

SIDO KANHU MURMU UNIVERSITY, DUMKA



**CBCS BASED
COURSE CURRICULUM
(ZOOLOGY)**

For

**POSTGRADUATE
PROGRAMME**

[M.Sc. (Zoology)]

ACADEMIC SESSION

2017-2019

**UNIVERSITY DEPARTMENT OF ZOOLOGY
S.K.M.UNIVERSITY, DUMKA - 814101
JHARKHAND**

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M.Sc. Zoology

Choice Based Credit System

Academic Session 2017-19

Total no. of credits = 72

Some Important Regulations of CBCS for Students made by University

Duration of the course:

Minimum duration for completion of a two year Post Graduate Programme is four semesters.

Normal	Duration	4	Semesters
Maximum	Duration	8	Semesters

1. Semester is used to mean a half yearly term or term of study including examinations, vacations and semester breaks. As academic year consists of two semesters.

Odd Semester (I & III): December to April

Even Semester (II & IV): July to November

A semester normally extends over a period of 16 class weeks. Each week has 30 hours of instruction spread over the week.

2. Attendance: A student shall be permitted to appear for the semester examination, only if he/she secures not less than 75 % attendance in each semester. Condonation of shortage of attendance of each week a maximum of 12 days for a maximum of two spells within a programme may be granted as per the existing University rules. A student who is not eligible for such condonation shall repeat the course along with the subsequent batch.
3. Examination and Evaluation
4. Evaluation will be done on a continuous basis, three times during each semester. For the purpose of uniformity, particularly for interdepartmental transfer of credits, there shall be a uniform procedure of examination to be adopted by all teachers. There will be two mid term/sessional tests and one End semester examination in each course during every semester.

5. Mid term /Sessional Test I will be held during the sixth week of the semester for the syllabi covered till then.
6. Mid –Term / Sessional Test II will be held during eleventh week for the syllabi covered between 7th and 11th week.
7. Mid term / Sessional Tests(of one to two hours duration) may employ one or more assessment tools such as objective tests,assignments,paper presentation, laboratory work,etc suitable to the course. This requires an element of openness. The students are to be informed in advance about the nature of assessment. Students shall compulsorily attend the two sessional tests failing which they will not be allowed to appear for end semester examination. A student can not repeat sessional Sessional Tests. However, if for any compulsive reason a student could not attend the test, the prerogative of arranging a special test lies with the teacher provided the concerned student reports the matter to the course teacher within one week of the date on which the test was conducted. In case of students who could not attend any of the sessional tests due to medical reason or under extraordinary circumstances, a separate shall be conducted before the End Semester Examinations by the concerned faculty member.
8. The mid term sessional tests will carry 40 %(20%+20%) of total marks for the course. The marks of the two Sessional Tests shall be taken into account for the computation of Grades.
9. There shall be one End Semester Examination of 3 hours duration carrying 60% of Marks in each course covering the entire syllabus prescribed for the course. The end semester examination is normally a written / Laboratory –based examination. The mode of end semester examination and evaluation will be decided by teacher in consultation with the Departmental committee. Model Question Paper for each course has to be prepared by the teacher and same should be forwarded to the Head of the Department. The end semester examination schedule will be prepared by the Head of the Department/College and displayed on the notice board at least one week before the examination with intimation to the controller of Examinations. The course faculty must evaluate the answer scripts and submit the results to the Head of the Department before the Departmental/Class committee meeting. The Head of the Department will fix the date for Departmental committee meeting to finalise the results.
10. End semester practical examination shall normally be held before the theory examinations
11. The result of mid-semester examination shall be notified by the concerned course teacher(s) within ten days of the examination.
12. Evaluation of Project Report/Dissertation and Viva voce
The distribution of marks for the dissertation will be as below:
Periodical Presentation-20 Marks Concise Dissertation-60 Marks

Viva Voce - 20Marks

Total = 100 Marks

Dissertation/Project report must be submitted by the candidates in the department one week before the commencement of the end semester examination and it will be valued jointly by the supervisor and one other examiner within the department/University) nominated by the departmental council. Students may be asked to make a presentation before the faculty members and students.

13. Pass Marks

A candidate has to secure a minimum of 40% of marks (Two sessional test marks plus End – Semester examination marks) in the course taken, to pass in that course. Candidate securing below 40% marks shall be deemed to have failed in that course.

Improvement is allowed for the end semester examination. Candidates who have passed in theory papers are allowed to appear again for theory paper/papers only once in order to improve his/her marks, by paying the fee prescribed from time to time within a maximum period prescribed thereto, counting from his/her first semester of his/her admission. If candidates improve his/her marks, then improved marks will be taken into consideration for award of grading only. Such improved marks will not be counted for the award of Prizes/Medals, Rank and Distinction. If the candidate does not show improvement in marks, his/her previous marks will be taken into consideration.

No candidate will be allowed to improve marks in Practicals, Project, Viva –voce, Field work.

14. Award of Grades, SGPA, CGPA

Grade –Letter is a index to indicate the performance of a student in a particular course (Paper).It is the indicated by grade letter O, A, B, C, D, E, F. There is range of marks for each grade letter.

Grade Point is weight age allotted to each grade letter depending on the marks awarded in a course / paper

Award of Grades

Range of % of Marks	Grade Letter	Grade Point
85 to 100	O	10
70 to 84	A	9
60 to 69	B	8
55 to 59	C	7
50 to 54	D	6
40 to 49	E	5
Less than 40	F	0

15. Semester Grade Point Average (SGPA)

Credit Point for the paper-No. Of credits assigned for the paper x Grade point secured for that course / paper. SGPA indicates the performance of a student in a given semester. SGPA is calculated by dividing the total credit points earned by the student in all the courses by the total number of credits assigned to the courses/papers in a semester.

Note:-SGPA is computed only if the candidate passes in all the papers(gets a minimum 'E' Grade in all the papers)

16. Cumulative grade point average (CGPA)

'Cumulative Grade Point Average'(CGPA) is the value obtained by dividing the sum of credit points in all the Courses taken by a student for the entire Programme by the total number of credits.CGPA shall be rounded off to two decimal places.CGPA indicates the broad level of academic performance of a student in a programme. An overall letter grade (Cumulative Grade) for the entire programme shall be awarded to a student depending on his/her CGPA.The final result at the end of all the semesters is declared in the form of CGPA.

Note: - CGPA is calculated only when the candidate passes in all the papers of all the semesters.

Example:

I. Semester

Total Credit Points=24(total credits) x8(Grade Point) =192

SGPA=192/24=8

II. Semester

Total Credit Points=24(total credits) x7(Grade Point) =168

SGPA=168/24=7

III. Semester

Total Credit Points=20(total credits) x8(Grade Point) =160

SGPA=160/20=8

IV. Semester

Total Credit Points=16(total credits) x9(Grade Point) =144

SGPA=144/16=9

CGPA=Total Credit Points of all Semesters/Total Credits
= (192+168+160+144)/(24+24+20+16)=664/84=7.90

17. Pattern of questions

17.1 Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in a new situations, critical evaluation of knowledge and ability to synthesize knowledge. The question setter shall ensure that questions covering all the skills are set. He/ She shall also submit a detailed scheme of evaluation along with the question paper.

17.2. A question paper shall be judicious mix of objective type, short answer type, and long answer type questions. The pattern of the questions will be as follows-

Part A

Objective Type Multiple Choice Questions (No. Of choice) 10×2 marks=20 Marks

Part B

Short Answer Type Questions

Four questions (Out of eight questions) 4×5 marks =20Marks

Part C

Two Questions (Out of four questions) 2×10 marks=20Marks

17.3 Components for continuous internal assessment (Sessional Test I and Sessional Test II) will be:

Two tests 20 Marks

(a) Seminar/Multiple Choice Test 10 Marks

(b) Assignments/Regularity in Attendance $5+5= 10$ Marks

Total 40 Marks

Credits & Courses:

(a) A candidate who successfully completes the entire core courses, the project prescribed, the optional and supportive courses, and acquires not less than 72 credits and puts in the minimum of residence time will be eligible for receiving the degree.

(b) One credit means one teaching period per week for one semester(16 weeks) for theory courses and one laboratory session of two periods / week for one semester. One teaching period is of 60 minutes duration.

Courses are divided into 5 categories

1. Core courses-Compulsory and total credits=48

2. Elective courses-May be chosen by the student from options offered by the department. Total credits for Elective Courses are 16.

3. Supportive Courses-This may be taken from other disciplines.Total credits for supportive courses are 6.
4. Self Study courses-A Department may allow students to choose three additional courses to enable them to acquire extra credits through self study (Not to be taken into account for awarding grades/Class).Maximum 9 credits (3x3=9)-not mandatory
5. Soft Skills- minimum 8 credits-
Internship- minimum 2 credits- carried out in an organization recommended by the department during summer vacation of the first year.
6. Project-6 credit (Compulsory)

1st Semester

Core	Paper-I	4 Credits	64 Hours
Core	Paper-II	4 Credits	64 Hours
Core	Paper-III	4 Credits	64 Hours
Core	Paper-IV	4 Credits	64 Hours

1st Semester-Core Papers
Paper I : Foundation of Zoology
(A) Systematics and Taxonomy
(B) Tools and Techniques
Paper II
(A) Structure & Function of Invertebrates
(B) Comparative study of Chordates
Paper III
(A) Tissue culture and cancer
(B) Reproductive Biology
Practical IV

1st Semester detailed curriculum

Paper I- Foundation of Zoology

Systematics, Taxonomy & Tools and Techniques

(A) Systematics and Taxonomy

1. Definition and basic concepts of biosystematics & taxonomy
2. Importance and application of biosystematics in biology
3. Species concepts-Species category, subspecies and other infra specific categories.
4. Theories of biological classification, hierarchy of categories.
5. Taxonomic procedures-Taxonomic collection, preservation, curation, process of identification.
6. Taxonomic Keys- Different kinds of taxonomic keys, their merits and demerits.
7. Concepts of chemotaxonomy, cytotoxicology & molecular taxonomy.
8. International code of Zoological nomenclature (ICZN)-formation of scientific names of various taxa.

(B) Tools and Techniques

1. General principle and application of Microscope - Light, Contrast, Fluorescence, Scanning electron and Transmission Electron Microscopy

2. Principles and uses of analytic instruments-, pH meter, Colorimeter, Spectrophotometer,
3. Histological techniques for animal tissues-Fixation, ,use of microtomes and section cutting, Dehydration, staining.
4. PCR-Polymerase chain reaction.
5. Radioisotope Technique in Biochemistry.
 - i. Radio immune assays(RIAs)
 - ii. Enzyme linked Immunosorbant Assay(ELISA)-basic ELISA protocol, Hormonal assay for pregnancy test.
6. Separation techniques

Centrifugation- Centrifuges and their types, Chromatography-theoretical basis, Column Chromatography, Paper Chromatography, Thin layer Chromatography(TLC)

Electrophoresis- Separation of DNA by agarose gel electrophoresis.

Paper II- Animal Diversity

(A) Structure & Function of Invertebrates

Locomotion

1. Flagellar movement in Protozoa
2. Ciliary movement in Protozoa
3. Hydrostatic movement in Annelida

Nutrition & Digestion

- i) Filter feeding in Polychaeta,
- ii) Filter feeding in Mollusca

Respiration

- (i) Organs of respiration-Gills, Lungs and Trachea and mechanism of respiration
- (ii) Respiratory pigments

Excretion

- i) Organs of excretion-Coelomoducts, Nephridia and Malpighian tubules and mechanism of excretion

Nervous system

- (i) Primitive nervous system-Coelenterate and Echinodermata
- (ii) Advanced Nervous System-Annelida, Arthropod (Crustacean & Insects) and Molluscs (Cephalopod)

Invertebrate larvae

- (i) Larval forms of Crustacea
- (ii) Larval forms of Echinoderms

(B) Comparative study of Chordates

1. Classification of Vertebrates
2. Evolution of Heart and aortic arches
3. Comparative account of Respiratory organs.
4. Evolution of urinogenital system in vertebrate series.
5. Comparative account of brain in vertebrates.

Paper III

(A) Tissue Culture and Cancer

1. Types of cancer and carcinogenic agents
2. Cytology of cancer cells.
3. Physiology of cancer cells
4. Methods of tissue culture

(B) Reproductive Biology

1. Anatomy - human reproductive organs.
2. Histophysiology of ovary and testis.
3. Semen composition, formation and assessment of sperm functions
4. Physiology, biochemistry of follicular growth and atresia.
5. Corpus luteum structure and function.
6. Hormonal regulation of implantation, pregnancy, parturition, placental hormones.
7. Structure and function of Mammary glands and physiology of lactation.
8. Control of fertility and role of hormones in contraception.

Practical IV

List of Practical

Structure & Function of Invertebrates

1. Dissection-

Nervous system of Earthworm, Prawn, Pila, Unio, (CD-rom or Video demonstration)

2. Mounting-

Gills of Pila, Trachea of Insect, Nephridia of Earthworm, Malpighian tubule of Cockroach, (CD-rom or Video demonstration)

3. Spotting

Slides- (CD-rom or Video demonstration and light microscopic observations and comment.)

Malarial parasite, Leishmania, T.S. Hydra, T.S of Earthworm, Gill of Unio, Trachea of Cockroach, Nephridia of earthworm, Malpighian tubule of Cockroach, Crustacean larvae, Larval forms of common helminth parasites.

Specimens-observation and comment

Sycon, Aurelia, Fasciola, Taenia, Ascaris, Earthworm, Aphrodite, Prawn, Pila, Unio, Octopus, Sepia, Balanoglossus

Chordates

List of Practical

1. Dissection-

General anatomy of Scoliodon and Labeo rohita, (CD-rom or Video demonstration)

2. Mounting-

Scales of fishes, feathers in birds, blood film, Pecten in bird, (CD-rom or Video demonstration and light microscopy-use of techniques of microphotography)

3. Spotting-

A. Slides-Mammal-

Integument, Kidney, Pancreas, Liver, Spleen, Thymus,

(CD-rom or Video demonstration and light microscopy-use of techniques of microphotography)

- B.Specimens-observation and comment upon
Scoliodon, Labeo,Lung fish, Ichthyophis ,Salamandra, Hyla, Wall lizard ,Krait, Cobra, Pigeon, Rat(CD-rom or Video demonstration and specimen study)
- C.Osteology-Skull of Dog and Man.

1. Tools and Techniques

Comment upon one of the following

- (i)Principles and use of light contrast fluorescence, scanning electron microscopy and transmission electron microscopy
- (ii). Principles and uses of analytic instruments-Monopan balance, pH meter, colorimeter, Spectrophotometer, Centrifuge and ultracentrifuge.
- (iii). Principles and use of microtomes and section cutting,
- (iv).Principles and use of PCR-Polymerase chain reaction.
- (v).Principles and uses of Radio immune assays
- (VI).Principles and uses of Techniques of animal tissue culture
- (VII).Principles and uses of Thin layer Chromatography (TLC)
- (VIII).Principles and uses of Electrophoresis

Tissue Culture and Cancer

- 1Principles and use of tissue culture technique
- 2 Study of cytological atlas of breast cancer -comment upon the photograph provided.
- 3. Study of cytological atlas on uterine cancer.
- 4 Blood picture showing-stages of leukaemia

Reproductive Biology

Histology of ovary and testes
Assessment of sperm functions
Pregnancy test

Model of questions
1. Dissection-
2. Mounting-
3. Spotting- (Slides-3 Specimens-2 C.Bone-1)
4. Taxonomy-
5Tools and Techniques
6Quantitative Biology
7.Reproductive Biology
5. Viva-
6. collection/Record-

2nd Semester

Semester-II

Core	Paper-V	4 Credits	64 Hours
Core	PaperVI	4 Credits	64 Hours
Core	Paper-VII	4 Credits	64 Hours
Core	Paper-VIII	4 Credits	64 Hours

2nd Semester
Paper V
Skill development programme
Paper VI
(A)Immunology
(B)Bioinformatics
(C)Histochemistry
Paper VII
(A)General and Comparative Endocrinology
(B)Cell Biology
(C) Biochemistry
Practical Paper VIII

2nd Semester detailed curriculum

Paper V

Skill Development Programme

Paper consists of 60 credit hours

In all nine questions are to be set and five question are to be answered. Question no. One is compulsory of short answer 2 marks each and includes seven question of fill in the blanks / one word answer / true / false type. Rest eight question are to be set and examinees are required to answer four question (long answer 14 marks each selecting not more than two from each group.

Skill Development programme

Time 3 Hours

Paper consists of 60 credit hours, In all NINE questions are to be set and five questions are to be answered. Question number 1 is compulsory of very short type (2 marks each) and includes 7 questions of fill in the blanks/one word answer, /true/false type. Rest eight questions are to be set and examinees are required to answer four questions (long answer 14 marks each) selecting not more than two from each group.

Basics of Computer, Internet and Biostatistics

Group – A

1. Computer and its application
 - 1.1. Basic components of computer –hardware (CPU, input] storage devices)
 - 1.2. software
 - 1.2.1.system software (operating systems)
 - 1.2.2.Operating software
2. Introduction of MS office – Word, Excel and Power point
3. Internet protocol and information technology
 - 3.1 Basic of home pages
 - 3.2 Web page
 - 3.3 Uniform Resource Locator.
4. Concepts of digital Library.
5. Principles of bioinformatics and its application.
6. Biological databases :
 - i. File formats
 - ii. Nucleic acid sequences databases :
 - iii. Genomic databases:
 - iv. Protein sequence, structural and interacting proteins databases
 - v. Literature databases.

Group B

(A)Quantitative Biology

1. Biostatistics and its application.
2. Sampling, data collection, tabulation, diagrammatic and graphical presentation of data.
3. Mean, Standard deviation and standard error.
4. Test of significance of large and small samples – Student T-Test.
5. Chi square test.
6. Correlation
7. Regression analysis
8. Anova – One way and two way analysis of variance.

Paper VI

(A)Immunology

1. History and scope of Immunology.
2. Architecture of immune system-lymphoid organs thymus, bone marrow, spleen, lymph nodes.
3. Innate and acquired immunity.
4. Antigen, Antigen-antibody interaction and immune response.
5. Structure and function of antibodies
6. Organisation and expression of Ig Genes, Models for Ig Gene structure, Multiple organisation of Ig Gene, Generation of Antibody diversity.

7. Cytokines-structure and function.
8. T-cell receptors and B-cell receptors.
9. Immunodeficiency Diseases

(B)Bioinformatics

1. Introduction and scope of bioinformatics
2. Genomics and Proteomics, biodiversity informatics and evolutionary informatics.

(C)Histochemistry

1. Histochemistry of mucopolysaccharides (PAS, Alcian blue),
2. Histochemistry of Alkaline phosphatase'
3. Fuelgen test
4. Sudan test

Paper VII

(A)General and Comparative Endocrinology

1. Aims and scope of Comparative endocrinology
2. Phylogeny of endocrine glands (Pituitary, Thyroid, Adrenal, Pancreas)
4. Neuroendocrine system and neurohormones.
5. General principles of hormonal actions.
6. Hormonal regulations of carbohydrates, Protein and Lipid metabolism,
7. Hormones in growth and development

(B)Cell Biology

1. Bio membranes-molecular organisation-Fluid mosaic model.
2. Transport across the cell membrane.Diffusion,Active transport.Membrane potential
- 3.Cell cycle-Cycs and CDK.Regulation of CDK-cyclin activity.
- 4.The energy transducers of the cell. Mitochondria structure, Oxidative Phosphorylation
- 5.Cell signalling-cell surface receptors, second messenger system.Signaling from plasma membrane to nucleus.
- 6.Ultra structure of chromatin fibre.
7. A concept of programmed cell death (apoptosis).

(C)Biochemistry

1. Bioenergetics-Concept of free energy, laws of thermodynamics applied in biochemical system, role of high energy phosphates in bioenergetics and energy capture.
2. Proteins-Formation of peptide bonds and polypeptide chain, molecular configuration of secondary and tertiary structure of protein
3. Enzymes and co enzymes, enzyme kinetics, enzyme regulation and inhibition, Isozymes
4. DNA sequencing, DNA finger printing, Overlapping genes, Split genes.
5. Application of Genetic engineering.

Practical Paper VIII

List of Practical

Immunology

- (I). Determination of human blood group
- (II) Principles of Dot ELISA
- (III) Experiment to show Radial Immunodiffusion (RID) technique for estimation of antigen antibody contents in the samples.
- (IV) Principles of Counter current Immunelectrophoresis

General and Comparative Endocrinology

- (I). Surgical techniques-
Thyroidectomy, Adrenalectomy, Castration in Rat
- (II) Study of vaginal smear -Stages of Oestrous cycle-in Rat
- (III) Use of Micrometer in measuring Thyroidal cell height.

Physiology

- (I). Determination of systolic and diastolic blood pressure by-manual blood pressure instrument /Electronic digital blood pressure instrument.
- (II)Recording of muscle contraction.
- (III)Determination of rate of oxygen consumption in rat.

Cell Biology

- 1 Demonstration of Mitochondria in human buccal epithelium-vital staining by Janus green.
- 2 Demonstration of salivary gland chromosome in Chironomous larva.
- 3 Demonstration of different stages of mitosis in onion root tip-by acetocarmine
- 4 Demonstration of different stages of meiosis in grass hopper testis.

Histochemistry

1. Histochemical demonstration -PAS, Alcian blue, Feulgen, Sudan black.

Biochemistry

1. Test for pepsin enzyme activity
2. Test for Trypsin enzyme activity
3. Estimation of blood glucose by electronic glucometer/colorimeter or spectrophotometer
4. Test of urine for-urea, proteins, ketones and sugar
5. Separation of amino acids in a mixture by paper chromatography

6. Colorimetric estimation of Plasma protein and cholesterol.

Model of questions
1. Immunology-
2. Endocrinological experiment-
3. Physiology-
4. Cell Biology
5. Histochemical test-
6 Biochemistry
7. Viva-
8. Record-

3rd Semester

Semester-III

Core	Paper-IX	4 Credits	64 Hours
Core	Paper- X	4 Credits	64 Hours
Elective	Paper-I	4 Credits	64 Hours
Elective	Paper-II	4 Credits	64 Hours

3rd Semester
Theory Paper IX
(A)Genetics and Molecular Biology
(B)Population Biology, Population Genetics and Evolution
(C) Developmental Biology
Practical Paper X
Open Elective Paper I
Elective Paper Practical-II

3rd Semester detailed curriculum

Paper V

Theory Paper IX

(A)Genetics and Molecular Biology

1. DNA types, molecular organisation.
2. DNA replication-DNA polymerase, Primosome, Process of replication in ssDNA, dsDNA, Circular DNA
3. DNA repair-Role of Rec A Protein, Site specific recombination
4. RNA Polymerase
5. Genetic Code
6. Gene expression:-

- (a) Transcription in prokaryotes
 - (b) Transcription in Eukaryotes
 - (c) Translation in prokaryotes.
 - (d) Translation in Eukaryotes
7. Gene regulation (i) Lac operon (ii). Tryptophan operon (iii) repressor (iv) Post transcriptional control

(B) Population Biology, Population Genetics and Evolution

1. Population characteristics
2. Hardy Weinberg law of genetic equilibrium and factors of its destabilization.
3. Microevolution.

(A) Developmental Biology

1. Fertilization-Pre fertilization events, biochemistry and post fertilization events
2. Embryonic induction, primary organiser, differentiation and competence.
3. Stem cells and their application
4. Ageing -Theories of ageing, Ageing related diseases, Anti ageing therapy.

Practical Paper- X

List of Practical

1. Genetics and molecular biology

- (i). Structural traits of Drosophila
- (ii) Isolation of genome DNA
- (iii) Restriction Digestion of DNA
- (iv) Agarose gel electrophoresis of DNA
- (v) Study of chromosomal aberrations-slides
- (vi) Polytene Chromosome

2. Evolution

- (i) Adaptive modification in feet of birds
- (ii) Adaptive modification in mouth parts of insects
- (iii) Adaptive modification in dentition of mammals
- (iv) Estimation of gene and genotypic frequencies in the light of Hardy –Weinberg law based on ABO blood group data in a large sample of human population or a class room sample

Developmental Biology

- (i) Whole mount of chick embryo-18, 24,33,48,72 and 96 hrs.-slides
- (ii) Preparation of whole mounts of chick embryo-18, 24,33,48,72 and 96 hrs.
- (iii) Observation of metamorphosis of Amphibian tadpole larva

Model of questions
1. Genetics and molecular biology-
2. Population Biology, Population Genetics
3. Developmental Biology

4.Viva-
5Record-

Open Elective Paper I Elective Paper Practical-II

Elective Papers for 3rd semester

There shall be two options to select

1. Open Elective Paper- I Cytogenetics and Recombinant DNA technology (Paper XI) (Genetic engineering)

1. Scope and history of recombinant DNA technology.
2. Tools and techniques-Plasmids and other vehicles, genomic DNA, handling of DNA, RNA and cDNA and techniques required for establishing a Recombinant DNA Tech. Laboratory.
3. Gene Cloning and cloning vectors for E.Coli.
4. Application of gene cloning in research in biotechnology and medicine.
5. Basic principles of genetic engineering
 - Restriction enzymes, DNA ligases, polymerases
 - Cloning vehicles-plasmids, cosmids, phase vectors
6. Gene libraries-construction and analysis of cDNA library
7. Transgenic animals.

1. Open Elective Paper(Practical) II Cytogenetics and Recombinant DNA Paper XII technology

- (I). Mitotic and Meiotic Cell preparation in mammalian cell
- (II). Mitotic metaphase in Onion root tip and Meiotic metaphase in Grasshopper Testis
- (III) Sperm head morphology and mean sperm count
- (IV) Experiments on restriction digestion to find out the molecular weights of different DNA fragments-agarose gel electrophoresis.
- (V). Experiment to show genomic DNA extraction from bacteria.
- (VI). Experiment to show isolation and cleaning of DNA fragment of interest from agarose gel.
- (VII) Cell hybridization and fusion

Model of questions
1.Tools and techniques
2.Experiments on RDT

3.Viva-

4.Record -

2. Open Elective Paper-I - Fish Biology and Fisheries

Paper XI

(Group A)

1. Classification of fishes up to orders.
2. Origin and evolution of fishes.
3. Skin and scales in fishes
4. Electric organs in fishes.
5. Colouration and light production in fishes.
6. Swim bladder in fishes.
7. Hill stream fishes.

(Group-B)

1. Fish seed collection.
2. Fish culture techniques - Induced breeding and hybridization
3. Aquaculture culture of carps – Qualities of cultivable indigenous and exotic species
 - Preparation and management of nursery and rearing ponds
 - Management of pond and polyculture
 - Air breathing fish culture – Breeding of *Clarias batrachus*
 - Larval rearing and culture of *Clarias*
4. Estuarine fisheries
5. Fish diseases and parasites.
6. Crafts gears in fishing.
7. Fish preservation
8. Fish by products.
9. Larvivorious fishes and public health.

2. Open Elective Paper Practical II- Fish Biology and Fisheries

Paper XII

List of experiments

(I). Major dissection-Scoliodon/bony fish

Afferent vessels,Efferent vessels,V,VII,IX, X cranial nerves

(II)Minor dissection-Swim bladder,Weberian ossicles,Internal ear,Accessory respiratory organs in fishes.

(III)Spotting(4 slides+2bones+4 Museum)

(IV)Viva

(V)Record/Coollection

Model of questions

1.Major Dissection-

2.Minor dissection-

3.Spotting- (Slides-4 Specimens-3, Bones-3)

4.Viva-

5.collection/Record-

6.survey report.

4th Semester

Semester-IV

Core	Paper-XIII	4 Credits	64 Hours
Core	Paper-XII	4 Credits	64 Hours
Elective	Paper-III	4 Credits	64 Hours
Elective	Paper-IV	4 Credits	64 Hours

4th Semester
Theory Paper XIII
(A)Environmental Biology and Physiological ecology
(B)Animal behavior
Practical Paper XIV
Elective Paper III (XV)
Elective Paper Practical IV (XVI)

4th Semester detailed curriculum

Paper V

Theory Paper XIII

(A)Environmental Biology and Physiological ecology

1. Concept of productivity-primary and secondary productivity.
2. Plankton community structure and species diversity.
3. Environmental pollution and remedial strategies.
4. Ozone layer and its depletion -Possible effects on plants, animals and man.
5. Predation- Models of prey predatory dynamics .Role of predation in nature.
Parasitism.
6. Lakes-origin and classification of lakes.

(B)Animal behaviour

1. Innate behaviour and learned behaviour.
2. Animal communication-chemical.
3. Social behaviour
 - (i) Aggregations-schooling in fishes.
 - (ii)Herding

4. Reproductive behaviour – Courtship and mating.
5. Biological clock - Circadian and circannual rhythms.
6. Migration in fish.
7. Migration in birds.

Practical Paper XIV

List of Practicals

1. Environmental Biology and Physiological ecology

- (I). Determination of Primary productivity
- (II) Temperature, pH, turbidity, dissolved O₂ and Free CO₂
- (III) Plank tonic studies, counting
- (iii) Community structure analysis-quadrant method
- (iv) Analysis of species dominance or richness, diversity.
- (V). Moisture content, acidity, alkalinity of soil samples of your locality.-a survey report
- (Vi) Studies on Bio indicators of pollution in sewage system

2. Animal behaviour

- (I) Behavioural studies on fishes in lab conditions-
Reading of opercular beating time and effects of various toxicants. , Reading of surfacing time (in air breathing fishes) and effects of various toxicants.

Model of questions
1.Environmental Biology -
2.Animal behaviour
3.Field report-
5.Viva-
6.Record -

- **Elective Paper III (XV)**
- **Elective Paper Practical IV (XVI)**

Elective Papers for 4th semester

There shall be two options to select

(A)

3. Elective Paper III (XV) - Animal Haematology

1. Scope, prospects and history of Haematology.
2. Mammalian Blood corpuscular composition of Human beings.
 - (a) Erythrocytes (RBC=Red Blood Cell)

- (b) Leucocytes (WBC=White blood cell)-types, structure and function. (i) Lymphocytes (ii) Monocytes (iii) Neutrophil (IV) Basophil (v) Eosinophil (vi) Macrophages
 (c). Blood platelets.
- 3 Haemopoiesis-process, stem cells of haemopoietic tissue
 5. Structure and function of blood in invertebrates
 6. Comparative account of blood in vertebrates.
 - 7 Structure and function of lymph glands and lymphoid tissue.
 8. Structure and function of Thymus
 9. Structure and function of Spleen.
 10. Structure and function of bone marrow
 11. Anaemia-Definition, types, diagnosis and therapy
 12. Polycythaemia- Definition, types, diagnosis and therapy
 13. Leucocytosis and leucopaenia
 14. Composition of blood plasma in man and clinical consequences.

Elective Paper Practical IV (XVI) - Animal Haematology

List of experiments

- (1). Giemsa/Leishman stained preparation of blood smear slide of Fish/Amphibia/Aves/Mammal
- (2). Interpretation of results on the basis light microscopy of blood smear slide provided.
- (3). Micrometry- Use of Sage and Ocular micrometer
 Measurement of length and width and diameter of erythrocytes in the blood smear of slide provided. (Fish/Amphibia/Aves/Mammal)
- (4). Perform two haematological experiments

List of experiments

- (I). Total erythrocyte count - Fish/Amphibia/Aves/Mammal
- (II) Total leucocytes count.- Fish/Amphibia/Aves/Mammal
- (III). Estimation of Haemoglobin- Fish/Amphibia/Aves/Mammal
- (IV). Differential leucocytes count in the stained blood smear - Fish/Amphibia/Aves/Mammal
- (v) Determination of Packed cell volume (PCV) - Fish/Amphibia/Aves/Mammal
- (VI). Determination of Bleeding and clotting time.- Fish/Amphibia/Aves/Mammal
- (VII) Identification of blood group and Rh factor of your own blood

Model of questions
1.Preparation of blood smear slide -
2.Interpretation of results -
3.Micrometry -
4Two haematological experiments
5.Spotting -(Two) -
6.Viva-
7.Record -

(B)

3. Elective Paper III (XV) - Environmental Biology

1. Biosphere and major ecosystems of the world.
2. Freshwater resources—river, lakes, reservoir, ponds- zonation, character and Morphometry, productivity in ponds, lakes and reservoir
3. Reservoir limnology and its thermal stratification, stratification and dynamics of oxygen, nitrogen, phosphorus and inorganic carbon.
4. Water quality parameter necessary for aquaculture and role in fish production
5. Environmental factors and global environment.
6. Limnology-Origin and classification of lakes, vertical stratification, eutrophication.
7. Natural disasters and management.
8. Climatic change and its impact on plants, animals and human beings.
9. Biodiversity and its threats, conservation.
10. Environmental laws for protection of wild life, natural habitats and environment

Elective Paper Practical IV (XVI) - Environmental Biology

List of experiments

(I). Analysis of water

Physicochemical-Temperature, Turbidity, Light penetration, Conductivity, Total suspended solids, Total dissolved solids, pH, Total alkalinity, Carbonates and bicarbonates, Free CO₂, Dissolved O₂, BOD, COD, Nitrate, Chloride, Silicate, Phosphate.

Biological-

Phytoplankton analysis, Biomass estimation, Zooplankton analysis, benthic macro invertebrates

(II). Analysis of soil

Physico chemical-

Sampling, texture, pH, Conductivity, Total alkalinity, Carbonates and bicarbonates, Acidity

Biological

(III).Community analysis of Grass land,

(IV).Study of bio indicators of pollution

(V)Primary productivity-biomass method, light and dark method,

(VI) Tools and techniques of- Flame emission spectrometry, Absorption spectrophotometry, Atomic absorption spectrophotometry, Gas chromatography

Model of questions
1.Physico chemical Analysis of water -
2.Biological Analysis of water -
3.Physicochemical Analysis of soil-

4.Experiments on one of the following
(Community analysis/ Study of bioindicators/ Primary productivity)
5.Spotting-(One)-
6.Viva-
7. Record -

PROJECTS

Project-1.

Study of animal biodiversity

- (i) **Insects**-beetles, Butter flies and moths
 - (i) **Fishes**
 - (iii) **Reptiles**
 - (iv) **Aves**
 - (v) **Mammals**
- (Of your locality-field survey report supported by still photographs.)

Project-2.

Survey of human population

- (i) Survey of human population of your district-various castes, socio economic states, health and education, male and female ratio-, Fertility/Mortality ratio-a brief report on your data.
- (ii) Survey of hospitals, private clinics to gather report on health status and diseases prevalent in your locality-field survey and report.
- (iii) Identification of malarial, Filaria, Kalaazar, TB, AIDS, anaemia, malnutrition, contaminated water drinking(diarrhoea), prone area of your locality- field survey and report.
- (iv).Field survey of human beings(Male Female, Age groups-between 10-16, 17-22, 23-32, 32-62) of your locality -Normal hair and baldness, hypertrichosis, Tongue rollers and non rollers of your locality-a brief survey report with suitable proofs of your work.

Systematics and Taxonomy

- Documentation of different animals of Santhal parganas

Project-3

Animal behaviour

- (I). Use of Binoculars, Digital still and video camera for still photography and videography in behavioural studies of animals.
- (II). Field observation –
 1. Watching of bird behaviour-courtship and mating, Nest building, brooding, feeding, etc. a brief pictorial field study
- (III) Watching of social life of insects of your locality-a brief pictorial study.
- (IV) Report on watching of behavioural studies of your pets and domestic animals
- (V) Study trip to Zoo for observing behaviour of animals.
- (VI) Study of behaviour of monkeys

Project-4

- Chemical and biological investigation of ponds and other water bodies of your village.
- Waste Management ecofriendly use of renewable source of energy and to develop social forestry scheme at your village
- Innovations in irrigation techniques and use of land for agriculture purpose and Soil testing of your village –brief report
- Introduction of bio fertilizers by the use of Vermiculture technology for your native place.

Project-5

Survey of human population suffering from anaemia, Sickle cell anaemia, malaria, filaria, leukaemia, AIDS of your locality--brief survey report.

Project-6

Survey on fish diversity of your locality

Project-7

- Field survey (during rainy season) of nearby ponds and ditches to observe embryological development of frog.-brief survey report

Book - List

1. M. Kato - The Biology of Bio-diversity, Springer.
2. J.C.Avisé - Molecular Markers, Natural History & Evolution. Chapman & Hall. N. York.
3. E.O.Wilson - Biodiversity, Academic Press, Washington
4. G. G. Simpson - Principles of Animal Taxonomy. Oxford IBH, Publishing Co.
5. E. Mayer. Elements of Taxonomy.
6. E.O.Wilson, The Diversity of Life (The College Edition) W. W. Northern & co.
7. B.K. Tikador - Threatened Animals of India ZSI Publicatio, Calcutta,
8. Batschelet E. Introduction to Mathematics for life Scientist, Springer-Verlag Berlin.
9. Sokal, R.R. and F.J. Rohif, Biometry (Freeman)
10. Sendecor, G.W. & W. G. Cochran. Statistical Methods, Affiliated East west Press, New Delhi. (Ind. ed)
11. Murray, J. D. Mathematical Biology, Springer - Verlag, Berlin.
12. E.J.W. Barrington - General & Comparative Endocrinology, Oxford, Clarendon Press.

13. P.J.Bentley, **Comparative Vertebrate Endocrinology**, Cambridge University Press.
14. R.H. Williams - **Text Book of Endocrinology**. W.B. Saunders.
15. C.R. Martin - **Endocrine Physiology**, oxford.
16. A Gorbman et al. **Comparative Endrocrinology**. John Willey & Sons
17. **Molecular Cell Biology** - J. Darnell et al, American Book. Inc.U.S.A.
18. **Molecular Biology of the Cell**-B.Alberts, et. al. Garland Publishing. Inc. New York.
19. Jha, A.P. **Genes and Evolution**, John Pub. N. Delhi.
20. King M. - **Species Evolution, The Role of Chromosomal change**, The cam, Univ, Press.
21. Strik Berger, M.W. **Evolution**, Jones & Bartett. Publishers, Boston, London.
22. Austen, C.R. and Short, R.V. **Reproduction in Animals**.
23. Schatten & Schatten - **Molecular Biology of Fertilization**.
24. F.T.Longo - **Fertilization**, Chapman & Hall
25. R.G. Edwards - **Human Reproduction**.
26. **Introduction to Instrumental Analysis**, Robbert Brauh, HNI International Editions.
27. **A. Biologist's Guide to Principles & Techniques of Practical Biochemistry**, K. Willson & K.H.Goulding. ELBS Ed.
28. Eckert, R. **Animal Physiology, Mechanism and Adaptation**. (Freeman) New York.
Hochachaka, P.W. and Somero. G.N. **Biochemical Adaptation**, Princeton, New Jersey.
29. Rummer. L. **Practical Biochemistry**, Tata Mac Graw.
30. Prosser. C. L **Environmental & Metabolic Animal Physiology**-Willey-Liss Inc. N.York.
31. Townsend, C.R. and P. Calow-**Physiological Ecology. An evolutionary approach to resource, use** Blackwell Sci. Publ. Oxford U.K.
32. Loun, G.N. **Physiological animal Ecology** Longman, Harios, U.K.
33. Russei - Hunter, W.D. **A Biology of Higher Invertebrates**.
34. Read, C.P. **Animal Parasitism** Prentice Hall Inc. New - Jersey.
35. Krebs. C.J.**Ecology** - Harpar & Row, N.York.
37. Krebs. C.J.**Ecological methodology**, Harper & Row, N. York.
38. **Animal Behaviour, An evolutionary approach**, U.S. A.
39. Glutton - Brock, T.H., **The evolution of Parental Care**, Princeton University Press - U.S.A.
40. Krebs, J.R. and N.B. Davis, **Behavioural Ecology**, Blackwell, Oxford U.K.
41. Wilson, E.O.-**Socio Biology, The New Synthesis** Harvard univ. Press, Cambridge Mass USA.
42. Kuby - **Immunology** W.H.Freeman, USA.
43. W.Paul - **Fundamentals of Immunology**.
44. I. M. Roitt - **Essential Immunology** ELBS edition.
45. **Introduction to Practical Molecular Biology**, P.O. Dabre, John Willey & Sons Ltd. N. York.
46. L.P.Freeman, **Molecular Biology of Steroid & Nuclear Hormone Receptors**, Birkhansar.
47. G.Litwack, **Biochemical Actions of Hormones** - Academic Press

48. Animal Diversity - E.D. Hanson. Prentice-Hall of India Pvt. Ltd. N. Delhi.
49. Biology Teachers, Hand Book, Joseph J. Schwab. Supervision, John Willey & Son Inc. (B.S.C.S) N. York.
50. Biological Science - An inquiry into Life (NCERT) Indian Edition, Harcourt, Brace & World, Inc. N.York.
51. Biological Science: Molecules to Man. Houghton Mifflin Co. Boston Mass. (BSCS Publication) "Blue version"
52. High School Biology BSCS "Green Version" Rand, Me Nally Co. Chi Caq O.
53. Microbes, their growth, nutrition, interaction [D.V.Health. & Co. Boston. Mass.]
54. Biological Investigations for Secondary School Students. Research Problems in Biology - Investigations for students -Series 1,2,3 & 4. Double Day & Co. New York.
55. Laboratory Exerciser in Biology - K. Krishna Swami : The Navcheton Press Pvt. Ltd., Naya Bazar, New Delhi – 6
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59. The Seas : Our Knowledge of life in the Sea and how it is gained. F.S. Russel & C.M. Younge, Warne.
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61. Cell and Molecular Biology - De Roberte and De Robertes (Sander's College)
62. Cell Physiology - A. Geese
63. Manual of Laboratory Exp. in Cell Biology (W.C.Brown publishers) Chordate
64. The Chordates - Alexander, R.M. (Cambridge University Press)
65. The Chordates - Monaith, A. R. (Cambridge University Press)
66. Chordata - Structure and Function - Waterman, A. J. (Mac Millan Co.)
67. Animal Physiology - Eckert, R. (W. H. Freeman) Review of Medical physiology, Ganong (Lange)
68. Outlines of Biochemistry- (Wilay) Conn. Stumpi, R.K. Bruening and Doc.
69. Endocrinology - Hadley. General Endocrinology - Bagnara, and Turner (W.B. Saunders)
69. Reproductive Physiology - (Nalbandov, A.V.)
70. Evolution Introduction to Evolution - Moody (Indian Ed) Envolution - Savege - (Holt, Reimhart, Winston)
71. Ecology - Odum (Amerind)
72. Fundamentals of Ecology - Odum - (Saunders)
73. Ecology - Ricklets (W.H. Freeman)
74. Limnology- Welch (Me Graw Hills)

75. Genetics (Mac Millan) - Strikberger
76. Genetics - Farnsworth (Harper & Raw)
77. Biochemistry Stryer, L. (Freeman)
78. Outlines of Biochemistry - Corntel (Willy)
79. Molecular Biology of the Gene - Watson, J.D et al (Benzamin/ Commings)
80. Development Biology - A Modern Sythesis, Rao, K.V. (oxfor, IBM, Publishers)
81. Principles of Gene Manipulation - An introduction to genetic engineering - R.W. Old, and S.B. Primrose.) (VCH, Publishers)
82. Biology - (Benzamin) Campbell
83. Text book of Zoology, Marshal & Williams
84. Biology the Foudations - (Wordsworth) Wolfe
85. Cell - (Bartlett & Jones) prescott.
86. Molecular Biology of the Cell (Garland) Albearts etal
87. Molecular Cell Biology (Freeman) Lodish et al
88. General & Comparative Physiology - Hoar (Prentice Hall)
89. Animal Physiology - Neilsen (Cambridge)
90. Integrated Principles of Zoology - Hickman, Robert and Hickman(Timer - Mirror Mosby)
91. Comparative Animal Physiology - Progser (Satish Book Enterprise)
92. Endocrinology - Hadley'(Prentice Hall)
93. A Introduction to Empryology - Balinsky (CBS College Publication)
94. Biology of Developing system - Grant (Holt, Reihart, Winston)
95. Developmental Biology - Gilbert (Sinour)
96. Economic Zoology - Shukla & Upadhyaya (Rastogi Publishers)
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98. Economic Zooiogy - VenKitaraman (Sudarsane Publishers)
99. Invertebrate Zoology - Sarnes (Half - Sanunder International)
100. Invertebrate structure and Function - Barrington (Nelson)
101. College Zoology - Boolootin & Stiles (Mac Millan)
102. A manual of Zoology - Part - I Invertebrate -Ekambarnath I Year (5. Vishwanathan)
103. A life of Invertebrates - Russel - Hunter (Mac Millan)
104. Molecular Biology of the Gene - Watson, J.D et al (Benzamin/ Commings)

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106. Molecular Biology - Glick College Zoology: Boolotian and Stiles (Mac Miilan) S.B.
- 107 Introduction to Embroyology - Balinsky (CBS College publishers
108. Developmental Biology - Biology - Berril, N. J. (Tata- Mc Graw Hill)
- 109 An outlines of Animal Development, -Davenport (Addison - Werley)
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113. Molcular Biology & Biotechnology - R. A. Meyers (ed
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119. Molcular Biology & Biotechnology - R. A. Meyers (ed)

(Sample Sheet)



SIDO KANHU MURMU UNIVERSITY

DUMKA, INDIA

GRADE SHEET

M.Sc. (Zoology)

Name.....

Roll No.....

Registration No.....

Semester.....

Session.....

Examination held in.....

Course Paper	Paper Title	Credit hours	Grade	Grade Points
Credit Hours			SGPA	

SGPA is computed only if the candidate passes in all the papers (gets a minimum 'E' Grade in all the papers)

Date.....

Controller of Examinations

(Sample Sheet)



SIDO KANHU MURMU UNIVERSITY
DUMKA, INDIA

Final GRADE SHEET

M.Sc. (Zoology)

Name.....

Roll No.....

Registration No.....

Semester.....

Session.....

Examination held in.....

Elective Papers.....

Semester	Total Credit Hours	Total Grade Points	Grade Point Average
Credit Hours		CGPA:	

CGPA is computed only if the candidate passes in all the papers of all the Semesters.

Date.....

Controller of Examinations