ sialic acid in reproductive tissue using animal wastes from recognized slaughter houses/ poultry farms etc.
6. Histology: Histological changes in male reproductive organs and sex accessories during active and inactive stage with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
7. Study of slides- (T.S. of Testies, Ovary, Epidedymis, Cowpers gland, Prostate gland, seminal Vescicle)
8. Study of following endocrine glands with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
   a. Pituitary gland: anatomy, cell types and identification of cell types

b. Thyroid gland: Histology of active and inactive glands, effects of antithyroid drugs
c. Adrenal: Normal histology and effects of metapyrone and corticosteroids administration

9. Field Work: Visit to Artificial insemination centre.

Distribution of Marks:		**Marks**
1	Major Experiment Any one	10
2	Minor Experiment Any one	05
3	Identification of spots (1-5)	05
4	Practical Record	03
5	Viva voce	02
	Total marks	30

Books Recommended

1. Biology of Gestation: Assalye, N.S. (1968). Academic Press, London.
2. Biology of ovarian follicles in mammals (1985). S. S. Guraya Springer-Verlag.
3. Comparative Endocrinology and Reproduction. Eds. K.P. Joy, A. Krishna and C. Haldar, Narosa Publishing House (1998).
4. Control of ovulation: Crighton, D.B., Haynes, N.B. Foxcroft, G.R. & G.E. Lamming (1978). Butterworths, London.
5. Hormonal Control of Lactation: Cowie, A.T. Forryth, I.A. and I. Hart (1980). Springer-Verlag, Berlin & New York.
6. Marshall's Physiology of Reproduction. 4th Edition Vol. 3 Pregnancy and Lactation Part I, II, III edited by G.E. Lamming, Champan and Hall.
7. Ovarian Cycle of Mammals: Perry, J.S. Oliver and Boyd, Edinburgh.
8. Patterns of Reproduction: Asdell, S.A. (1964). Constable and Co. London.
9. Physiology of Lactation: Smith, Vearch, Constable & Co., London.
10. Postgraduate Reproductive endocrinology. 4th Edition. 1997. R. RajanJaypee brothers. Medical Publishers (P) Ltd.
11. Practice of fertility control, Choudhary S. K. Churchill and Livingstone.
12. Progress in Reproductive Biology, Vol. 4. The pineal and reproduction: Reiter, R.J. Series Ed. P.O. Hubinant, Karger, Basel. Paris, London (latest edition).
13. Contraceptive Technology Past, Present and Future: Das. R.P. (1989). N.I.H.F.W. New Delhi.
14. Encylopedia of Reproduction Vol. I, II, III, IV eds. Ernst Knobil and J.D. Neill (1998).
15. Endocrinology and metabolism. 4th edition 2001. Philip Felig&Lowrence A. Frohmon McGraw Hill Inc. Medical Publishing Division.
16. Endocrinology. Vol. 1 to 3: L.J. Degroot et al. (1989). W.B. Saundors Co. Philadelphia.
17. General Endocrinolgoy: Turner, C.D. & J.T. Bagnara (1990) W.B. Saunders Co., & Toppan Co., Philadelphia, London & Tokyo.

18. Mammalian Oviduct: Hafez, E.S., and R.J. Blandu. The University of Chicago Press, Chicago, London.
19. Reproduction in Mammals Series: 1 to 6: Austin, C.R. and R. V. Short (1984 & 1994), Cambridge University Press, Cambridge.

M.Sc. Part II Semester –III Zoology

Paper-IV, Fresh water Zoology-I (03MSCZ004)

NEP-2020 (Core DSE) Credits-2 Marks – 40

Unit-I (6 hrs)

1.1 Dynamics of Aquatic Ecosystems (predators, consumers, decomposers, transformers, ecological pyramids & trophic levels), Energy flow models.
1.2 Lotic Habitat: Major river systems in India.
1.3 Lentic Habitat: Lakes and their origin
1.4 Bog lakes & succession of lakes, man-made lakes and reservoirs

Unit-II (6 hrs)

2.1 Physical conditions of water: Movement of water, Viscosity, Density.
2.2 Buoyancy, Surface film and surface film animal.
2.3 Temperature and Light, Transparency and turbidity.
2.4 Influence of physical conditions on pH of surface and bottom water.

Unit-III (6 hrs)

3.1 Chemical conditions of water: Dissolved oxygen & carbon dioxide
3.2 Phosphates, Nitrates & Silicates.
3.3 Hardness: Total Hardness, Mg - hardness & Ca – Hardness.
3.4 Nitrogen and Ammonia, Importance of Chemical Parameters.

Unit-IV (6 hrs)

4.1 Primary and secondary productivity in aquatic ecosystems.
4.2 Classification of waterbodies based on productivity.
4.3 Methods of measurement of productivity.
4.4 Factors affecting primary productivity and significance of productivity studies

Semester –III Practical, DSE- Fresh water Zoology I (Credits -2/ 4 Hrs / Week)

1. Measurement of transparency of water body by Secchi disk method.
2. Estimation of Dissolved Oxygen (DO) & free carbon dioxide from water.
3. Estimation of Alkalinity (Carbonates & Bicarbonates), Hardness (Total, Ca & Mg)
4. Biochemical oxygen demand (BOD) from given water sample.
5. Determination of primary productivity of a water body by light and dark bottle method.
6. Identification of commercially important freshwater fishes and prawns using fishes available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.
7. Morphometric study of fish available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.
8. Determination of length - weight relationship of fish available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.
9. Study of maturity stages of fish by using pictures.

10. Histological study of fish organs with the help of already available permanent slides/ ICT tools/ charts/ Models / Photographs etc.
11. Identification of common parasites of fish with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
12. Visit to a fresh water body for the study of aquatic ecosystem.

Distribution of Marks:		**Marks**
1	Major Experiment Any one	10
2	Minor Experiment Any one	05
3	Identification of spots (1-5)	05
4	Practical Record	03
5	Viva voce	02
	Total marks	30

Books Recommended

1. The Science of Ecology: Brewer, A. (1998), Sanders Pub. New York.

2. The Science of Ecology: Ehrlich, P. R. &Roughsrden, J. (1987) McMillan Pub. Co. New York.

3. Population Biology: Emlein, J. M. (1984). McMillan Pub. London.

4. Current Ecology: Pattern & Progress: Killawa, J. & Anderson, G.J. (1986), Blackwell Science Publication, Oxford.

5. Basic Ecology: Odum, E. P. (1983), Sanders Pub. New York.

6. Systems of Ecology: Odum, H. T. (1983), John Wiley & Sons, New York.

7. Ecology with Special Reference to Animals and Man: Kendelgh, Prentice Hall Co.

8. National Resources & Conservation: Owen, O. S. (1985) McMillan Pub. New York.

9. Elements of Ecology: Smith, R. L. (1986), Harper & Row Pub. New York.

10. Environmental Physiology: Sonim, N. B. (1974), C. V. Mosby Pub. St. Louis, USA.

11. Environmental Physiology: Philips, J. G. (1975), Blackwell Science Publication, Oxford.

12. Ecology: Ricklefts, R. E. (1973), Thomas Nelson & Sons Ltd.

13. Threatened Animals of India: Tikader, B. K. ZSI Calcultta.

14. Ecology & Field Biology: Smith, R. L. Harper &Rw Pub. New York.

15. Wildlife in India: Sharin, V. B. (1985), Natraj Pub. Dehradun.

16. Fresh Water in India: Kulkarni, K. H. (1957), ICAR, New Delhi.

17. Marine Fishes: Bal, D. V. & Rao, K.V. (1989), Tata McGraw Hill, New York.

18. Textbook of Marine Ecology: Balkrishnan, N. A. &Thumpy, D. N. (1980), McMillan Co.

19. Marine Ecology & Fishes: Cushly, B. H. (1980), Cambridge University Press.

20. Treatise on Limnology: Hutchinson, G.E., (1967), John Willy Pub. New York.

21. Methods of Soil Analysis: De, S. K. (1962), Narayan Pub. House, Allahabad.

22. Fish & Fishes of India: Jhingran, V. G. (1985)

23. Aquatic Pollution: Edward A. (2000) Laws. 3rd edition**. John Wiley** and **Sons**, NewYork.

24. A Manual of Fresh Water Ecology: Santhanam, R., Velayntan, P. &Jagathesan, G. (1989), Daya Pub. House, Delhi.

25. Limnology: Welch, P. S. (1957), McGrall& Hill Co. New York.

26. Air Pollution: Perkins, H.C**.,** (1974) McGraw-Hill, New York.

M.Sc. Part II Semester –III Zoology

Paper-IV, Applied and Industrial Entomology-I (03MSCZ004)

NEP-2020 (Core DSC) Credits-2 Marks – 40

Unit 1- Mulberry sericulture (6 hrs.)

1.1 Mulberry sericulture:- life history and rearing.

1.2 Silk gland of mulberry silkworm:- structure and silk synthesis.

1.3 Cocoon formation, cocoon harvesting and reeling.

1.4 Mulberry plantation and silkworm rearing house.

Unit 2- Tasar sericulture (6 hrs.)

2.1 Tasar silkworm biology and life cycle.

2.2 Mature tasar larvae, silk gland and silk proteins.

2.3 Hammock and cocoon formation, cocoon harvesting.

2.4 Natural host plants and predators of tasar silkworm.

Unit 3- Eri, lac culture and medical entomology (6 hrs.)

3.1 Eri silkworm biology and life cycle.

3.2 Lac insect- biology, lac cultivation and economic importance.

3.3 Forensic entomology- basic concepts and importance.

3.4 Insect causes diseases in man- (Malaria, Filarial, Kala- Azar).

Unit 4- Apiculture (6 hrs.)

4.1 Types of honey bees, *Apisdorsata, A. indica* and *A. melifera.*

4.2 Colony formation and Apiary products.

4.3 Beekeeping techniques: moveable frame hive and bee rearing management.

4.4 Economic importance of honey, wax and other apiary products

Semester –III Practical, DSE- Applied and Industrial Entomology-I (Credits -2/ 4 Hrs / Week)

1. Study of external morphology of the egg, larva, pupa and adult of different silkworm types, sexual dimorphism in larva, pupa and adults with the help of already available specimens, permanent slides/ ICT tools/ charts/ models / photographs etc.
2. Study of life history of different silkworm types with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.
3. Anatomical observations, demonstration and detailed explanation of the digestive system, silk gland, nervous system, circulatory system and mouth parts of larva; Reproductive system of larva and adults with the help of ICT tools/ models/ charts/ photographs etc.
4. Identification of the locally available varieties of mulberry.

5. Study of the locally available non-mulberry host plants.

6. Study of the anatomy of leaf, stem, root and petiole of different locally available varieties of mulberry.

7. Propagation of mulberry through cutting, grafting and layering.

8. Analysis of organic, inorganic contents and pH of the soil.

9. Identification and Study of economic importance of the local pests of mulberry silkworm with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.
10. Identification and Study of economic importance of the locally found pests and diseases of mulberry with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

11. Identification of diseases of mulberry silkworm with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc.

Distribution of Marks:		**Marks**
1	Major Experiment Any one	10
2	Minor Experiment Any one	05
3	Identification of spots (1-5)	05
4	Practical Record	03
5	Viva voce	02
	Total marks	30

Books Recommended

1. General text book of Entomology, Eds. O. W. Richards and R. G. Davis Chapman and Hall, London.

2. General and Applied Entomology, K.K. Nayar, T. N. Ananthkrishan and B.V. Davis Tata McGraw -Hill Co.Ltd. Bombay.

3. The Insect: Structure and function, R.F. Chapman, Cambridge University Press.

4. The Physiology of Insect , Ed. M.Rockstein ,Vol, 1-5, Academic Press, New York.

5. The Physiology of Insect Reproduction, F, Englemann, Pergamon Press, New York.

6. Comprehensive Insect Physiology, Biochemistry and Pharmocology , Eds. G.A. 85 Kerkut and I. A. Gillberd, VOL. 1-13, Pergamon Press, New York.

7. Analytical Biochemistry of Insect, Ed. R. B. Turner, Elsevier, Amsterdam.

8. Insect Hormone, M. J. A. Novak. Chapman and Hall, London.

9. Modern Entomology(Second edition): D. B. Tembhare, Himalaya Publication House, Bombay.

10. Destruction and Useful Insect, Their Hanits and Control, C. L. Metcalf, W. P. Flint and R. I. Metcalf, Mc Grow I Ill Co. New York.
11. Integrated Pest Management, J.L. Apple and R. E. Smith, Plenum Publication Co., New Delhi.

12. An Introduction Of Biological Control RVD Boarscho, P. S. Y. Messenger and A. P. Gaiter, Plenum Publication Co.

13. Text Book of Entomology, K. P. Shivastava, Vol. 1 And 2 Kalyani Publication, Ludhiana.

14. Agriculture Entomology, H. S. Dennis, Timber Press Inc.

15. Entomology and Pest Management, Larry P. Pedigo, Prentice Hall.

16. Text Book of Agriculture Entomology, Alford V. David, Blackwell Science.

17. Biopesticides In Insect Pest Management, S. J. Ignacimulha and AlokSen , Phoenix Publishing House Pvt, Ltd.

18. Biotechnology in Invertebrate Pathology and Cell culture (Maramorosch, K. ed.). Academic Press, New York.

19. PEBFANS (2003)" (Solomon Raju, A. J. ed.). Andhara University Press, Visakhapatnam.

20. Living Resources for the Millennium 2000 (S. J. William ed.), Students Offset Press, Chennai.

M.Sc. Part II Semester –III Zoology

Paper-III, Applied Fresh Water Fisheries-I (03MSCZ004)

NEP-2020 (Core DSE) Credits-2 Marks – 40

Unit – I (6 Hrs.)

1.1 Scope and importance of fresh water fisheries, culturable fishes, fishery resources
1.2 Predators and their eradication.
1.3 Aquatic weeds and their control.
1.4 Fishing gears and crafts

Unit – II (6 Hrs.)

2.1 Pearl culture
2.2 Frog culture.
2.3 Sewage fed fisheries.
2.4 Prawn culture.

Unit – III (6 Hrs.)

3.1 Role of co-operative societies in fish marketing.
3.2 Introduction to fisheries economics
3.3 Economics of fish seed & fish production.
3.4 Fisheries extension services.

Unit- IV (6 Hrs.)

4.1 Fresh water pearl culture.
4.2 Cage and Pen culture.
4.3 Setting up of aquarium and its maintenance.
4.4 General outline of fish diseases

Semester –III Practical, DSE- Applied Fresh Water Fisheries-I (Credits-2 /4 hrs -Week)

1. Anatomical observations, demonstration and detailed explanation of the digestive system of fish with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc
2. Anatomical observations, demonstration and detailed explanation of the digestive system of prawn with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc
3. Anatomical observations of mantle and shell of fresh water oyster with the help of already available specimens, permanent slides/ ICT tools/ charts/ models/ photographs etc
4. Identification of local fishes upto species.
5. Identification of Aquatic weeds upto species.
6. Identification of ecto-parasites of fishes
7. Study of locally available Fishing Gears and Crafts.
8. Study of Aquarium Fishes with the help of already available preserved material, permanent slides/ charts/ models / photographs/ ICT tools etc.
9. Identification of various stages of fry and fingerlings of major carps with the help of already available preserved material, permanent slides/ charts/ models / photographs/ ICT tools etc.
10. Permanent preparation of various scales using wastes from recognized fish markets..
11. Estimation of dissolve oxygen in water sample.
12. Estimation of CO_2 in water sample.
13. Visit to fisheries co-operative society of your area

Distribution of Marks:		**Marks**
1	Major Experiment Any one	10
2	Minor Experiment Any one	05
3	Identification of spots (1-5)	05
4	Practical Record	03
5	Viva voce	02
	Total marks	30

Books Recommended

1. Fish Physiology Vol. 1 to 13: Hoar H.S. & Randall (Eds.) (1964-1994) Academic press London, New York.

2. The physiology of fishes Vol. 1&2: Brown M.E.(1957) Academic press, New York.

3. Natural history of fishes & systematic of fresh water fishes:PDattaMunshi, J.S. &Shrivastva, M.P.(1988): Narendra pub. House, Delhi.

4. Air breathing fishes of India- Their structure, function and life history: Dutta Munshi, J. S., Hunghes G.M. (1992) .Oxford and JBH publication Co. New Delhi.

5. The freshwater fishes of India, Pakistan, Bangladesh, Burma and Shri Lanka Handbook: Jayaram, K.C. (1981): Zoological Survey of India, Calcutta.

6. Fish migration: Jones, F.R. S. (1968), E.Arnold, London

7. Aquaculture, Bardach, Ryther and Mc Lamy

8. Marine fisheries: D. K. Dal, K. V. Rao

9. Ichthyology: Lagler, K. F., Bardach, J. and Miller, R.(1977) John Wileys and sons.

10. Fish Endocrinology: Matty, A. J. (1985), Chapman and Hall, London.

11. An aid to the identification of common commercial fishes of India and Pakistan: Mishra K. S. (1982).

12. Aquaculture: The farming and husbandry of freshwater and marine organism: Bardach, J.E. (1974). Narendra Publication House, New Delhi.

13. Handbook of breeding of Indian Major Carps by pituitary hormone injection: Chonder,

S. L. (1970). Satish book enterprises, Agra.

14. Diseases of fish: Duijin, C:VanInr. (1973), life books London.

15. Fish and fisheries of India: Jhingran , V. G. (1985). Hindustan Publication Company, New Delhi.

16. Prawns and prawn fisheries of India: Kurian, C.V. and Sebastian, V. O. (19876) Hindustan Publication Company, New Delhi

Project work for Semester III (Credits 4)

C) Project/Dissertation – Students have to prepare and submit the work based on following criteria

1. Selection of topic for Sem IV Project
2. Abstract
3. Introduction/Statement Finding
4. Literature review
5. Plan of work/Methodology
6. Conclusion including scope and limitation of study
7. References/Bibliography

The project/dissertation will be of 100 marks which consist of 80 marks for synopsis work and 20 for presentation. Students have to prepare a project file as a synopsis and submit to the head of the department.

M.Sc. Part II Semester–IV Zoology
Session 2024-25

M.Sc. Part II Semester–IV Zoology

Paper-I, Evolution and Genetics (04MSCZ001)

NEP-2020 (Core DSC) Credits-4 Marks-80

Unit-I (15 Hrs.)

1.1 Origin of life: Special creation theory, abiogenesis, spontaneous generation, panspermia, theory of chemical evolution, Oparin's hypothesis, Urey-Miller's experiment

1.2 Process of origin of life : structure of cosmos, primitive earth, prebiotic synthesis, evolution of progenote— origin and evolution of RNA world, origin and evolution of ribonucleoprotein (RNP) world, origin of plasma membrane, DNA world, origin of progenote, retrograde evolution, evolution of eukaryotes

1.3 Direct evidences of evolution: Fossils: formation, nature, types and significance. Geological time scale

1.4 Indirect evidences of evolution: comparative anatomy, connecting link, homology, analogy, vestigial organs, comparative embryology.

Unit-II (15 Hrs.)

2.1 Theories of organic evolution: Lamarckism, Darwinism, Modern Synthetic Theory, Germplasm

Theory and Mutation Theory

2.2 Adaptive radiation, microevolution, macroevolution, Megaevolution, Punctuated equilibria

and related phenomena

2.3 Isolation: types of isolating mechanism (prezygotic, postzygotic)

2.4 Phyletic evolution, Speciation (Instantaneous, Quantom, Allopatric, Sympatric), Barriers

Unit-III (15 Hrs.)

3.1 Genes and Genomes: DNA supercoiling, types of DNA topoisomerases, chromatin composition, histone non histone proteins, Nucleosome

3.2 Chromosome: structure, Karyotyping, structural characteristics of viral, bacterial and eukaryotic chromosome

3.3 Linkage and Crossing Over. Polygenes, Sex-Linked Inheritance, Quantitative Inheritance,

3.4 Gene expression: Fine Structure of a Gene, Gene Expression, Regulation of Gene Expression, Genetic Basis of Differentiation and Development, Immunogenetics, Genetics of Cancer,

Unit-IV (15 Hrs.)

4.1 Protein Structure and Engineering, Purification of Proteins, Characterization of Proteins, Protein-Based Products, Designing Proteins, Proteomics

4.2. Recombinant DNA technology, Tools of Recombinant DNA Technology, DNA Library, DNA Sequencing

4.3 Genomics: Genome mapping, Human genome project, gene prediction and counting.

4.4 Eugenics, euphenics, Transposable genetic elements, genetic counseling, application of genetic engineering.

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Books Recommended

1. Genetics Vol. I and II by Pawar C. B., Himalaya publication.
2. Gene VI by Benjamin Lewis, Oxford press.

3. Gene VIII by Benjamin Lewis, Oxford press.
4. Molecular biology of Gene by Watson J. D. et. al., Benjamin publication.
5. Human Genetics: Problems and Approaches - T Vogel F. and. Motulsky A. GT, Springer Verlag
6. Human Molecular Genetics . - Strachan T & Read A, Garland Science
7. An Introduction to Human Molecular Genetics - Mechanism of Inherited Diseases Pasternak J Fitzgerald, Science Press
8. Human Genetics - Cummings, M.R, Cehage Learning, USA.
9. Principles and branches of Medical Genetics, Emery and Rimoih, Churchill Livingstone, Newyork, Vol-1-3.
10. Human Cytogenetics-Constitutional analysis (Ed) D.E. Rooney, Oxford University Press.
11. Recombinant DNA - J.D. Watson Gillman, Scientific American books, W.H, freeman company N.Y. 8. Human Genetics - The molecular revolution McConkey, Edwin H, Jones & Bartlett publishers.

M.Sc. Part II Semester–IV Zoology

Paper-II, Developmental Biology (04MSCZ002)

NEP-2020 (Core DSC) **Credits-4** **Marks-80**

Unit I **(15Hrs.)**

1. Implantation in mammals.
2. Foetal membranes- types, structure and functions.
3. Placenta- types, structure, functions. Hormones of placenta and their functions.
4. Metamorphosis in amphibian: morphogenetic and biochemical mechanism, hormonal control.

Unit II **(15Hrs.)**

1. Regeneration in vertebrates: tail, limb, lens and retina.
2. Apoptosis- mechanism and significance.
3. Ageing – mechanism, concepts and models.
4. Polymorphism (caste differentiation) in insects (Termites, honey bees and ants)

Unit III **(15Hrs.)**

1. Multiple ovulation and embryo transfer technology (MOET).
2. Application of embryonic stem cells, clinical and economic significance.
3. Embryonic sexing, cloning, screening for genetic disorders diagnosis (ICSI, GIFT etc.)
4. Cloning of animals by nuclear transfer.

Unit IV **(15Hrs.)**

1. Immuno contraception- fertilization, inhibition and pregnancy termination.

2. Classical contraceptive techniques; physical, chemical, surgical and IUCD devices.
3. Anti-androgen and anti- spermiogenic compounds (LDH-CY and SP-10)
4. Role of mutants and transgenics in human welfare.

Books Recommended

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. Principles of animal developmental biology: S. C. Goel, Himalaya Publishing House.
4. Developmental Biology, S.F. Gilbert. 4th Edn. Sinauer Associates Inc. Publishers.
5. An Introduction to Developmental Biology: D. A. Ede.
6. Principles of developmental: Paul Weiss edited by Hafner publishing company New York.
7. Cells into organs. 2nd Edition. The forces that shape the Embryo. John Philip Trinkaus ed. Tom Aloisi.
8. Principles of development: Lewis Wolpert et al. 1998. Oxford University Press.
9. Foundations of Embryology. B. M. Patten & B. M. Carlson. Tata McGraw Hill Publishing Company Ltd., New Delhi.
10. An Introduction to Embryology: Balinsky (1981) 5th Ed. (CBS College Publishing).

11. Embryonic and foetal development. Cambridge University Press by Austin and Short, 1982, 1994 2nd Ed.
12. Marshall's Physiology of Reproduction Longmont, Green and Co. London Vol. 1 &2. Lamming 1984, 2000.

Semester-IV, Practical-I, (CREDIT - 2)

C1 – Evolution and genetics

1. Study of parallel, convergent and divergent evolution with the help of already available permanent Material/slides/ ICT tools/ models/ charts/ photographs etc.
2. Study Quantom, Allopatric, Sympatric speciation with the help of already available permanent Material/slides/ ICT tools/ models/ charts/ photographs etc.
3. Study Adaptive radiation with the help of already available permanent Material/slides/ ICT tools/ models/ charts/ photographs etc
4. Types of fossils with the help of already available permanent Material/slides/ ICT tools/ models/ charts/ photographs etc
5. Study of various human genetic traits with the help of already available permanent Material/slides/ ICT tools/ models/ charts/ photographs etc
6. Study of pictures of human chromosomal abnormalities.
7. Determination of linkage and cross-over analysis (through two point test cross and three point test cross data).
8. Study on sex linked inheritance in Drosophila.
9. Study of models on DNA and RNA structures.
10. Demonstration of - i. Deletion or deficiency ii. Duplication iii. Inversion iv. Translocation with

the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc

Distribution of Marks:	Marks
1. Major Expt.	**10**
2. Minor Expt.	**5**
3. Identification and comment on spots(1-5)	**5**
4. Practical Record	**5**
5. Viva-voce	**5**

Total Marks	**30**

Semester-IV, Practical-II, (CREDIT - 2)

C2 – Developmental biology

1. Study of foetal membranes, with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
2. Study of different types of placenta with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
3. Study of Metamorphosis in Amphibia (stages of larvae) with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
4. Study of IUCD devices with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc
5. Field work: Visit to laboratory for embryo transfer and family planning clinics
6. Specimen study of Termites, Honey bee and Ants with caste differentiation with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.
7. Histological Study of Ovary, Uterus, Fallopian Tube, Placenta, umbilical cord with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

Distribution of Marks:	**Marks**
1. Major Expt.	10
2. Minor Expt.	5
3. Identification and comment on spots(1-5)	5
4. Practical Record	5
5. Viva-voce	5

Total marks	**30**

M.Sc. Part II Semester–IV Zoology
Paper-IV, Fish and Fisheries II (04MSCZ003)

NEP-2020 (Core DSE) Credits-4 Marks-80

Unit-I (15 hrs.)

1.1 Structure of alimentary canal in teleosts; feeding habits, histology of different parts

1.2 Modification of alimentary canal in relation to feeding habits, digestion and absorption of food.

1.3 Structure of kidney in teleosts: Head kidney and trunk kidney, histology, blood supply

1.4 Osmoregulation in Freshwater forms, Marine forms, Rays and Skates, Diadromous fishes.

Unit-II (15 hrs.)

2.1 Chemoreceptors: Structure of olfactory system, morphology of peripheral olfactory organ, cellular composition of olfactory epithelium, olfactory bulb and central projections

2.2 Structure and functions of taste buds.

2.3 Migration in fishes: Types- Anadromous, Catadromous, Amphidromous, factors responsible for migration (Intrinsic and environmental), periodicity of migration.

2.4 Role of hormones in migration, Orientation and Navigation during migration.

Unit-III (15 hrs.)

3.1 Structure of male reproductive system

3.2 Mechanism of spermatogenesis and its hormonal control

3.3 Structure of female reproductive system

3.4 Oogenesis, egg development, hormonal control of oogenesis

Unit-IV (15 hrs.)

4.1 Structure, hormones and functions of pituitary gland in fishes

4.2 Structure, hormones and functions of other endocrine glands.

4.3 Stucture of Hypothalamo-hypophysial system in fishes.

4.4 Neurohormones and their functions.

Books Recommended

1. Fish Physiology Vol. 1 to 13: Hoar H.S. & Randall (Eds.) (1964-1994) Academic press London, New York.

2. The physiology of fishes Vol. 1&2: Brown M.E.(1957) Academic press, New York.

3. Natural history of fishes and systematic of fresh water fishes: P. Datta Munshi, J.S. &Shrivastva, M.P.(1988): Narendra pub. House, Delhi.

4. Air breathing fishes of India- Their structure, function and life history: Dutta Munshi, J. S., Hunghes G.M. (1992) .Oxford and JBH publication Co. New Delhi.

5. The freshwater fishes of India, Pakistan, Bangladesh, Burma and Shri Lanka Handbook: Jayaram, K.C. (1981): Zoological Survey of India, Calcutta.

6. Fish migration: Jones, F.R. S. (1968), E.Arnold, London

7. Aquaculture, Bardach, Ryther and Mc Lamy

8. Marine fisheries: D. K. Dal, K. V. Rao

9. Ichthyology: Lagler, K. F., Bardach, J. and Miller, R.(1977) John Wileys and sons.

10. Fish Endocrinology: Matty, A. J. (1985), Chapman and Hall, London.

11. An aid to the identification of common commercial fishes of India and Pakistan: Mishra K. S. (1982).

12. Aquaculture: The farming and husbandry of freshwater and marine organism: Bardach J.E. (1974). Narendra Publication House, New Delhi.

13. Handbook of breeding of Indian Major Carps by pituitary hormone injection: Chonder

M.Sc. Part II Semester–IV Zoology

Paper-IV, Mammalian Reproductive Physiology II (04MSCZ003)

NEP-2020 (Core DSE) Credits-4 Marks-80

Unit-I (15 hrs.)

1.1 Differentiation of the ovary and female genital tract. The process of folliculogenesis and its hormonal control.

1.2 Mechanism and hormonal control of ovulation, Corpus luteum: histogenesis, function, maintenance and luteolysis

1.3 Implantation of mammalian blastocyst, Development of chorio–allantoic placenta.

1.4 Foetal membranes – Development, structure, function of chorion, amnion, allantois, yolk sac.

Unit-II (15 hrs.)

2.1 Onset of puberty and delayed puberty, Gestation, pregnancy diagnosis.

2.2 Onset and endocrine control of parturition, Lactation and its regulation.

2.3 Chemical toxicants and Testicular toxicity, Environmental factors and reproductive health.

2.4 Induction of gonadal toxicity in females, Interruption of pregnancy by pesticides.

Unit-III (15 hrs.)

3.1 Hypothalamo- Hypophysial- Gonadal axis; location, regulation, function and factors affecting it. Prostaglandins and their role in reproduction.

3.2 The Androgen: Biosynthesis, mode of action, transport and functions of testosterone.

3.3 The oestrogen: Biosynthesis, mode of action, transport and functions.

3.4 The progesterone: Biosynthesis, mode of action, transport and function. Physiology of inhibin-biosynthesis, mode of action and functions.

Unit-IV (15 hrs.)

4.1 Intrauterine and intra cervical devices (IUDS and IUCDS) medicated and non-medicated IUD's, Long acting steroidal contraceptives. Vasectomy and reversible vas occlusion.

4.2 Recent advances in female contraception (inhibin, prostagladin, hormone analogues, subdermal implants). Surgical sterilization and medical termination of pregnancy (MTP).

4.3 Pregnancy vaccine (anti-HCG, Antizona vaccine, immunization with FSH). Anti-androgen and anti-spermiogenic compounds (LDH-Cy and Sp-10), Inhibin.

4.4 LH-RH antagonist, estrogen antagonist, Antibodies for acrosomal enzymes and sperm surface proteins

Books Recommended

20. Biology of Gestation: Assalye, N.S. (1968). Academic Press, London.
21. Biology of ovarian follicles in mammals (1985). S. S. Guraya Springer-Verlag.
22. Comparative Endocrinology and Reproduction. Eds. K.P. Joy, A. Krishna and C. Haldar, Narosa Publishing House (1998).
23. Control of ovulation: Crighton, D.B., Haynes, N.B. Foxcroft, G.R. & G.E. Lamming (1978). Butterworths, London.
24. Hormonal Control of Lactation: Cowie, A.T. Forryth, I.A. and I. Hart (1980). Springer-Verlag, Berlin & New York.
25. Marshall's Physiology of Reproduction. 4th Edition Vol. 3 Pregnancy and Lactation Part I, II, III edited by G.E. Lamming, Champan and Hall.
26. Ovarian Cycle of Mammals: Perry, J.S. Oliver and Boyd, Edinburgh.
27. Patterns of Reproduction: Asdell, S.A. (1964). Constable and Co. London.
28. Physiology of Lactation: Smith, Vearch, Constable & Co., London.
29. Postgraduate Reproductive endocrinology. 4th Edition. 1997. R. RajanJaypee brothers. Medical Publishers (P) Ltd.
30. Practice of fertility control, Choudhary S. K. Churchill and Livingstone.
31. Progress in Reproductive Biology, Vol. 4. The pineal and reproduction: Reiter, R.J. Series Ed. P.O. Hubinant, Karger, Basel. Paris, London (latest edition).
32. Contraceptive Technology Past, Present and Future: Das. R.P. (1989). N.I.H.F.W. New Delhi.
33. Encylopedia of Reproduction Vol. I, II, III, IV eds. Ernst Knobil and J.D. Neill (1998).
34. Endocrinology and metabolism. 4th edition 2001. Philip Felig&Lowrence A. Frohmon McGraw Hill Inc. Medical Publishing Division.
35. Endocrinology. Vol. 1 to 3: L.J. Degroot et al. (1989). W.B. Saundors Co. Philadelphia.
36. General Endocrinolgoy: Turner, C.D. & J.T. Bagnara (1990) W.B. Saunders Co., & Toppan Co., Philadelphia, London & Tokyo.
37. Mammalian Oviduct: Hafez, E.S., and R.J. Blandu. The University of Chicago Press, Chicago, London.
38. Reproduction in Mammals Series: 1 to 6: Austin, C.R. and R. V. Short (1984 & 1994), Cambridge University Press, Cambridge.

M.Sc. Part II Semester–IV Zoology
Paper-IV, Fresh Water Zoology II (04MSCZ003)
NEP-2020 (Core DSE) Credits-4 Marks-80

Unit-I (15 hrs.)

1.1 Plankton: Definition and classification. Diurnal and vertical movement of plankton.

1.2 Collection and preservation of plankton. Qualitative and quantitative study of plankton, importance of plankton.

1.3 Periphyton: Definition, composition, types and importance.

1.4Aquatic weeds: Definition, composition, types and importance.

Unit-II (15 hrs.)

2.1 Nekton: Definition and composition, Study of various forms of nekton from aquatic ecosystem.

2.2 Bottom material: Sedimentations, Sediments in lakes and rivers.

2.3 Benthos: Definition and collection of benthos. Qualitative and quantitative study.

2.4 Importance of benthic organisms with reference to water quality and aquatic pollution.

Unit-III (15 hrs.)

3.1 Physico-chemical characteristics: light, temperature, turbidity, dissolved solids, phosphates and nitrates, dissolved gases (oxygen, free carbon dioxide)

3.2 Definition of Aquatic pollution, types & sources of pollutants.

3.3 Heavy metal and pesticide residues from agriculture fields & control measures.

3.4 Pollution processes in aquatic ecosystem: dispersion, degradation, accumulation, bio-magnificance, transformation, movement and recycling.

Unit-IV (15 hrs.)

4.1 Eutrophication: Definition, types, effects and control measures

4.2 Methods of assessment of pollutional status, Biological indicators of pollution

4.3 Drinking water treatment, Water pollution acts of India.

4.4 Aquatic toxicology: Toxicants, toxicity concentration response relation and Bioassay study.

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Books Recommended

1. The Science of Ecology: Brewer, A. (1998), Sanders Pub. New York.

2. The Science of Ecology: Ehrlich, P. R. &Roughsrden, J. (1987) McMillan Pub. Co. New York.

3. Population Biology: Emlein, J. M. (1984). McMillan Pub. London.

4. Current Ecology: Pattern & Progress: Killawa, J. & Anderson, G.J. (1986), Blackwell Science Publication, Oxford.

5. Basic Ecology: Odum, E. P. (1983), Sanders Pub. New York.

6. Systems of Ecology: Odum, H. T. (1983), John Wiley & Sons, New York.

7. Ecology with Special Reference to Animals and Man: Kendelgh, Prentice Hall Co.

8. National Resources & Conservation: Owen, O. S. (1985) McMillan Pub. New York.

9. Elements of Ecology: Smith, R. L. (1986), Harper & Row Pub. New York.

10. Environmental Physiology: Sonim, N. B. (1974), C. V. Mosby Pub. St. Louis, USA.

11. Environmental Physiology: Philips, J. G. (1975), Blackwell Science Publication, Oxford.

12. Ecology: Ricklefts, R. E. (1973), Thomas Nelson & Sons Ltd.

13. Threatened Animals of India: Tikader, B. K. ZSI Calcultta.

14. Ecology & Field Biology: Smith, R. L. Harper &Rw Pub. New York.

15. Wildlife in India: Sharin, V. B. (1985), Natraj Pub. Dehradun.

16. Fresh Water in India: Kulkarni, K. H. (1957), ICAR, New Delhi.

17. Marine Fishes: Bal, D. V. & Rao, K.V. (1989), Tata McGraw Hill, New York.

18. Textbook of Marine Ecology: Balkrishnan, N. A. &Thumpy, D. N. (1980), McMillan Co.

19. Marine Ecology & Fishes: Cushly, B. H. (1980), Cambridge University Press.

20. Treatise on Limnology: Hutchinson, G.E., (1967), John Willy Pub. New York.

21. Methods of Soil Analysis: De, S. K. (1962), Narayan Pub. House, Allahabad.

22. Fish & Fishes of India: Jhingran, V. G. (1985)

23. Aquatic Pollution: Edward A. (2000) Laws. 3rd edition**. John Wiley** and **Sons**, NewYork.

24. A Manual of Fresh Water Ecology: Santhanam, R., Velayntan, P. &Jagathesan, G. (1989), Daya Pub. House, Delhi.

25. Limnology: Welch, P. S. (1957), McGrall& Hill Co. New York.

26. Air Pollution: Perkins, H.C**.,** (1974) McGraw-Hill, New York.

M.Sc. Part II Semester–IV Zoology

Paper-IV, APPLIED AND INDUSTRIAL ENTOMOLOGY II (04MSCZ003)

NEP-2020 (Core DSE) Credits-4 Marks-80

Unit-I (15 hrs.)

1. Study of different species of silkworms and its characteristic features,
2. Moriculture - silk and its uses, pests and diseases of silkworms,
3. Rearing and management of silkworms.
4. Lac insect- natural enemies and their management.

Unit-II (15 hrs.)

1. Bee keeping- General colony management during different seasons. Seasonal management.
2. Artificial queen rearing. Pests and diseases of honey bees. Bee poisoning.
3. Production and marketing of quality honey and value added honey products.
4. Establishment and maintenance of apiaries.

Unit-III (15 hrs.)

1. in human habitation and habitats,
2. Biology, damage and control of mosquitoes, houseflies, bed bugs, ants, termites, cockroaches, flies, silverfish, head and body lice,
3. Insect pests of cattle, poultry, pet animals and their management.

Unit-IV (15 hrs.)

1. Principles and methods of pest management in residential places and public buildings, insecticides for domestic use and their safety,
2. Pre- and post-construction termite proofing of buildings,
3. Appliances for domestic pest control. Rodent control methods.
4. Organic methods of domestic pest management.

Books Recommended

2. General text book of Entomology, Eds. O. W. Richards and R. G. Davis Chapman and Hall, London.

2. General and Applied Entomology, K.K. Nayar, T. N. Ananthkrishan and B.V. Davis Tata McGraw -Hill Co.Ltd. Bombay.

3. The Insect: Structure and function, R.F. Chapman, Cambridge University Press.

4. The Physiology of Insect , Ed. M.Rockstein ,Vol, 1-5, Academic Press, New York.

5. The Physiology of Insect Reproduction, F, Englemann, Pergamon Press, New York.

6. Comprehensive Insect Physiology, Biochemistry and Pharmocology , Eds. G.A. 85 Kerkut and I. A. Gillberd, VOL. 1-13, Pergamon Press, New York.

7. Analytical Biochemistry of Insect, Ed. R. B. Turner, Elsevier, Amsterdam.

8. Insect Hormone, M. J. A. Novak. Chapman and Hall, London.

9. Modern Entomology(Second edition): D. B. Tembhare, Himalaya Publication House, Bombay.

10. Destruction and Useful Insect, Their Hanits and Control, C. L. Metcalf, W. P. Flint and R. I. Metcalf, Mc Grow I Ill Co. New York.
11. Integrated Pest Management, J.L. Apple and R. E. Smith, Plenum Publication Co., New Delhi.

12. An Introduction Of Biological Control RVD Boarscho, P. S. Y. Messenger and A. P. Gaiter, Plenum Publication Co.

13. Text Book of Entomology, K. P. Shivastava, Vol. 1 And 2 Kalyani Publication, Ludhiana.

14. Agriculture Entomology, H. S. Dennis, Timber Press Inc.

15. Entomology and Pest Management, Larry P. Pedigo, Prentice Hall.

16. Text Book of Agriculture Entomology, Alford V. David, Blackwell Science.

17. Biopesticides In Insect Pest Management, S. J. Ignacimulha and AlokSen , Phoenix Publishing House Pvt, Ltd.

18. Biotechnology in Invertebrate Pathology and Cell culture (Maramorosch, K. ed.). Academic Press, New York.

19. PEBFANS (2003)" (Solomon Raju, A. J. ed.). Andhara University Press, Visakhapatnam.

20. Living Resources for the Millennium 2000 (S. J. William ed.), Students Offset Press, Chennai.

M.Sc. Part II Semester–IV Zoology

Paper-IV, Applied Fresh Water Fisheries II (04MSCZ003)

NEP-2020 (Core DSE) Credits-4 Marks-80

Unit-I (15 hrs.)

1.1 Inland fisheries resources - riverine, reservoir and lacustrine fisheries.

1.2 Construction of ideal fish farm, Liming and manuering of pond.

1.3 Prestocking management of Nursery, Rearing and stocking ponds, Control of aquatic weeds, predatory fishes, weed fishes and insects.

1.4 Natural Fish seed collection, Bundh breeding, Glass jar hatchery and Chinese hatchery systems for seed production

Unit-II (15 hrs.)

2.1 Post stocking management – Stocking density, carrying capacity, enhancement of carrying capacity

2.2 Nutritional requirements of culturable carps. Supplementary feeding. Artificial feed. Use of growth promoting hormones.

2.3 Cryopreservation of gametes, Transport of live fish seed, Brood fish and food fish.

2.4 Fisheries of major river systems in India. Effect of dams on fisheries, Development of reservoir fisheries in India.

Unit-III (15 hrs.)

3.1 Different systems of fish culture, Monosex culture, cage culture and pen culture.

3.2 Composite fish farming, Polyculture of Indian and Exotic carps, Culture of air breathing fishes.

3.3 Integrated fish farming: fish-cum-poultry and fish-cum-paddy, fish-cum-duck and fish-cum-pig.

3.4 Sewage fed fish culture.

Unit-IV **(15 hrs.)**

4.1 Ornamental fish culture: i) Oviparous, ii) Live bearers

4.2. Construction and maintenance of aquarium, Breeding and care of aquarium fishes.

4.3 Fisheries co-operative societies and their role in fish production and marketing

4.3. Fishery legislation and their role in fishery development.

Books Recommended

1. A textbook of fishery science and Indian fisheries- S. B. L. Srivastava.
2. Fish and fisheries – Kamleshwar Pandey and J. P Shukala
3. A textbook of fish biology and fisheries – S.S. Khanna and H. R. Singh
4. A text book of fish biology and Indian fisheries- R.P. Parihar
5. General and Applied Ichthyology- S.K.Gupta and P.C.Gupta
6. An introduction to fishes- S. S. Khanna.
7. Aquaculture – T. V. R. Pillay.
8. Diseases of cultivable freshwater fishes and their control – N. M. Chokraborty.
9. Fish and fisheries in India - V. G. Jhingran.
10. Indian fishes (Identification of Indian Teleosts) – T. A. Qureshi.
11. Introduction to tropical fish assessment per share, Erik Ursine and Siberian C. Verma.
12. Fish population dynamics – M. Devaraj.