NEHRU GRAM BHARATI
(DEEMED TO BE UNIVERSITY)

KOTWA- JAMUNIPUR- DUBAWAL

ALLAHABAD (UTTAR PRADESH)

SYLLABUS

For the

B.Sc. – ZOOLOGY

(Six Semester Credit System)

[W.e. f. 2019-2020]

ABOUT NEHRU GRAM BHARAT

Nehru Gram Bharati (Deemed to be University) occupies an esteemed place among the rural universities of India for over decades now. Established on 27th June 2008, it is one of the promising institutes in the State of Uttar Pradesh situated at the bank of river Ganges. It was basically conceived by our Ist Prime Minister of India, Late Pt. Jawahar Lal Nehru, who laid the foundation stone of Nehru Gram Bharati on 26th July 1962 in the village of Rishi Durvasha Ashram, Kotwa-Jamunipur, Dubawal Complex of his phulpur constituency in Allahabad District. His dream was translated into reality by Sri J.N. Mishra, who had a clear vision and dedication to the cause of upliftment of rural masses through education.

As on date, the campus has emerged as a prominent establishment of professional, technical education and traditional education for meeting the aspirations of youth from rural as well as urban areas. To begin with Rajiv Gandhi Degree College was established in the year 1996 and upgraded to Rajiv Gandhi Post Graduate College from the academic session 2000-01 which subsequently merged into the Nehru Gram Bharati (Deemed to be University) in 2008-09 after University Grants Commission recommended to the Ministry of Human Resource & Development for granting it Deemed to be University Status. The MHRD notified vide its gazette Notification no. F.9-42/2005-43(A) dated as 27th June 2008 bestowing the Deemed to be University status to Nehru Gram Bharati

The Nehru Gram Bharati (Deemed to be University) is composed of six campuses encircling approximately 76 acres of land spread over within a radius of about 5 Kilometers. The campuses are as under :

Nehru Gram Bharati (Deemed to be University), Jamunipur Main Campus: The lush green campus has buildings for Administrative Office, Central Library, Faculty of Teacher Education, Arts, Science & Commerce. The Undergraduate Courses viz., Bachelor of Arts (in the subjects Ancient History, Pol. Science, Hindi, Geography, Education, Sanskrit, English, Sociology, Home Science, Economics, Music & Philosophy), Bachelor of Commerce, Bachelor of Science (In Physics, Chemistry, Zoology, Mathematics & Physics), Bachelor of Education(B.Ed.), Bachelor of Special Education (Hearing Impairment), Diploma in Special Education(D.Ed.Spl.Ed.[HI]), Bachelor of Elementary Education (B.El.Ed.), Diploma in Elementary Education (D.El.Ed.) are being offered in this campus. The Post Graduate Courses viz., Master of Arts (In Ancient History, Pol. Science, Hindi, Education, Sanskrit, English, Economics, Sociology, Home Science, Philosophy & Geography), Master of Commerce, Master of Science (In Physics, Chemistry, Zoology, Mathematics and Botany), Master in Education (M.Ed.), Master of Special Education in Hearing Impairment (M.Ed.Spl.Ed.[HI] are being offered in the campus.

VISION

We aim to nurture and promote youth especially from rural area by providing high quality education and training in keeping with the promise of Late Pt. Jawahar Lal Nehru. Our dream is to build a role model Institution with state of art infrastructure providing right ambience for creativity and stimulation in thinking to generate new ideas for research and application of skill for developing technology for welfare of mankind.

MISSION

Our mission is to empower the nation through preparation of competent and trained human resource. University has plans to enhance capability of young talents for fulfillment of their aspirations through innovation, skill development and proper training. We endeavor to enhance employability through training and spirit of competitiveness. We emphasize inculcating initiative for entrepreneurship generating self employment and national wealth.

ABOUT DEPARTMENT

The Department of Zoology came into existence in1996 for UG level teaching in Rajeev Gandhi Post Graduate College. It was upgraded as a PG and Research Department in 2008 after come in to existence of Nehru Gram Bharati (Deemed to be University). Now the Department runs semester based Under Graduate programme (B.Sc.) and Choice Based Credit System pattern Post Graduate programme (M.Sc.) with three specializations viz., Environmental Biology, Fishery Science and Cell Biology. In addition, the curriculum of M.Sc. Zoology includes general papers such as Biochemistry and Development Biology, Endocrinology, Molecular Biology, Biotechnology, Sericulture, Apiculture and Tools and Techniques in Biology which provides an ample knowledge in the domain of Life Sciences.

The Department offers Ph.D. Programme in the field of aquatic ecology, Fisheries, Biochemistry and Biotechnology. The Department also offer two Post graduate Diploma in "Aquaculture Technology and Management" and "Environmental Impact Assessment (EIA)". The main aim of the department is to impart training to students by which they can become self-employable and attain the heights of success in future. The Environmental Biology provide ample of jobs opportunities in the field of EIA and EMP sectors as environmental executives in Government and private institution. In India, Fisheries has been developed as agro-based industries with a vast potential to the rural economy.

The department is credited for producing several post-graduate students and awarded many doctoral degrees. Its alumni are doing exceptionally well in the society. The academic training imparted to the department's M.Sc. students, equips them to enter doctoral programs of leading institutes in the country and abroad. These areas generate employment opportunities as given below:

1. Generation of employment and revenue through inland fish culture.
2. Generation of employment and revenue through Sericulture
3. Generation of employment and revenue through Apiculture
4. Direct employment through EIA as Environmental executive

Vision:

The holistic development of the student and make them able to contribute effectively for their welfare and society in this dynamic era.

Mission

- Provide inexpensive educational services, inspire to all the section of society to get expertise /skills at P.G. and above level in biological sciences.
- To develop research aptitude and a scientific advancement.
- Inculcate high values through a liberal education and also to provide platform to have non-formal educational services.
- To bring about an awareness regarding nature and biodiversity and help to solve different problems to establish sound and peaceful environment and life for community and society.
- Provide a broad range of Transform society through the empowerment of youth.
- Reinvent ourselves in response to the changing demands of society with high moral values as a good citizen.

PREAMBLE

The syllabus for B. Sc. based on semester with credit based pattern comprises of six semesters. The examination shall be of Minimum 18 (eighteen) and Maximum 20 (twenty) theory papers and 6 practical. From semester I to IV, each theory and practical will be of 50 marks. The Examination in each theory paper and laboratory course shall be of three hours duration.

PROGRAMME INTRODUCTION

PROGRAMME OBJECTIVES (POs)

The aim and objective of the B.Sc. Zoology programme

- To provide knowledge to the students about working principles, design guidelines and experimental skills associated with different fields of Zoology.
- To provide knowledge many job and self employment oriented course such as Genetics and Cell Biology, Biochemistry, Molecular Biology, Biotechnology, Economic Zoology etc.
- To educate about conceptual and practical knowledge of the Ecology, Biostatistics, Biodiversity, Physiology, Endocrinology, Developmental Biology, Biochemical Techniques, Animal tissue culture etc.
- To aware the students with scientific and technological knowledge for uplifting and improvement of the social and environmental health in the rural areas

PROGRAMME SPECEIC OUTCOMES (PSOs)

The students pursuing this course would have to develop in depth understanding various aspects of the subject.

- After completion of the programme students have all the conceptual and practical knowledge about basic and advance course for utilizing seeking of jobs and self employments
- The students get opportunities in technical expert government as well as private sector especially in the filed of environmental pollution, fisheries, molecular biology laborites and many more.
- The students get opportunities in various competitive exams like civil services, defense, and other graduate level exams.
- Students join various higher studies in advance courses in India and aboard and obtained better job opportunity and play role for social improvement.

ORDINANCE AND REGULATIONS FOR M.Sc. (ZOOLOGY) DEGREE PROGRAMME

A. ORDINANCE

1. The Degree of Bachelor Science (B.Sc.)

The Nehru Gram Bharati (Deemed to University) may confer the Degree of Bachelor's Programme in Science on Such candidates who, being eligible for admission to the Bachelor's Degree Programme, have received regular instruction in the prescribed course of study, passed successfully relevant examinations and being otherwise suitable by virtue of their character, have fulfilled such other condition as may be laid down from time to time by the appropriate authorities.

2. Requirement for Admission

A. Registration:

Candidates of Bachelor Degree shall first be admitted to the first semester upon the reopening of the University after summer vacation every year.

Subsequent Registration

A candidate, who fails to clear a regular course of study during any of the second, third, fourth, fifth and sixth semesters may be registered in the appropriate term of any subsequent year to the semester concerned but within such time as enables him, to compete the study of all semester comprising Bachelor Degree Programme within a maximum period of five years from the date of his/her registration for the first semester.

Minimum Qualification For Admission

(i) Admission to the Bachelor's Degree Programme of study shall be open to those candidates who have passed the 10+2/intermediate exam from any Board (U.P Board/CBCS board/ICSC/or any other Govt. recognized board). Admission shall be made according to merit subject to the fulfillment of eligibility requirement as determined by the University and availability of seats in the Bachelor courses.

Conditions of Admission:

(i) No application for registration to the First Semester shall be entertained unless it is accompanied by:

(a) Original Transfer certificate of a candidate who has been a regular student in any Institution at any time prior to making application for registration in the Faculty.

(ii) Candidate shall give also a written undertaking to the effect that:

(a) He/She shall exclusively devote his/her time to the study of courses prescribed for Bachelor's Degree and in particular he/she shall not offer any other course leading to a degree of any description whatsoever, not shall he/she undertake any remunerative work, though with the prior permission of the Faculty, he/she may join certificate of or diploma courses in any foreign language.

(b) He/She shall abide by the provision of NGB (DU) Act, Statutes, Ordinances, Regulations and Rules that are framed or may be framed there under and the orders of Officers and authorities of the University and the concerned Faculty from time to time.

3. **The Curriculum and Duration of Studies**

(i) The Curriculum of study of the Bachelor Degree shall comprise of three years.

(ii) The Departmental Committee shall prescribe the detailed content of various of study, if required before the of beginning V^{th} and 6^{th} semester. The Departmental Committee can make changes in the optional papers/subjects, subjects to the availability of teaching facility/ faculty.

4. **Intake Capacity:** 120 seats (As per NGB policy)
5. **Reservation Policy:** As per Govt. of India Policy
6. **EVALUATION**

The evaluation scheme of examination consists of two parts: Internal Assessment (IA) and End Semester Examination (ESE). Internal assessment includes Assignments/Seminars/ Unit test/Group activities/Discussion, etc. The internal assessment will contribute 20% and the end semester examination will contribute 80% to the total marks.

There shall be continuous assessment of the student in each course. The course instructor shall hold a maximum of three and minimum of one internal test /assignment /presentation, etc.

In case of semester examination, there shall be no binding on the number of external paper setters/examiners, generally the course instructor shall be the paper setter and examiner. The duration of the End Semester Examination (ESE) of each course will be 3 Hours.

7. **FEE:**

The students pursuing Bachelor's Degree Programme of study shall have to pay fee as may be prescribed by the University from time to time.

REGULATIONS

(a) The syllabus for B.Sc. based on semester with credit based pattern comprises of six semesters. The examination shall be of Minimum 18 (eighteen) and Maximum 20 (twenty) theory papers and 6 practical. From semester I to IV, each theory and practical will be of 50 marks.

(b) During semester V & VI, paper 1 and 2 is compulsory while paper III is elective. There are two elective papers for paper 3. Out of 2 elective papers the students may choose any one. In the semesters V & VI, the marks for theory will be 75 and the marks of practical will be 75. The credits for theory papers and practical in semesters I to IV will be of 2 credits, while in V and VI semester will be of 3 credits. Thus total number of credits from I to IV will be 32 credits while in V and VI semester the number of total credits will be 24 credits. Thus the grand total of credits in B.Sc. will be 56 for each subject.

(c) The semester I to IV has 8 credits (2X3=6 theory and 2×1=2 practical, Total=08 credit in each semester) and V to VI has 12 credits (3X3=9 theory and 3×1=3 practical, Total 12 credits). There shall be six practical and one seminar/project in complete course. The Examination in each theory paper shall be of three hours duration. The structure of syllabus for B.Sc. (Semester with credit based pattern) is given in the following table.

(d) Each semester shall have minimum 90 teaching days, exclusion of holidays, admission and examinations.

PROGRAMME STRUCTURE

The M.Sc. in Zoology programme is a two-year course divided into four semesters, each semester is of six months duration. The 2-year full-time Masters' degree in Zoology with 80 credits (each semester of 20 credits).

Course Credit Scheme

Semester	**Compulsory paper**			**Elective papers**			**Total credits**
	No. Of Papers	Credits (T+L)	Total Credits	No. Of Papers	Credits (T+L)	Total Credits	
I	3	6T+2L	**8**	-	-	**-**	**8**
II	3	6T+2L	**8**	-	-	**-**	**8**
III	3	6T+2L	**8**	-	-	**-**	**8**
IV	3	6T+2L	**8**	-	-	**-**	**8**
V	2	6T+3L	**9**	1	3T+0L	**3**	**12**
VI	2	6T+3L	**9**	1	3T+0L	**3**	**12**
Total Course Credits	-	-	-	-	-	-	**56**

Semester Wise Breakup Structure

Sr. No.	Code	Paper	Title	IA	ESE	Total Marks	Credits
Semester I							
1.	BOZ 101	Paper I	Lower Non-chordate	10	40	50	2
2.	BOZ 102	Paper II	Higher Non-chordate	10	40	50	2
3.	BOZ 103	Paper III	Taxonomy & Evolution	10	40	50	2
4.	BOZ 104	Practical				50	2
			Total Credits			**200**	**8**
Semester II							
5.	BOZ 201	Paper I	Chordate	10	40	50	2
6.	BOZ 202	Paper II	Animal Physiology	10	40	50	2
7.	BOZ 203	Paper III	Endocrinology & Comparative Anatomy	10	40	50	2
8.	BOZ 204	Practical				50	2
			Total Credits			**200**	**8**
Semester III							
9.	BOZ 301	Paper I	Cell Biology and Immunology	10	40	50	2
10.	BOZ 302	Paper II	Genetics	10	40	50	2
11.	BOZ 303	Paper III	Biochemistry	10	40	50	2
12.	BOZ 304	Practical				50	2
			Total Credits			**200**	**8**
Semester IV							
13.	BOZ 401	Paper I	Ecology	10	40	50	2
14.	BOZ 402	Paper II	Wild Life & Management	10	40	50	2
15.	BOZ 403	Paper III	Instrumentation	10	40	50	2
16.	BOZ 404	Practical				50	2
						200	**8**
Semester V							
17.	BOZ 501	Paper I	Economic Zoology	15	60	75	3
18.	BOZ 502	Paper II	Animal Behavior	15	60	75	3
19.	BOZ 503EB	Paper III	Environmental Biology	15	60	75	3
20.	BOZ 503V	Paper III	Vermicomposting	15	60	75	3
21.	BOZ 504	Practical				75	3
			Total Credits			**300**	**12**
Semester VI							
22.	BOZ 601	Paper I	Molecular Biology	15	60	75	3
23.	BOZ 602	Paper II	Genetic Engineering	15	60	75	3
24.	BOZ 603B	Paper III	Biostatistics	15	60	75	3
25.	BOZ 603BI	Paper III	Bioinformatics	15	60	75	3
26.	BOZ 604	Practical				75	3
			Total Credits			**300**	**12**

B.Sc. [Zoology]

PROGRAMME OUTCOME (POS)

PO1	After completion of the programme students will have the conceptual and practical knowledge about basic and advance courses for utilizing it in seeking of jobs and self employment.
PO2	The students get opportunities to become technical expert in the government as well as private sector jobs, especially in the filed of environmental pollution, fisheries, molecular biology laboratories etc.
PO3	The students get opportunities in various competitive exams like civil services, defence, and other graduate level exams.
PO4	Students join various higher studies in advance courses in India and abroad and obtain better job opportunity and play role for social improvement.
Programme Specific Outcome (PSOs)	
PSO1	The students will get opportunities to become technical expert in the government as well as private sector jobs.
PSO2	Students will get opportunities to work in the field of environmental pollution.
PSO3	Students get opportunities to work in the field of fisheries.
PSO4	Students get opportunities to work in the field of molecular biology laboratories etc.

COURSE OUTCOMES- B.Sc. [Zoology]

Semester-I

Paper-I Lower non-chordate (BOZ101)	**CO.1** Describe unique characters and diversity of protozoa and type study
	CO.2 Describe unique characters and diversity of porifera and type study
	CO.3 Describe unique characters and diversity of coelenterata and type study
	CO.4 Describe unique characters of platyhelminthes and type study
	CO.5 Describe unique characters of Aschelminthes and type study
Paper-II Higher non-chordate (BOZ 102)	**CO.1** Describe unique characters of annelids and life functions of the organisms
	CO. Describe unique characters of arthropods and life functions of the organisms
	CO.3 Describe unique characters of mollusca and life functions of the organisms
	CO.4 Describe unique characters of echinoderms and life functions of the organisms.
	CO. 5 Describe unique characters of hemichordates and life functions of the organisms belong to this group
Paper-III Taxonomy &Evolution (BOZ103)	**CO.1** Understand the relation between Taxonomy & evolution and describe Zoological nomenclature.
	CO.2 Understand theories of evolution and origin
	CO.3 Understand the various theories; Lamarckism and Darwinism
	CO.4 Understand the mutation and isolations
	CO.5 Understand the speciation and mimicry pattern
Practical (BOZ 104)	Practical understanding of nervous system of the animals with models. Prepare permanent slides and museum conservations. Know about Taxonomic identification and characteristic features. Know about animal evolution

	through practical process

Semester-II

Paper-I Chordates (BOZ 201)	**CO.1** Understand unique characters of Urochordates, cephalochordates
	CO.2 Understand unique characters of fishes and type study
	CO.3 Understand unique characters amphibian and reptiles and their features
	CO. 4 Understand unique characters of birds and their migration features
	CO.5 Understand unique characters of mammals
Paper- II Animal Physiology (BOZ 202)	**CO.1** Understand the physiology at cellular and system levels
	CO.2 Describe the physiology of respiratory, renal, digestion and reproductive systems
	CO.3 to define normal and abnormal functions
	CO.4 Understand how physiological parameters are measured in mammals
	CO.5 Understand solution and their transport of molecule
Paper-III Endocrinology & Comparative Anatomy (BOZ 203)	**CO.1** Understand the endocrine system and their functions
	CO.2 Describe the physiology endocrine and reproductive systems to define normal and abnormal functions.
	CO.3 Describe the functioning of hormones
	CO.4 Understand the comparative anatomy of the various systems
	CO.5 Understand the comparative anatomy of the brain
Practical (BOZ 204)	Know about afferent and efferent arterial system of *Scoliodon* through practical process. Know about cranial nerves, internal ear nervous system of the animals with practical models. Prepare the permanent slides and museum conservations. Know about vertebrate physiological study through experiments. Endocrine gland and its functions.

Semester-III

Paper-I Cell Biology & Immunology (BOZ 301)	**CO.1** Differentiate between prokaryotes and eukaryotes cells and their structure functions
	CO.2 Understand the importance of the nucleus and its components.
	CO.3 Understand how the endoplasmic reticulum and Golgi apparatus interact with one another and know with which other organelles they are associated
	CO.4 Understand and explain the basic concepts of immune system and how it helps a person to overcome various types of diseases
	CO.5 Understand and antigen and antibody reactions and Immune disorder
Paper- II Genetics (BOZ 302)	**CO.1** Understand comprehensive and detailed understanding of the chemical basis of heredity.
	CO. 2 Understand about role of mutation and nucleic acid in genetics
	CO. 3 Evaluate conclusions that are based on genetic data
	CO. 4 Understand results of genetic experimentation in animals
	CO. 5 Understand the molecular and cytoplasmic inhertance
Paper-III Biochemistry (BOZ 303)	**CO.1** Understand the physiology at cellular and system levels
	CO.2 Describe the role and functions of different biomolecules
	CO.3 Describe the physiology of glycolysis, Kreb's Cycle, oxidative phosphorylation and Electron Transport system

	CO.4 Understand the mechanisms of Gluconeogeneis, Cori's cycle, Urea cycle, fatty acid synthesis and enzymes.
	CO.5 Understand role of vitamins for health
Practical (BOZ 304)	Know about cell division mitosis and meiosis through experiment. Know about immunological study with staining methods and blood group detection. Know experimentally about genetic disorders and sex linked disease

Semester-IV

Paper-I Ecology (BOZ 401)	**CO.1** Understand the concept of ecology and its type
	CO.2 Understand various ecosystems
	CO.3 Describe various natural biogeochemical cycles and law of energy flow
	CO.4 Understand the population dynamics and age structure
	CO.5 Understand the communities in the ecosystem
Paper-II Wild Life Management (BOZ 402)	**CO.1** Understand the wild life, its type and management
	CO.2 Understand various rules and act for conservations and also public movements to conserve the wild life
	CO.3 Know about endangered flora and fauna and national parks and sanctuaries
	CO.4 Know about the national parks and sanctuaries and their role
	CO.5 Understand the various environmental movement by human beings
Paper-III Instrumentation (BOZ 403)	**CO.1** Understand principals and functioning of Centrifuge
	CO.2 Develop skill for handling electrophoresis and chromatography
	CO.3 Understand principals and functioning of various microscopes
	CO.4 Understand principals and functioning of electron microscopes
	CO.5 Understand principals and functioning of microtome
Practical (BOZ 404)	Understand physicochemical study of water and soil through practical methods. Know adoption through experiment/model methods. Know wild life study through model sheet. Experimental knowledge of various biological instruments

Semester-V

Paper-I Economic Zoology (BOZ 501)	**CO.1** Understand the life cycle of various kinds of useful insects
	CO.2 Know about pest and their managements
	CO.3 Know about protozoan disease and its impact on human health
	CO.4 Know about life cycle and culture of useful insects
	CO.5 Know about life cycle and knowledge aquatic culture
Paper-II Animal Behaviour (BOZ 502)	**CO.1** Understand animal behavior and its type
	CO.2 Understand migration and social behavior of animals
	CO.3 Understand reproduction and courtship behaviour
	CO.4 Understand motivational behaviour of animals
	CO. 5 Understand role of hormones in behaviour
Paper-III Environmental Biology (BOZ 503EB)	**CO.1** Know about pollution and its impact on human health
	CO.2 Know about various kinds of natural resources
	CO.3 Understand about biodiversity concept and its role in environment
	CO.4 Know about various kinds of techniques for environment conservation
	CO.5 Know solid –waste management and its role

Paper-III Vermi-composting (BOZ 503V)	**CO.1** Able to understand conceptual knowledge of Vermicomposting
	CO.2 Able to understand practical knowledge of Vermitechnology
	CO. 3 Able to know about how to use Vermitechnology for self employment
	CO.4 Student able to know about farming in rural areas
	CO.5 Student able to know about practical application of the Vermicompostin
Practical (BOZ 504)	Know experimental knowledge of the life cycle of the insect pests. Know about preparation and submission project based on animal behaviour. Know about experimental estimation of the water quality and biodiversity study from various ecosystems

Semester-VI

Paper-I Molecular Biology (BOZ 601)	**CO.1** Understand structure and functions of DNA
	CO.2 Understand structure and functions of RNA
	CO.3 Know about the protein synthesis in prokaryotic cells
	CO.4 Understand gene and its function
	CO.5 Understand the gene expressions in various models
Paper-II Genetic Engineering (BOZ 602)	**CO.1** Know about genetic engineering and cloning
	CO.2 Understand DNA finger printing
	CO.3 Know about Gene therapy and Gene Library
	CO.4 Know about job orientation in genetic engineering technology
	CO.5 Knowledge about vaccine
Paper-III Biostatistics (BOZ 603)	**CO.1** Understand biological data collection and analysis
	CO.2 Know about data presentation in various method like charts, graphs,
	CO.3 Know about determining the level of data significance
	CO. 4 Know about various methods for data testing
	CO.5 Knowledge about hypothesis and types
Paper-III Biostatistics (BOZ 603)	**CO.1** Students able to gain knowledge about bio-informatics
	CO.2 Students able to know about data base study of nucleic acid sequence
	CO.3 Students able to know about scientific role of bioinformatics in research
	CO.4 Students able to know about multiple sequence, primer designing
	CO.5 Students able to know genomics and microarray
Practical (BOZ 604)	Know about molecular study based on models experiments. Know about genetic engineering like cloning, Recombinant Technology through work sheet. Know about biological data collection, analysis, presentation and interpretation

B.Sc.-Zoology

Semester I

Paper I: Lower Non-chordate (BOZ101)

Unit - I

General Classification of Phylum Protozoa upto classes
Protozoa: *Trypanosoma*: Structure, Nutrition, Life cycle
Paramecium: Structure, Nutrion, Excretion, Reproduction

Unit - II

General Classification of Phylum Porifera upto classes
Porifera: *Sycon (Scypha)*: Structure, nutrition & Reproduction
Canal system in sponges: cell types, spicules

Unit - III

General Classification of Phylum Cnideria upto classes
Cnideria: *Obelia*: Structure, Obelia colony, Nutrition, Reproduction, Life Cycle, Polymorphism

Unit – IV

General Classification of Phylum Platyhelminthes
Platyhelminthes: *Echinococcus, & Taenia Solium*: Structure, Nutrition & Life Cycle

Unit - V

General Classification of Phylum Aschelminthes upto classes
Aschelminthes: *Wuchereria bancrofti & Ascaris:* Structure, Nutrition & Life Cycle
Parasitic adaptations in helminthes

Recommended Books

1. Parker, Haswell and Williams - Text book of Zoology (Non Chordata) Vol. I A.Z. T.B.S. Publisher and Distributor.
2. Nigam H.C. - Zoology of Non Chordate, Vishal Publication
3. Hyman, L.H. - The Invertebrate (Vol 1 to 6.)
4. Kotpal R.L. - A text book of Invertebrate, Rastogi Publication

Paper II- Higher Non-chordate (BOZ 102)

Unit - I

General Classification of Phylum Annelida upto classes
Annelida: *Nereis* : Structure, Nutrition, Excretion,
Nervous system, Reproduction

Unit - II

General Classification of Phylum Arthropoda upto classes
Arthropoda: *Palaemon* Structure, Nutrition, Excretion,
Nervous system, Reproduction
Insect Metmorphosis

Unit - III

General Classification of Phylum Mollusca upto classes

Mollusca: *Unio, Pila*: Structure, Nutrition, Excretion, Nervous system, Reproduction
Torsion and detorsion in Gastropods

Unit - IV
General Classification of Phylum Echinodermata upto classes
Echinodermata: *Asterias*: Structure, Nutrition,
Excretion, Reproduction

Unit - V
General Classification of Hemichordata upto classes
Hemichordata: *Balanoglossus* and its affinities.
Affinities of Ctenophora

Recommended Books

1. Parker, Haswell and Williams - Text book of Zoology (Non Chordata) Vol. I A.Z. T.B.S. Publisher and Distributor.
2. Nigam H.C. - Zoology of Non Chordate, Vishal Publication
3. Hyman, L.H. - The Invertebrate (Vol 1 to 6.)
4. Kotpal R.L. - A text book of Invertebrate, Rastogi Publication

Semester I
Paper III- Taxonomy & Evolution (BOZ 103)

Unit - 1

Principles of taxonomy and hierarchy
International code of Zoological Nomenclature
Numerical taxonomy
Chemical taxonomy

Unit - II
Origin of Life
Evidences of organic evolution: Vestigial organ
Connecting link, Homologous & Analogous

Unit –III
Theories of evolution: Lamarckism, Neo-Lamarckism,
Darwinism, Neo- Darwinism
Natural selection

Unit –IV

Mutation: Definition and types
Isolation Definition and Types

Unit-IV

Speciation Definition and types
Mimicry Definition & role in evolution

Recommended Books

1. Moody : Introduction to Evolution (Indian Edition).
2. Strickberger : Evolution
3. Ashok Verma : Principal of Animal taxonomy

Practical

Practical (BOZ 104)

Models	10
Permanent slide preparation	05
Comments on spots from 1-10	20
Evolution	05
Viva-voce	05
Practical record & Attendance	05
	50

Models

Palaeomon **(Prawn) -** Appendages and nervous system.

Unio & Pila **-** External features, General anatomy and nervous system.

Contents of Practicals:

Study of Museum Specimens and slides relevant to the type studies in theory:

Mounting:

Gemmule, Parapodium of Nereis, Gill of Pila & Unio, Statocyst of Prawn, spermathecae, nephridium and ovary of Earthworm.

Museum Specimens:

Porifera **:***Leucosolenia, Sycon, Grantia, Cliona, Spongilla, Euspongia, Hylonem*

Cnideria **:** *Physalia, Millipora, Aurelia, Rhizostoma, Alcyonium, Tubipora Gorgonia, Pteroids, Adamsia, Madrepora, Fungia, Metridium, Fungia, Rhizostoma, Prorpita*

Platyhelminthes **:***Planaria, Fasciola, Taenia solium.*

Aschelminthes **:** *Ascaris,* (Male & Female).

Annelida **:***Nereis, Heteroneries, Aphrodite, Chaetopterus, Pontobdella.*

Mollusca **:***Chiton, Dentalium, Patella, Aplysia, Doris, Pecten, Pinctada, Teredo, Loligo, Sepia, Octopus, Nautilus.*

Arthropoda **:***Lepus, Balanus, Sacculina, Mysis, Eupagurus, Limulus, Julus, Scolopendra, Lepisma.*

Echinodermata **:***Astropecten, Clypeaster, Holothuria, Antidon.*

Permanent Slides:

Protozoa : *Paramecium,* W.M. Binary Fission, Conjugation in *Paramecium, Monocystis, Opalina, Balantidium, Entamoeba, Leishmania.*

Porifera : Spongin fibres, gemmule, spicules, L.S. & T.S. of *Sycon.*

Coelenterate (Cnideria) : T.S. of *Hydra* through gonads, *Obelia* W.M., *Obelia* medusae, Ephydra Larva.

Helminthes : *Fasciola* through testes; Scolex, mature and gravid proglottid of *Taenia solium,* Miracidium, Redia, Cercaria, Metacercaria, Cysticercus larva.

Annelida : T.S. *Nereis,* parapodium of nereis and heteronereis, trochophore larva, T.S. of Leech through Crop.

Arthropoda : Megalopa, Mysis, Zoea, Nauplius, Daphnia, Cyclopes, Mouthparts of male and female *Culex* and *Anapheles, Pediculus* W.M., *Cimex* W.M.

Echinodermata : T.S. of arm of starfish, pedicellaria, bipinnaria larva.

Hemichordata : T.S. of *Balanoglossus* through anterior and branchiogenital regions.

Taxonomy & Evolution: Photo Sheet exercise

B.Sc.-Zoology

Semester II

Paper I- Chordates (BOZ 201)

Unit -I

General classification of chordates upto orders
Functional morphology of type forms
Protochordata: *Herdmania, Branchiostoma*
Retrogressive metamorphosis

Unit -II

Pisces: *Scoliodon*: Structure, Nutrition, Blood vascular system,
Nervous system, Urino-genital System
Type of scales

Unit -III

Amphibia: Neoteny, parental care
Reptilia: Poisonous & non poisonous snakes
Snake biting mechanism.

Unit -IV

Birds (Aves): Characteristics features
Flight adaptations
Bird migration

Unit -V

Mammals: Characteristics features
Egg laying mammals
Marsupiales

Recommended Books

1. Romer - The life of Vertebrates.
2. Colbert - Introduction to Vertebrate Evolution.
3. Parker & Haswel -Book of Zoology (Volume II), (Chordata) CBS Publishers
4. Yong J.Z. -Life of Vertebrates, ELBS
5. Nigam H.C. -Zoology of Chordates, Vishal Publications, Jalandhar.
6. Kotpal R.L. -Text book of vertebrates, Rastogi Publications.
7. Chapman G. & Baker, W.B.-Zoology, Longmans Greens, London.
8. Prasad S. N. & Kashyap V.-A Textbook of Vertebrate Zoology, (New Age)

Semester II

Paper II- Animal Physiology (BOZ 202)

Unit I

Digestion System: Structure, Function & regulation
Digestive glands and its functions

Unit II

Circulatory system: Structure of heart, artery & veins
Mechanism of Blood circulation
Blood: Types, functions

Unit III

Respiratory System: structure of reparatory organ
Breathing Mechanism, Lung capacity
Gaseous transport & control

Unit IV

Excretory system: Structure and function of Nephron
Urine formation, Micturation
Skeleton system, bones, cartilages

Unit V

Mechanism of neuromuscular co-ordination
Solutions, Osmotic Pressure, diffusion, active and passive transport
Buffers, pK and pH
Homeostasis

Recommended Books

1. Wood D.W. : Principles of Animal Physiology
2. Eckert and Randell :Animal Physiology CBS
3. Guyton A.C. : Medical Physiology
4. Berry A.K. : Animal Physiology
5. Srivastava, Agrawal and Kumar : Animal Physiology
6. Samson Wright : Applied Physiology, Oxford Medical Publications

Semester II
Paper III- Endocrinology & Comparative Anatomy (BOZ 203)

Unit I

Origin of Pituitary, Structure and function
Types of Hormones from Pituitary Gland

Unit II

Thyroid Gland: Structure, Types of Hormones & Functions
Adrenal Gland: Structure, Types of Hormones & Functions

Unit III

Hormones from Pancreas
Hormones from Sex organ
Penal gland

Unit IV
Circulatory system
Integumentary system

Unit V
Urino-genital system
Nervous system with special reference to brain

Recommended Books

1. Gorbamn, A & Burn H.A. : A text book of comparative endocrinology (Willey Eastern)
2. Yadav J.S. :Endocrinology
3. Guyton A.C. : Medical Physiology
4. Srivastava, Agrawal and Kumar : Animal Physiology
5. Baynara & Turner : General Endocrinology (W.B. Saunder's
6. Yong J.Z. : Life of Vertebrates, ELBS
7. Nigam H.C. : Zoology of Chordates, Vishal Publications, Jalandhar.
8. Kotpal R.L. :Text book of vertebrates, Rastogi Publications

Practical

Practical (BOZ 204)

Models	10
Permanent slide Preparation	05
Physiological Exercise	10
Endocrinology	05
Comments on spots from 1-10	10
Viva-voce test	05
Practical record	05
	50

Contents of Practical:

Study of Museum Specimens and slides relevant to the type studies in theory:

1. Museum Speciation

Protochordata **:** *Herdmania, Amphioxus*
Cyclostomes **:** *Petromyzon, Ammocoete* larva, *Myxine*
Pisces **:***Trygon, Pristis, Torpedo, Protopterus, Hilsa, Labeo, Wallago, Exocoetus, Hippocampus, Anabas, Chiemera, Diodon, Synaptura, Echeneis, Tetradon*
Amphibia **:***Icthyophis, Ambystoma,* Axolotal larva, *Salamendra, Amphiuma, Proteus, Siren, Alytes, Pipa,*
Reptilia **:***Chelone, Testudo, Sphenodon, Chaemeleon, Phrynosoma, Draco, Iguana, Haloderma, Typhlops, Python, Bangarus, Naja, Hydrophis, Viper, Natrix, Crotalus*
Aves **:***Pigeon, Fowl*, Chick, W.M. Flight Feather

Mammals **:***Hedgehog, Manis, Hystrix,* Bat

2. Permanent Slides

Protochordata	**:**	W.M. *Salpa, Doliolum,* T.S. of *Amphioxus*, Spicules of *Herdmania.*
Amphibia		**:**V.S. of Skin, T.S. through alimentary canal, C.S. of Liver, C.S. of Lung, T.S. of Kidney, T.S. of gonads.
Aves		**:**W.M. of filoplumes, W.M. of down feather
Mammals		**:**V.L.S. through Skin, T.S. of Liver, T.S. of Lung, T.S. of Kidney, T.S. of Gonads.
3. Models- *Scoliodon*		: Afferent and efferent arterial system Cranial nerves, Internal ear.

4. Physiology

: Estimation of Haemoglobin, Counting of RBC and WBC in Human Blood, Preparation of Hemin Crystals, Preparation of blood film of frog.

5. Endocrinology: Photo sheet of various disease caused by Endocrine gland: Exopthalmic Goiter, Acromegly, Graves Disease, Midget

Semester III

Paper I- Cell Biology& Immunology (BOZ 301)

Unit I

Introduction of Cell
Prokaryotic and Eukaryotic
Cell theory, Cell organelles

Unit II

Ultra structure & Functions: Mitochondria
Ultra structure & Functions: Golgi bodies
Ultra structure & Functions: Endoplasmic Reticulum

Unit III

Ultra structure: Endoplasmic Reticulum
Cell cycle
Cell division: Mitosis and Meiosis

Unit IV

An Introduction to cellular basis of Immunity
Active & Passive immunity

Unit V

Characteristics of antigen and antibody
Antigen -Antibody reaction, MHC Molecules
Immune disorder: AIDS.

Recommended Books

1. Lewis C.D. and Levin, R. : Biology of gene, Mc. Grew Hill - Toppan Co. Ltd.
2. Robertes & Robertes : Cell & Molecular Biology.

3. Verma P.S. & Agarwal : Cell Biology.
4. Gupta P.K. : Cytology.
5. Lodish, H.et.al. : Molecular cell biology.
6. Karp G. : Molecular Cell Biology.
7. Kuby :Immunology

Semester III

Paper II- Genetics (BOZ 302)

Unit I
Elements of Heredity and Variation
Mendel's Laws of inheritance

Unit II

Linkage & type
Crossing over
Sex linked inheritance: Hemophilia, Colour blindness,

Unit III
Sex determination: Human beings and Drosophila
Blood Groups
Dosage compensation

Unit IV

Nucleic acids: as genetic material
Hershey - Chase & Fraenkel - Conrat experiment

Unit V
Gene mutation
Molecular basis of gene mutation
Cytoplasmic inheritance

Recommended Books

1. Strickberger : Genetics, Macmillan Publications.
2. Enderson : Genetics.
3. Verma P.S. and J.K. Agarwal : Genetics, S. Chand and Co.
4. Gupta P.K. : Genetics, Rastogi Publication

Semester III

Paper III- Biochemistry (BOZ 303)

Unit I
Biomolecules
Structure & Classification: Proteins
Structure & Classification: Carbohydrates and fats

Unit II
Glycolysis
Kreb's Cycle
Oxidative phosphorylation,
Electron transport system

Unit III
Gluconeogenesis
Cori's cycle
Fatty acid synthesis
Urea cycle

Unit IV

Enzymes: Nature, Properties
Classification action
Co-enzyme; isozyme;
abzyme; ribozyme; co-factors.

Unit V

Vitamins: Classification
Chemical nature of Vitamins
Importance and Sources

Recommended Books

1. Harper's : Review of Biochemistry.
2. Voet and Voet : Biochemistry William and sons, John Wiley & Sons.
3. Stryer L. : Biochemistry (Fifth edition)
4. Nelson & Cox : Lehininger's Biochemistry CBS

Practical

Practical (BOZ 304)

Cytological Exercise	10
Immunology	10
Genetic Exercise	10
Biochemical test	10
Viva-voce	05
Practical record	05
	50

Cytology:

Study of various stages of mitosis and meiosis
Slide preparation of onion root tip and grasshopper testis. Preparation of slides for Mitochondria and Barr body

Immunology:

Preparation of Blood Film from the blood of animal provided. Leishman's Staining to localize lymphocytes and other leucocytes
Structural knowledge of antibodies (IgG, IgM, IgA). Blood group detection with Rh factor

Genetics:

Problems on monohybrid, di-hybrid crosses, back cross, blood groups, sex linked diseases and pedigree exercises.

Biochemical tests:

Test for Carbohydrate (Glucose and Starch), Protein, Fats/Lipids.

B.Sc.-Zoology

Semester IV

Paper I Ecology (BOZ 401)

Unit 1
Ecology: Definition, aim & scope
Ecological factors
Adaptation: Definition, types with adaptive features and examples

Unit II
Definition and types
Terrestrial Ecosystem
Aquatic Ecosystem

Unit III
Energy flow in ecosystem
Food chain, food web
Biogeochemical cycles

Unit IV
Ecological pyramids
Ecological succession

Unit V
Population interactions: Intra and inter specific
Community- Definition and characteristics

Recommended Books

1. Odum : Fundamental of Ecology (W.B. Saunders)
2. Ricklefy : Ecology (W.H. Freeman)
3. Willimer & Stone: Environmental Physiology (Blackwell Sci. Oxford 4K)
4. Singh H.R. : Ecology & Environmental Science.

Semester IV

Paper II Wild Life Management (BOZ 402)

Unit I

Wild Life in India
Endangered flora
Endangered fauna of India

Unit II
Wild life management
Wild life conservation (*in-situ* and *ex-situ*): Zoos

Unit III

Rules and regulations of Wild life
Modern concept (IUCN categories)
Different projects for animal preservation

Unit IV

National Parks in India
Sanctuaries
Biosphere reserves

Unit IV

Important movements: Chipko movement
Narmada Bachavo Aandholan, Pani Panchayat
Seed Movement

Recommended Books

1. S.K. Singh : Text Book of Wildlife Management, Ibdc, Publisher
2. Sulphey & Safeer : Introduction to Environment Management, PHI, Publisher
3. Singh H.R. : Ecology & Environmental Science.
4. P.D. Sharma : Ecology & Environmental Science, Rastogi Publication

Semester IV

Paper III Instrumentation (BOZ 403)

Unit I
Principles and applications of pH meter
Principles and applications centrifuge

Unit II
Principal and application of Electrophoresis
Chromatography: Paper and TLC

Unit III

Microscopy and type
Compound microscopy
Unit IV

Phase-Contrast microscope
Electron Microscopy

Unit V

Microtomy: Paraffin embedding of tissues
Cutting of sections & processing

Recommended Books

1. Introduction to Instrumentation in Life Sciences Plastic Comb by Prakash Singh Bisen , Anjana Sharma
2. Biological Instrumentation and Methodology (Tools & Techniques) S Chand & Co Ltd

Practical

Practical (BOZ 404)

Ecological Models	10
Ecological Exercise	10
Adaptation	05
Wild life exercise	05
Instrumentations	10
Viva-voce test	05
Practical record	05
	50

Ecological Exercise

Study of Physio-chemical factors (temperature, pH, salinity and light)
Properties of water (turbidity, hardness, CO_2, acidity, alkalinity),
Ecological apparatus

Adaptation

Adaptive features of animals in relation to their habit and habitat: *Synaptura, Exocoetus,* Axoltle larva, *Chameleon, Phrynosoma, Hedgehog,* Bat

Wild Life Exercise:

Photosheet of different wild life fauna: Elephant. Lion, Tiger

Instrumentation

Centrifugation and types, Chromatography
Agarose Gel Electrophoresis, SDS PAGE,
Spectrophotometry, Fractionation of rat liver/Fish,
Distribution of enzymes in the cell

B.Sc.-Zoology

Semester V

Paper I Economic Zoology (BOZ 501)

Unit I

Pest, types, characteristic features
Integrated Pest Management (IPM)

Unit II

Life cycle and control measure: Sugarcane pests, vegetables Pests
Life cycle and control measure stored grain pests

Unit III
Protozoa and human diseases
Diseases caused by ticks and mites

Unit IV

Apiculture
Sericulture
Lac culture

Unit III

Pearl culture
Pisciculture
Prawn culture

Recommended Books

1. Shukla Upadhyay - Economic Zoology, Rastogi Publication, Meerut.
2. Srivastava - Text book of Applied Entomology
3. Venkatraman -Economic Zoology

Semester V
Paper II Animal Behaviour (BOZ 502)

Unit I

Ethology: Definition and scope
Patterns of Behaviour

Unit II

Methods used in ethological studies
Courtship Behaviour

Unit III
Migratory behaviour in fish
Socialism in animals

Unit IV
Motivation
Imprinting

Unit V
Learning
Role of hormones in behaviour

Recommended Books

1. Mathur Reena - Animal Behaviour, S.Chand & Co.
2. Mannings - Ethology
3. Gundevia H.S. and Hargovind - Animal Behaviour.
4. Lucas J. R. and Simmons L. W. - Essays in Animal Behaviour

Semester V
Paper III Environmental Biology (BOZ 503EB)

Unit I

Environmental Pollution - Water, air, soil and noise pollution
Greenhouse effect & global warming
Acid rain, ozone layer depletion

Unit II

Conventional and non-conventional sources of energy
Environment & human health
Water quality & water borne diseases

Unit III

Environmental hazards of radiations and safety measures
Environmental Impact Assessment
Bio-indicators

Unit IV

Biodiversity: Concept, types and values
Hotspots; Threats to biodiversity

Unit V

Biodegradation
Biomagnifications and Bioremediation
Solid waste management: Causes, effects and control

Recommended Books

1. Willimer, Stone & Stone: Environmental Physiology (Blackwell Sci. Oxford 4K)
2. Singh H.R.- Ecology & Environmental Science
3. Sharma P.D. - Environmental Biology and toxicology
4. Introduction to instrumental analysis - Robert Brown, Mc.Graw Hill, International Edition

Semester V
Paper III Vermi-composting (BOZ 503V)

Unit 1

Introduction about Vermitechnology
Requirements of Vermicomposting and Vermiculture

Unit 2

Choice Composting species
Physico-chemical factors

Unit 3

Feed and feeding materials for Vermiculture
Vermitechnology and methods

Unit 4

Vermiwash Technology
Feed and feeding materials for Vermiculture

Unit 5

Mineralization, Humification
Applications of Vermi-composting

BOOKS RECOMMENDED

1.Charls Darwin s Plough Tools for vermitechnology by Madhab Chandra Das
2. Vermitechnology: From Soil Health to Human Health 2006 by L.S. Ranganathan, 139

Practical

Practical (BOZ 504)

Economic Zoology (Life cycle)	20
Stored grain pests	10
Environmental Biology Exercise	15
Animal Behaviour Project	20
Viva-voce test	05
Practical record	05
	75

Economic Zoology

Comments upon the life cycle of *Bombyx, Apis, Lacifer*

Comments upon the life cycle and morphology of major crop and stored grain pests

Ethology Project

Preparation of Project report based on behavioural observations of any animal. Reports should have sub categories as Acknowledgement; Introduction &

Objectives; Methods; Observations; Results; Discussion and Bibliography

Environmental biology

Pond water analysis, Estimation of water quality & DO,

comments upon the Apparatus related with environmental assessment

Vermi-composting related practical will be conducted.

B.Sc.-Zoology
Semester VI
Paper I Molecular Biology (BOZ 601)

Unit I

Structure & function of DNA
DNA Types

Double helical model

Unit II
Nucleosome organization, Transposons
RNA: Types
Clover leaf model of t-RNA
Unit II

Central dogma
Concept of gene expression
Reverse transcription

Unit IV
Split gene, Replication of DNA
Transcription
Post-transcriptional modifications

Unit V

Translation
Protein sorting, packaging and transport
Regulation of gene expression in prokaryotes (Operon model)

Recommended Books

1. Singh B.D.: Biotechnology (Kalyani Pub.)
2. Mayers R.A.: Molecular Biology and Biotechnology.
3. Lodish et al - Molecular Cell Biology 5th ed
4. Watson, J.D - Molecular Biology of the Gene

Semester VI

Paper II Genetic Engineering (BOZ 602)

Unit I

Genetic engineering- Aims and scope
Restriction enzymes

Unit II
Gene Cloning
Cloning vectors
Unit II
Gene Library
Applications of Genetic engineering

Unit IV

DNA finger
DNA foot printing

Unit V
Edible vaccines
Gene therapy

Recommendations

1. Genetic Engineering - Principles and Methods (Vol 27) - J. Setlow, ed., (Springer, 2006)
2. Alfred Pingoud – Restriction Endonucleases, Springer Verlag Berlin Heildelberg New York
3. Lodish et al - Molecular Cell Biology 5th ed
4. Watson, J.D - Molecular Biology of the Gene

Semester VI
Paper III Biostatistics (BOZ 603B)

Unit I

Introduction of Biostatistics
Data and its type,
Data presentation, Table, Graphs

Unit II
Range
Variety
Coefficient of correlation

Unit III
Levels of significance
Regression

Unit IV
Student's t – test
Chi-square

Unit IV

Null hypothesis
Alternate Hypothesis
ANOVA,

Recommended Books

1. W.W. Daniel : Biostatistics, Wiley India, Publication
2. Arora P.N., P.K. Malhan : Biostatistics, Himalaya Publishing House.
3. Prasad S.G. : Biostatistics.

Semester VI
Paper III Bioinformatics (BOZ 603BI)

Unit 1
Introduction to Bioinformatics
Basic concepts of biological databases;

Unit 2
Databank search- data mining
Data management and interpretation

Unit 3
Databank search- data mining

Data management and interpretation

Unit 4
Multiple sequence alignment
Genes, primer designing

Unit 5
Computational genomics
Basics of microarray

BOOKS RECOMMENDED

1. Bioinformatics for Dummies, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, USA
2. Bioinformatics: Sequence and Genome Analysis, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, New York, USA

Practical

Practical (BOZ 604)

Course Learning Outcomes

- Knowledge about molecular study based on models/experiments
- Able to know about genetic engineering like cloning, Recombinant Technology through work sheet
- Able to know about biological data collection, analysis, presentation and interpretation

Molecular Biology (Models)	20
Molecular Biology	15
Genetic Engineering	10
Biostatistics	10
Seminar	10
Viva and record	10
	75

Molecular Biology

Molecular Worksheet, Model preparation of DNA, RNA and Proteins, Isolation of bacterial DNA, Bacterial growth curve, Demonstration of cloning

Genetic Engineering

Cloning, Recombinant DNA Technology worksheets

Biostatistics : Numerical exercise on Mean, mode, medium, and test of significance**s**

Bioinformatics related practical will be conducted.