B. K. BIRLA COLLEGE OF ARTS, SCIENCE AND COMMERCE (AUTONOMOUS), KALYAN

Syllabus for F.Y. B.Sc.

Program B.Sc.

Course: Zoology

Semester I and II

(With effect from 2021-22)

B.Sc. Zoology
Programme outcomes

PO	PO Description **A student completing graduation in Science (B.Sc.) will be able to attain the following**
PO1	Students will acquire basic knowledge of principles and processes underlying Life Sciences.
PO2	Graduates will develop essential skill to conduct independent research in Botany, Biotechnology, Chemistry, Biochemistry, Applied Mathematics, Bioanalytical Sciences, Environmental Science, Microbiology, Physics, and Zoology
PO3	Students will be able to demonstrate proficiency in sciences and develop scientific temper
PO4	To demonstrate professional and ethical attitude with enormous responsibility to serve the society
PO5	Problem Analysis: Identify, formulate, review research literature, and analyze complex Subject related problems reaching substantiated conclusions and solutions
PO6	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO7	Life-long Learning: Recognize the need and develop ability to be lifelong learner in the broadest context of Subject or beyond, via Online platforms.
P08	Students will acquire eligibility for higher studies
PO9	Students will be able to understand regulatory norms and will adopt ethical practices in the pursuit and application of science
PO10	Students will acquire soft skills to hone their personalities.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan (w).
Department of Zoology
Program: Bachelor of Science (B.Sc.)
(F.Y. B.Sc., S.Y. B.Sc., T.Y. B.Sc.)
Program Specific Outcome (PSO)

B.K. Birla College offers any one of the two combinations such as Chemistry, Botany and Zoology (CBZ) or Chemistry, Zoology and Microbiology at F.Y. B.Sc. level (Semester 1 and 2) for B.Sc. program. Students select any two subject combination for their S.Y. B.Sc. class (Semester 3 and 4). These combinations can be Chemistry, Zoology or Botany, Zoology. Students interested in learning Zoology opt for the single subject for their T.Y. class (Semester 5 and 6). At F.Y. and S.Y. levels along with the science subjects students also learn foundation course (FC) as one of the subjects. In T.Y. class along with Zoology the department offers Environmental Science as a subject of Applied Component.

As per the new norms laid by UGC, students at undergraduate level should earn 132 credits instead of 120. At B.K. Birla College students will be offered courses in English Language Proficiency and Digital Literacy of four credits as electives in semester I and II to begin with. Discipline specific electives will be offered in semester III and III and core subject specific electives of four credits will be offered in semester V and VI. Such electives added in the syllabus as a mandate will enhance the skill sets of the students and also enrich their subject knowledge. This will make the students ready for higher education at national and international levels.

Courses offered under Zoology in the program from F.Y. B.Sc. to T.Y. B.Sc. aim at providing fundamental knowledge of the subject along with the updates of the recent advances. It also aims to empower students to understand the challenges of society and the country that falls into the realms of Zoology, such as health and epidemiology, animal behavior, forest management and conservation, immunology and cancer biology , animal pathology, zoonosis , Microbiome and their roles in health and diseases, Bioremediation of pollutants and pesticides, etc.

The syllabus is in sync with the requirements of the modern society and industry hence the syllabus will be providing the knowledge and skills in the fields of genetic engineering, biotechnology, nanobiotechnology, developmental biology, research methodologies, enzymology etc.

Total number of credits allotted for hands on training and the practical skills are 22. The skills learnt in the hematology and genetics laboratory will help students in obtaining jobs in the fields of pathology and cytogentics, while those which are learnt in the molecular biology laboratories will give them a flavor of recent technology.

The program gives more emphasis on learning the invertebrate and vertebrate systems using virtual class rooms and does not use the real specimens unnecessarily. This approach instills the concept of animal rights and ethics among the students.

F. Y. BSc.
SEMESTER – I (2021-22)

Course Code	Unit	Topics	**Proposed Changes**	Credits	Lectures/Week
BUSZOO101 (100M)	I	Invertebrates –I	**Body Patterns in Animal**	2	1
	II	Special features of Non-chordates Protozoa to Nemathelminthes	**Systematics –I (Super phylum: Non-chordata)**		1
	III	Biodiversity and its conservation	**No Change**		1
BUSZOO102 (100M)	I	Laboratory Safety, Units and Measurement	**No Change**	2	1
	II	Basics of Biostatistics and Computer Application	**No Change**		1
	III	Instrumentation	**No Change**		1
BUSZOOP1 (50M+50M)			**Practical Component**	2	2

SEMESTER – II (2021-22)

Course code	Unit	Topics	**Proposed changes**	Credits	Lectures/week
BUSZOO201 (100M)	I	Invertebrates –II	**Systematics: II (Super phylum: Non-chordata)**	2	1
	II	Special features of Invertebrates Annelida to Hemichordata	**Special features in Protozoa and Other Non-chordates**		1
	III	Ecosystem	**Concept of Ecosystems**		1
BUSZOO202 (100M)	I	Genetics	**No change**	2	1
	II	Evolution	**No change**		1
	III	Ethology	**No change**		1
BUSZOOP2 (50M+50M)			**Practical component**	2	2

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan (W.)

Department of Zoology

Undergraduate Course Work Revised Credit Calculation

[As per New UGC Norms from credits 120 to 132 (with effect from 2021-22)]

Year of Implementation	Semester	Existing credits	Revised credits	Structure of additional credits	Total
2021-22	I	20	22	1. Digital Literacy 2.English Language Proficiency	22
	II	20	22	1. Digital Literacy 2.English Language Proficiency	22
2022-23	III	20	22	Subject Specific Electives	22
	IV	20	22	Subject Specific Electives	22
2023-24	V	20	22	Core Subject Specific Electives	22
	VI	20	22	Core Subject Specific Electives	22
Total credits		120			132

SEMESTER-I

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan (W.)

Syllabus w. e. f. Academic Year, 2021-22 (CBCS)

F.Y. B.Sc. Zoology, Semester- I

Course Code: **BUSZOO101** Credits- **02 (100M)**

Title: Systematics-I and Biodiversity

Course Outcome:

1. *The student will gain an insight on the basic body patterns of animals.*
2. *Students will learn the general characters of various phyla under nonchordata, which would help them to identify the animals with precision.*
3. *Students will acquire the knowledge in biodiversity and design the related projects which will enhance their understanding regarding the significance of biodiversity and its conservation.*

Units	**Topics**		**Lectures (45L)**
I	**Body Patterns in Animal**		**15L**
	1.1	Cellular life and body pattern:	
	1.1.1	Prokaryotic and eukaryotic cells. (Structure and differences)	
	1.1.2	Unicellular eukaryotic pattern (e.g. Amoeba, Paramoecium), Cell aggregate pattern (e.g. Sponges), Tissue grade pattern (e.g. Hydra), Organ grade (e.g. Platyhelmenthis) Organ system grade (e.g. Earthworm)	
	1.2	Symmetry, segmentations and cephalization:	
	1.2.1	Symmetry: Asymmetrical (e.g. Amoeba), Bilaterally symmetrical (e.g. Butterfly), radially symmetrical (e.g. Starfish or Sea urchin).	
	1.2.2	Segmentation: Mesomeric segmentation (eg. Earthworm)	
	1.2.3	Cephalization: Head and cephalothorax (e.g. Crab), Head , Thorax and abdomen (e.g. Cockroach)	
	1.3	Coelom:	
	1.3.1	Types: Acoelomate (e.g. Platyhelmenthis), Psuedocoelomate (e.g. Ascaris), Coelomate (e.g. Earthworm)	
	1.3.2	Formation of coelom.	
	1.4	Six kingdom Classification	
	1.4.1	Basis of six kingdom classification (Complexity of cell, complexity of body, nutrition, ecological role and phylogenetic relationship).	
	1.4.2	Kingdom: Archaebacteria, Kingdom: Eubacteria, Kingdom: Protista, Kingdom: Fungi, Kingdom: Plantae, Kingdom: Animalia (General characters of each kingdom and mention of examples)	
	1.5	Kingdom: Protista – Phylum: Protozoa (Classification of Phylum protozoa till class with two examples of two each class).	

II	**Systematics –I (Superphylum: Nonchordata)**		**15L**
	2.1	About Notochord: Definition, Position, function and structure.	
	2.2	Superphylum: Nonchordata: General characters, complete hierarchic presentation of the 10 phyla with respective classes and one example each.	
	2.3	Phylum: Porifera to Phylum Annelida (General characters, classification up to classes with two examples of each class)	
	2.3.1	Phylum: Porifera	
	2.3.2	Phylum : Coelenterata	
	2.3.3	Phylum : Platyhelmetheis	
	2.3.4	Phylum: Nemathelmentheis	
	2.3.5	Phylum: Annelida	
		Refer practical component for examples of Unit 2.3	
III	**Biodiversity and it's conservation**		**15L**
	3.1	Introduction to Biodiversity - Definition, Concepts, Scope and Significance	
	3.2	Levels of Biodiversity - Introduction to Genus, Species and Ecosystem Biodiversity	
	3.3	Direct and Indirect values of biodiversity.	
	3.4	Threats to Biodiversity: Habitat loss, Man-Wildlife conflict.	
	3.5	Biodiversity hotspots : Biodiversity hotspots and their significance, List of World Biodiversity hotspots, Examples: Western Ghats and Indo-Burma Passage (Geographical position and range, Flora, Fauna, Threats)	
	3.6	Biodiversity Conservation:	
	3.6.1	*Ex-Situ*: Botanical gardens, Zoos, Aquarium, Seed bank and cryopreservation. *IN-Situ* Conservation: National Parks: Definition and significance. (Examples: Sanjay Gandhi National Park) Sanctuaries: Definition and significance. (Example: Melghat Sanctuary). Biosphere Reserve: Definition and significance. (Example: Sundarbans National Park)	
	3.6.2	International Efforts: (Objectives of the organization only) Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural Resources (IUCN) United Nations Environment Program - UNEP-WCMC National Efforts: (Objectives of the Acts only) Indian Wild Life Act 1972 National Biodiversity Action Plan, 2002.	

	3.7	Ecotourism: Definition, scope, Benefits and Drawbacks	

References and Additional reading.

1. Invertebrate Zoology Volume II- Jordan and Verma, S. Chand and Co.
2. Invertebrate Zoology- T. C. Majupuria, S. Nagin and Co.
3. Invertebrate Zoology- P. S. Dhami and J. K. Dhami, R. Chand and Co.
4. Zoology- S. A. Miller and J. B. Harley, Tata McGraw Hill
5. Modern Textbook of Zoology, Invertebrates, R. L. Kotpal .
6. Biodiversity- S.V.S Rana- Prentice Hall Publications
7. Modern Biology- V. B. Rastogi
8. A Textbook of Zoology, Vol. II- T. Jeffery Parker and William
9. Wildlife Laws and its Impact on Tribes- Mona Purohit , Deep and Deep Publications
10. Biodiversity- K.C.Agarwal- Agro Botanica Publications

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan (W.)

Syllabus w. e. f. Academic Year, 2021-22 (CBCS)

F.Y. B.Sc. Zoology, Semester- I

Course Code: **BUSZOO102** Credits- **02 (100M)**

Title: Essentials in Biological Laboratories and Biostatistics.

Course outcome:

1. *Students will learn to work in the laboratory with discipline and follow the laboratory ethics.*
2. *Students will learn how to use the instruments with precision and use them efficiently for regular practical and projects as per the SOP*
3. *Knowledge of Biostatistics will help the learner to collect, classify, analyze and interpret data well, especially the one generated from their project findings.*

Units	Topics		Lectures (45L)
I	**Laboratory safety, Units and Measurement**		**15L**
	1.1	Introduction to good laboratory practices	
	1.2	Use of safety symbols: meaning, types of hazards and precautions	
	1.3	Units of measurement	
	1.3.1	Calculations and related conversions of each: Metric system- length (meter to micrometer); weight (gram to microgram), Volumetric (Cubic measures)	
	1.3.2	Temperature Scales: Celsius, Fahrenheit, Kelvin	
	1.3.3	Concentrations: Percent solutions, ppt, ppm, ppb dilutions, Normality, Molarity and Molality.	
	1.4	Problems based on Molarity and Normality	
II	**Basics of Biostatistics and Computer Application**		**15L**
	2.1	Collection, and classification of data	
	2.2	Representation of data – Tables and Graphs	
	2.3	Central Tendencies -Mean, Median, Mode & Standard Deviation	
	2.4	Excel Spread Sheet 2.4: Searching Databases	
	2.5	Use of Power point and Word	
	2.6	Create your digital foot print (Create your email account, write a blog, any one social networking site).	

III	**Instrumentation**		**15L**
	3.1	Microscopy: Construction, principle and applications of dissecting and compound microscope.	
	3.2	Colorimetry - Principle and applications.	
	3.3	pH - Sorenson's pH scale, pH meter- principle and applications.	
	3.4	Centrifuge - Principle and applications (clinical and ultra-centrifuges).	
	3.5	Chromatography - Principle and applications: Partition and Adsorption e.g. One Dimensional Paper Chromatography, Adsorption Chromatography using Chalk, Thin layer Chromatography, Column Chromatography	
	3.6	Electrophoresis - Principle and applications of AGE and PAGE	

References and Additional Reading

1. Basic Laboratory Techniques, Instrumentation and Biotechnology- University Text Book of Zoology, F.Y.B.Sc. Semester I Course 2. V.V. Dalvie, R. G. Deshmukh, R. D'souza and H.U. Shingadia. University Press.
2. Introduction to Practical Biochemistry – David T. Plummer, Tata McGraw Hill Publishing Co.
3. Methods in Biostatistics – B. K. Mahajan, Jaypee Publications
4. Bioinstrumentation – L. Veerakumari, M.J.P. Publishers
5. Introductory Practical Biochemistry – S.K. Sawhney and Randhir Singh, Narosa Publishing
6. Microscopy and Cell Biology - V. K. Sharma, Tata McGraw Hill Publishing
7. Principles and Techniques of Practical Biochemistry – Keith Wilson and John Walker, (Cambridge University Press)
8. Biochemistry –U. Satyanarayana
9. Biological instruments and methodology – Dr. P. K. Bajpai, S. Chand Co Ltd.

Practical I (Credit-1) (50M)
Course Code: BUSZOOP1
Title: Systematics-I and Biodiversity

Sr. No.	Experiment
1.	Temporary mounting of Prokaryotic cells from given sample of curd (major experiment)
2.	Temporary mounting of eukaryotic cell from given sample of blood (WBC – major experiment).
3.	Identify the prokaryotic and eukaryotic cells from the given slides A and B giving reasons (minor experiment).
4.	Identify the different cells in sponges (From the given picture or diagram).
5.	Identify the symmetry, segmentation, Cephalization, Coelom etc. of the given specimens (Picture/ diagram/ slides/Preserved specimen)
6.	Identification of two animals from Invertebrate Phylum - Protozoa to Phylum - Nemathelminthes Kingdom Protista - Animal-like (*Protists: Protozoa)* A. Phylum: Sarcomastigophora Class: Sarcodina - Amoeba , Difflugia Class: Mastigophora - Euglena , Leishmania B. Phylum: Ciliophora Class: Ciliata - Paramoecium, Nyctotherus Class: Phyllopharyngea - Dysteria C. Phylum: Sporozoa, Class: Aconoidasida - Plasmodium, Babasia Class: Conoidasida - Sarcocystis , Eimeria **Kingdom Animalia** D. Phylum: Porifera Class: Calcarea - Scypha (Little vase sponge), Leucosonia Class: Hexactinellida - Hyalonemma, Euplectella (Glass-rope sponge) Class: Demospongia - Euspongia, Spongilla (Freshwater sponge) E. Phylum: Cnidaria Class: Hydrozoa - Hydra and obelia (By-the-wind sailor) Class: Scyphozoa – Rhizostoma, Aurelia (Barrel jellyfish) Class: Anthozoa - Corallium, Sea anemon (Coral) F. Phylum: Platyhelminthes Class Turbellaria - Dugesia (Planaria) Polycelis Class: Trematoda - Fasciola (Liverfluke), Polystoma Class: Cestoda - Taenia (Tapeworm), Hymenolepis G. Phylum: Nematoda Class: Aphasmida (Adenophorea)- Trichinella (Trichina worm) , Trichiuris

	Class: Phasmida (Secernentea) - Ascaris (Roundworm) , Wuchereria H. Phylum: Annelida Class: Polychaeta- *Arenicola* (Lugworm), *Neanthes* (Nereis) Class: Oligchaeta- *Tubifex* (Sludge worm) *Pheretima* (earthworm) Class: Hirudinea - *Pontobdella* (Marine leech) *Hirudinaria granulosa* (Cattle Leach).
7.	Mounting of Paramoecium or any other ciliate from the water sample provided.
8.	Identification of Endemic, endangered, extinct, rare and threatened animals
9.	Locating the biodiversity hotspots and the key animals on the map with its status
10	Locating sanctuaries and national parks using maps.
11.	Field Visit to local fish market and submit a report on nonchrodates available for sale
11.	Field Visit to local fish market and submit a report on nonchrodates available for sale

Practical II (Credit-1) (50M)
Course Code: BUSZOOP1
Title: Essentials of Biological Laboratories and Biostatistics.

Sr. No.	Experiment
1.	Interpretation of safety symbols (toxic, corrosive, explosive, flammable, skin irritant, oxidizing, compressed gases, aspiration hazards and Biohazardous infectious material.)
2.	Calculation of pH of three different samples (one each acidic, alkaline and neutral) using pH paper/Universal Indicator and confirming the result with pH meter.
3	Study of parts of microscope and their functions. Technique of focusing a permanent slide under 10x and 45x objectives
4	a) Dilution of given sample and estimation of OD by using colorimeter. b) Calculation of concentration from the given OD using formula.
5	Separations of amino acids/ pigments from the mixture by paper chromatography. Calculation of Rf value of separated pigments/amino acids from given chromatogram and their identification from standard chart.
6	Separations of pigments by adsorption chromatography using chalk.
7	Separation of lipids/ sugars by TLC
8	Problems based on Normality and Molarity
9	Problems based on Mean/ Median/ Mode
10	Draw a Bar diagram/ Histogram/ Cumulative Frequency curve/ Pie chart
11	Preparation of a spread sheet for the data provided and Preparation of chart according to the data

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
F. Y. BSc. Semester-I
Skeleton Question paper Practical-I (BUSZOOP1)

Time: 2.30 hrs **Marks: 50**

Q.1	Mount a live paramecium/ ciliate from the given culture. Draw a labeled diagram and answer the given questions	10
	OR	
Q.1	Make a temporary mounting of Prokaryotic cells from given sample	10
	OR	
Q.1	Make temporary mounting of eukaryotic cell from given sample of blood (WBC).	10
Q.2	Identify the prokaryotic and eukaryotic cells from the given slides A and B giving reasons.	04
	OR	
Q.2	Identify the different cells in sponges (From the given picture or diagram).	04
	OR	
Q.2	Identify and describe (any two) symmetry, segmentation, Cephalization, Coelom etc. of the given specimens (Picture/ diagram/ slides/Preserved specimen)	04
Q.3	Identify the key animals (any 6) and place them on the map in the correct national park or sanctuary	06
	OR	
Q.3	Mark the given national park on Map and write the name of key species with its status and reason for decline (any 3)	06
	OR	
Q.3	Mark the biodiversity hotspots in the given map and write the names of the key animal with its status (any 3)	06
	OR	
Q.3	Identify and Place the key animals in the given map according to the correct biodiversity hotspot. (any 3)	06
Q.4	Identify and classify/Describe the animals from the following Phyla (three specimens for classification, three specimens for describing) a) Protozoa, b) Porifera, c) Coelenterate d) Platyhelminthes, e) Nematoda, f) Annelida	12
Q.5	Submission of Field Report (Zoo/ National park)	08
Q.6	Journal	05
Q.7	Viva – Voce	05

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Department of Zoology

F. Y. BSc. Semester-I

Skeleton Question paper Practical-II (BUSZOOP1)

Time: 2.30 hrs **Marks: 50**

Q.1	Dilute the given sample and estimate the OD using colorimeter (Two dilutions)	12
	OR	
Q.1	Calculate concentration from given OD by formula (Two concentrations)	12
	OR	
Q.1	Find the pH of water samples (three) using pH paper, Universal indicator and pH Meter and comment on their chemical nature.	12
	OR	
Q.2	Separate the pigments by adsorption chromatography. Calculate the Rf values of the separated pigments	12
	OR	
Q.2	Separate the amino acids from the given mixture by paper chromatography. Calculate the Rf values of the separated amino acid.	12
	OR	
Q.2	Separate the given mixture of lipids/ sugars by TLC. Calculate the Rf values of the separated lipids/sugars	12
Q.3	Problems based on normality and molarity (one each)	06
Q.4	Problems based on biostatistics – 2	10
Q.5	Journal	05
Q.6	Viva – Voce	05

SEMESTER-II

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan (W.)

Syllabus w. e. f. Academic Year, 2021-22 (CBCS)

F.Y. B.Sc. Zoology, Semester- II

Course Code: **BUSZOO201** Credits- **02 (100M)**

Title: Systematics-II and Ecosystem

Course outcome:

1. *The students will learn to classify the non-chordate animals based on their characters*
2. *Special features of non-chordates will kindle their curiosity to learn more about these animals*
3. *Knowledge of ecosystem, biogeochemical cycles, Food chain, ecological pyramids etc will enable the students to correlate various phenomena like pollution, climate change and inter -relationship between organisms and their ecosystems.*

Units	Topics		Lectures (45L)
I	**Systematics: II (Superphylum: Nonchordata)**		**15L**
	General characters, classification up till classes with two examples of each class		
	1.1	Phylum: Arthopoda	
	1.2	Phylum: Mollusca	
	1.3	Phylum: Echinodermata	
	1.3	Phylum: Hemichordata	
II	**Special features in Protozoa and other Nonchordates**		**15L**
	2.1	Phylum: Protozoa	
	2.1.1	Reproduction (Sexual and asexual)	
	2.1.2	Foraminiferan shells	
	2.2	Phylum Porifera: Canal systems in sponges (all types)	
	2.3	Phylum: Coelenterata	
	2.3.1	Polymorphism	
	2.3.2	Coral reefs	
	2.4	Phylum: Platyhelmenthis and Nemathelmenthis Morphological and physiological adaptations of helminthes for parasitic life.	
	2.5	Phylum: Annelida Regeneration (Possibly comparative between hydra and earthworm)	

	2.6	Phylum: Arthropoda	
	2.6.1	Metamorphosis (all types)	
	2.6.2	Crustacean Larvae	
	2.7	Phylum: Mollusca	
	2.7.1	Types Foot and shells	
	2.7.2	Torsion and de-torsion.	
	2.8	Phylum: Echinodermata	
	2.8.1	Water vascular system (only star fish)	
	2.8.2	Echinoderm Larvae	
III	**Concept of Ecosystems**		**15L**
	3.1	Ecosystem - Definition and components	
	3.1.1	Physical Components: Soil and topography, Sunlight, Temperature, Pressure	
	3.1.2	Chemical Factors: Air, Minerals, water,	
	3.1.3	Biological factors: Autotrophs (Chemoautotrophs and Photoautotrophs) Heterotrophs (Saprophytes, Consumers and decomposers)	
	3.2	Biogeochemical cycles: Water, Oxygen, Nitrogen, Carbon, Sulphur, Phosphorus	
	3.3	Types of ecosystem: Fresh water (Lotic and Lentic), Marine Ecosystem	
	3.4	Food chains and food webs in ecosystem (Fresh water and Grass land).	
	3.5	Ecological pyramids - energy, biomass and number.	
	3.6	Animal interactions (commensalism, mutualism, predation, antibiosis, parasitism)	

References and Additional Reading

1. Introduction to Ecology and Wildlife - University Text Book of Zoology, F.Y.B.Sc. Semester II Course University Press
2. Fundamentals of Ecology - Eugene P. Odum and Grey W. Barrett, Brook Cole/ Cengage learning
3. Fundamentals of Ecology - M. C. Dash , Tata McGraw Hill company Ltd, New Delhi
4. Ecology and Environment - Sharma P. D , Rastogi Publication, Mumbai
5. Economic Zoology, Biostatisticss and Animal Behaviour - Shukla, Mathur, Upadhyay, Prasad. Rastogi Publications.
6. Modern text book of Zoology - Invertebrates; Eleventh; Edition Professor R.L. Kotpal; Rastogi publication
7. Invertebrate Zoology by E. L. Jordan & P. S. Verma Rev. edition,2009, Chand publications Invertebrate Zoology by P. S. Verma, edition, 2009, Chand publications
8. B. Sc. Zoology, Invertebrate Zoology by V.K. Aggarwal2017, S. Chand publications
9. Invertebrate Zoolohy – Dhami and Dhami
10 Zoology for degree students, Non chordates by V.K. Agarwal 2011, S. Chand Publication Zoology for Degree Students, B.Sc. First Year, by V. K. Agarwal, Pub. S. Chand Coy.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan (W.)

Syllabus w. e. f. Academic Year, 2021-22 (CBCS)

F.Y. B.Sc. Zoology, Semester- II

Course Code: **BUSZOO202** Credits**- 02 (100M)**

Title: Genetics, Evolution and Ethology

Course Outcome:

1. *The students will learn Mendelian and Non -Mendelian genetics and co-relate it with traits in man. Students will also learn to construct the pedigree chart based on the traits observed in their family.*
2. *The students will learn animal behavior and use their knowledge in studying the behavior of animals in the natural environments, captivities, like zoos, breeding center, and the animals housed in pharmaceutical companies.*
3. *Students will get acquainted with various aspects of evolution, especially with reference to origin of earth, man and horse.*

Units	Topics		Lectures (45L)
I	**Genetics**		**15L**
	1.1	Introduction to genetics: Definitions (Allele, wild type and mutant alleles, locus, dominant and recessive traits, homozygous and heterozygous, genotype and phenotype, genome etc.	
	1.1.1	Scope, importance of genetics and classical and modern concept of Gene (Cistron, muton, recon).	
	1.2	Mendelian Genetics:	
	1.2.1	Monohybrid Cross, Dihybrid Cross, Reciprocal Crosses (Back Cross and Test Cross), Laws of Inheritance	
	1.2.2	Exceptions to Mendelian Inheritance: Incomplete dominance, Co-dominance, Lethal alleles, Epistasis - Recessive, Double recessive, dominant and double dominant.	
	1.2.3	Mendelian traits in humans.	
	1.2.5	Chromosome theory of inheritance.	
	1.2.6	Structure, types (autosomes , sex chromosomes and types based on the position of centromere)	
	1.3	Pedigree Analysis:	
	1.3.1	Symbols	
	1.3.2	Pedigree analysis: Autosomal dominance, Autosomal Recessive, X- linked dominant and X-linked recessive.	
II	**Evolution**		**15L**

	2.1	Introduction: Definition and Scope.	
	2.2	Origin of earth (Big Bang theory, Primitive earth)	
	2.3	Organic evolution: Theories of evolution, Protobionts and Coacervates theory, Miller Urey Experiment.	
	2.4	Geological Time Scale.	
	2.5	Isolation mechanisms: Spatial isolation, geographical isolation, reproductive isolation, sympatric and allopatric isolation.	
	2.6	Evolution of language in humans and use of human tools	
	2.7	Evolution of man and horse	
III	**Ethology**		**15L**
	3.1	Definition and scope of ethology, Development of Behaviour	
	3.1.1	Ontogeny of behaviour	
	3.1.2	Environmental influence on behaviour	
	3.1.3	Sensitive periods during development	
	3.1.4	Juvenile behavior, Innate behaviour.	
	3.2	Animal Learning.	
	3.2.1	Conditioning and Learning	
	3.2.2	Imprinting	
	3.2.3	Habituation and generalization	
	3.2.4	Instrumental Learning	
	3.2.5	Reinforcement operant behaviour	
	3.3	Biological aspect of learning.	
	3.3.1	Constrains of learning	
	3.3.2	Learning to avoid enemies- mimicry, learning to avoid sickness	
	3.3.3	Stimulus relevance.	

References and additional reading

1. Principles of Genetics. Gardner, E.J., Simmons, M.J and Snustad, D.P. John Wiley and Sons
2. Concepts of Genetics. Klug, W.S., Cummings M.R., Spencer, C.A. Benjamin Cummings.
3. Genetics- A Molecular Approach. Russell, P. J Benjamin Cummings.
4. Cell Biology, Genetics, Molecular Biology Evolution and Ecology. Verma P.S. and Agrawal P.K., 9th edition, S. Chand Publication, New Delhi.
5. Principles of Genetics – Eight edition- Eldon john Gardner, Michael J. Simmons, D. Peter Snustad
6. Animal Behavior: Mechanisms, Ecology and Evolution Stephen Vessey, Elizabeth Jacob, S. H. Vessey and L. C. Drickamer, McGraw-Hill.
7. Animal Behaviour- Mohan Arora

8 Animal Behaviour- Reena Mathur

9. Animal Behaviour-Agarwal

10 Organic Evolution- Virbala Rastogi

SEMESTER II
Practical: I (Credit-1) (50M)
Course Code: BUSZOOP2
Title: Systematics II and Ecosystem

Sr. No.	Experiment
1.	Identification of specimens/ photographs / from Superphylum: Nonchordata Phylum - Arthopoda to Hemichordata **Phylum Arthropoda:** a. Subphylum - Chelicerata Class: Arachnida e.g. ***Hotentotta*** (Scorpion) ***Ixodes scapularis*** (Tick) Class: Merostomata e.g. ***Limulus*** (Horseshoe crab) ***Eurypterus*** *"sea scorpions"* Class: Pycnogonida e.g. *Nymphon* (Sea spider) ***Pycnogonum*** b. Subphylum - Crustacea Class: Malacostraca e.g. *Panulirus* (Lobster) ***Palaeomon*** Class: Maxillopoda e.g. Cyclops (Copepods) ***Gelyella*** c. Subphylum - Uniramia Class: Chilopoda e.g. *Scolopendra* (Centipedes), ***Scutigera coleoptrata*** house centipede Class: Diplopoda e.g. *Xenobolus* (Millipedes) ***Oxidus gracilis*** Class: Insecta e.g. *Apis* , *Attacus* (Moth) **Phylum Mollusca:** Class: Aplacophora e.g. *Chaetoderma* (Glisten worm solenogaster) Class: Polyplacophora e.g. *Tonicella* (Lined Chiton) Class: Monoplacophora e.g. *Neopilina* Class: Gastropoda e.g. *Apylsia* , *Pila*, Class: Pelycypoda e.g Unio (Wedge shell) Class: Scaphopoda e.g. *Dentalium* (Tusk shell) Class: Cephalopoda e.g. *Octopus*, *Sepia* **Phylum Echinodermata:** Class: Asteroidea e.g. *Asterias* (Starfish) Class: Ophiuroidea e.g. *Ophiothrix* (Brittle star) Class: Echinoidea e.g. *Echinus* (Sea urchin) Class: Holothuroidea e.g. *Cucumaria* (Sea cucumber) Class: Crinoidea e.g. *Crinoid* (Sea lily) **Phylum Hemichordata:** Class: Enteropneusta e.g. *Saccoglossus* Class: Pterobranchia e.g. *Rhabdopleura* Class :Planctosphaeroidea e.g. *Planctosphaera*
2.	Mounting of foraminiferan shells from sand
3.	Identification: Binary fission, Conjugation in paramecium

4.	Identification: Spicules and Gemmules of sponge
5.	Identification: Polymorphic forms of coelenterates and Identification of corals
6.	Identification: Parasitic adaptations in Platyhelminthes and Nemathelminthes
7.	Identification: Crustacean larvae, shells in mollusks, echinoderm larvae, water vascular system.
8.	Estimation of Density, pH and conductivity of given water sample
9.	Measurement of intensity of light of given ecosystem by Lux Meter
10.	Estimation of Free carbon dioxide from two different samples-aerated drinks(diluted) v/s tap water
11.	Estimation of dissolved oxygen from given water sample (tap water v/s well water)
12.	Estimation of hardness from given water sample (tap water v/s well water)
13.	Identification and interpretation of aquatic and terrestrial (Grassland) food chains and food Webs
14.	Construction of food chain/food web using given information/data. a) Identification and interpretation of ecological pyramids of energy, biomass and number b) Construction of different types of pyramid from given data
15.	Local Ecological Survey.

Practical II (Credit-1) (50M)
Course Code: BUSZOOP2
Title: Genetics, Evolution and Ethology

1	Identifications of Mendelian traits in humans Polydactyly, Widow's Peak, Tongue rolling, Ear lobes, Eyebrow pattern
2.	Problems based on Mendelian crosses and epistasis
3.	Identification- Pedigree symbols, Inheritance Pattern.
4.	Problems based on Autosomal recessive, autosomal dominant, X-Linked recessive and X- linked dominant disorders.
5.	Identifications based on Ethology. Fixed action pattern- male stickle back, mason wasp Parental Imprinting- Lorenz's Goslings Classical conditioning and instrumental learning – Pavlov's Experiment, Puzzle box experiment of Thorndike Mimicry - Batesian mimicry, Mullerian mimicry
6	Identification based on evolution: Identify the given stage of human evolution Identification of stages of horse evolution Identification of tools of stone age man Assort the given animals in to their respective geological time scale Identification on isolation- Allopatric, sympatric, parapatric
7.	Projects. Submission: Human Survey for Mendelian characters

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
F. Y. BSc. Semester-II
Skeleton Question paper Practical-I (BUSZOOP2)

Time: 2.30 hrs **Marks: 50**

Q.1	Estimate the Density and Free carbon dioxide from the two different samples provided	12
	OR	
Q.1	Estimate the conductivity/ intensity of light by Lux Meter and dissolved oxygen from given water samples	12
	OR	
Q.1	Estimate the pH and hardness from the given samples	12
Q.2	Mounting of foraminiferan shells from sand	06
	OR	
Q.2	Identify and describe : Sponge Spicules, Sponge gemmule, Polymorphism in coelenterates, Parasitic adaptations in helminths	06
Q.3	Identify classify/Describe the given specimens (Two for description and two for classification) a) Arthopoda, b) Mollusca, c) Echinodermata, d) Hemichordata	08
Q.4	Identification and interpretation of ecological pyramids of energy, biomass and number	04
	OR	
Q.4	Construction of different types of pyramids from given data	04
	OR	
Q.4	Construction of food chain/food web using given information/data.	04
	OR	
Q.4	Study the given information and give answers on the basis of food chain/food web and or ecological pyramids	04
Q.5	Identify and describe (any 5) a) Crustacean larva b) Echinoderm larva c) Molluscan shell d) Molluscan foot e) Life cycle insect (honey bee and silk Moth)	10
Q.6	Journal	05
Q.7	Viva – Voce	05

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Department of Zoology

F. Y. BSc. Semester-II

Skeleton Question paper Practical-II (BUSZOOP2)

Time: 2.30 hrs **Marks: 50**

Q.1	Solve the given problems: Based on the Mendelian / Non Mendelian crosses/ Epistasis. (Any two)	08
Q. 2	Identify the given pedigree symbols (Any six)	06
	OR	
Q.2	Draw Pedigree symbols for the following (Any six)	06
Q.3	Draw the pedigree chart for the given inheritance (autosomal recessive or dominant)	08
	OR	
Q.3	Draw the pedigree chart for the given inheritance (X-linked recessive or dominant)	08
Q.4	Identify and comment on animal behaviour /Conditioning experiment (any 3)	09
Q.5	Identify and comment as per the instructions (Any three) Stage in human evolution/ Stage in horse evolution/Type of Isolation/Tools of prehistoric man/ Geological time scale	09
Q.6	Journal	05
Q.7	Viva	05

B. K. BIRLA COLLEGE OF ARTS, SCIENCE AND COMMERCE (AUTONOMOUS), KALYAN

Syllabus for S.Y. B.Sc.

Program B.Sc.

Course: Zoology

Semester III and IV

(With effect from 2020-21)

B.Sc.
Programme outcomes

PO	PO Description **A student completing graduation in Science (B.Sc.) will be able to attain the following**
PO1	Students will acquire basic knowledge of principles and processes underlying Life Sciences.
PO2	Graduates will develop essential skill to conduct independent research in Botany, Biotechnology, Chemistry, Biochemistry, Applied Mathematics, Bioanalytical Sciences, Environmental Science, Microbiology, Physics, and Zoology
PO3	Students will be able to demonstrate proficiency in sciences and develop scientific temper
PO4	To demonstrate professional and ethical attitude with enormous responsibility to serve the society
PO5	Problem Analysis: Identify, formulate, review research literature, and analyze complex Subject related problems reaching substantiated conclusions and solutions
PO6	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO7	Life-long Learning: Recognize the need and develop ability to be lifelong learner in the broadest context of Subject or beyond, via Online platforms.
P08	Students will acquire eligibility for higher studies
PO9	Students will be able to understand regulatory norms and will adopt ethical practices in the pursuit and application of science
PO10	Students will acquire soft skills to hone their personalities.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan (w).
Department of Zoology
Program: Bachelor of Science (B.Sc.)
(F.Y. B.Sc., S.Y. B.Sc., T.Y. B.Sc.)
Program Specific Outcome (PSO)

B.K. Birla College offers any one of the two combinations such as Chemistry, Botany and Zoology (CBZ) or Chemistry, Zoology and Microbiology at F.Y. B.Sc. level (Semester 1 and 2) for B.Sc. program. Students select any two subject combination for their S.Y. B.Sc. class (Semester 3 and 4). These combinations can be Chemistry, Zoology or Botany, Zoology. Students interested in learning Zoology opt for the single subject for their T.Y. class (Semester 5 and 6). At F.Y. and S.Y. levels along with the science subjects students also learn foundation course (FC) as one of the subjects. In T.Y. class along with Zoology the department offers Environmental Science as a subject of Applied Component.

As per the new norms laid by UGC, students at undergraduate level should earn 132 credits instead of 120. At B.K. Birla College students will be offered courses in English Language Proficiency and Digital Literacy of four credits as electives in semester I and II to begin with. Discipline specific electives will be offered in semester III and III and core subject specific electives of four credits will be offered in semester V and VI. Such electives added in the syllabus as a mandate will enhance the skill sets of the students and also enrich their subject knowledge. This will make the students ready for higher education at national and international levels.

Courses offered under Zoology in the program from F.Y. B.Sc. to T.Y. B.Sc. aim at providing fundamental knowledge of the subject along with the updates of the recent advances. It also aims to empower students to understand the challenges of society and the country that falls into the realms of Zoology, such as health and epidemiology, animal behavior, forest management and conservation, immunology and cancer biology , animal pathology, zoonosis , Microbiome and their roles in health and diseases, Bioremediation of pollutants and pesticides, etc.

The syllabus is in sync with the requirements of the modern society and industry hence the syllabus will be providing the knowledge and skills in the fields of genetic engineering, biotechnology, nanobiotechnology, developmental biology, research methodologies, enzymology etc.

Total number of credits allotted for hands on training and the practical skills are 22. The skills learnt in the hematology and genetics laboratory will help students in obtaining jobs in the fields of pathology and cytogentics, while those which are learnt in the molecular biology laboratories will give them a flavor of recent technology.

The program gives more emphasis on learning the invertebrate and vertebrate systems using virtual class rooms and does not use the real specimens unnecessarily. This approach instills the concept of animal rights and ethics among the students.

SEMESTER – III (2020-21)

Course code	Unit	Topics	Proposed changes	Credits	Lectures/week
BUSZOO301 (100M)	I	Fundamentals of Genetics	**Chordate Systematic- I**	2	1
	II	Chromosomes and Heredity	**Chordate Systematics- II**		1
	III	Nucleic acids	**Life processes I**		1
BUSZOO302 (100M)	I	Study of Nutrition and Excretion	**Molecular Biology**	2	1
	II	Study of Respiration and Circulation	**Biochemistry**		1
	III	Control and coordination, Locomotion and Reproduction	**Genetics**		1
BUSZOO303 (100M)	I	Amazing animals	**Parasitology I**	2	1
	II	Ethology and Conservation Biology	**Fisheries**		1
	III	Applied Zoology	**Research Methodology**		1
BUSZOOP3 (50M+50M+50M)			**Practical component**	3	9

SEMESTER – IV (2020-21)

Course code	Unit	Topics	Proposed changes under autonomy	Credits	Lectures/week
BUSZOO401 (100M)	I	Comparative Embryology	**Chordate Life** (Previously- Chordate systematic II)	2	1
	II	Biotechnology	**Life Processes II** (Previously- Special features of Chordates-II)		1
	III	Scientific Attitude, Methodology, Writing	**Life Processes III** (Previously- Life Processes)		1
BUSZOO402 (100M)	I	Cell Biology	**Biotechnology and Bioinformatics**	2	1
	II	Endomembrane System	**Cell biology**		1
	III	Biomolecules	**Embryology**		1
BUSZOO403 (100M)	I	Ecology	**Applied Entomology**	2	1
	II	Pollution	**Animal Husbandry**		1
	III	Evolution	**Wildlife Management and Zoogeography**		1
BUSZOOP4 (50M+50M+50M)			**Practical component**	3	9

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

S.Y. B.Sc. Zoology, Semester- III

Title: **Chordate Systematics and Life Processes-I**

Course Code: **BUSZOO301** Credits- **02 (100M)**

Course outcome:

1) *The students will recognize the distinguishing characters of each phylum and classify the animals*
2) *Students will learn life processes of several animals and compare them to understand the progressive development in the processes across kingdom Animalia.*
3) *Students will develop skill of presenting life processes in the form of diagrams.*

Unit	Topics		Lectures (45L)
I	**Chordate Systematics-I**		15L
	1.1	Super phylum Chordata : Hierarchical classification and General characters of chordates	
	1.2	Common ancestry of chordates	
	1.2.1	Annelids as chordate ancestor	
	1.2.2	Chordate affinities with Echinoderms	
	1.3	Phylum: Protochordata: General Characters	
	1.3.1	Sub-phylum: Urochordata. General characters of Urochordata Classification up till classes (General characters of each class with one example each).	
	1.3.2	Sub-phylum: Cephalochordata General characters of cephalochordate. Classification up till classes (General characters of each class with one example each).	
	1.3.3	Differentiating characters between urochordates and cephalochordates.	
	1.3.4	Retrogressive metamorphosis in Herdmania	
	1.4	Phylum: Euchordata (General Characters).	
		Subphylum: Vertebrata (General Characters).	

	1.4.1	Division: Agnatha General Characters of division Agnatha Classification up till classes (General characters with one example each)	
	1.4.2	Division: Gnathostomata General Characters of division gnathostomata Superclass Pisces (General characters, two classes with general characters of the classes and one example each) Differentiating characters between class chondrichthyes and osteichthyes.	
II	**Chordate Systematics- II**		15L
	2.1	Superclass: Tetrapod (General Characters, Introduction to four classes)	
	2.2.1	Class: Amphibia (general characters) Types of amphibians: Limbless amphibian e.g. Ichthyophis (Caecilian) Tailed amphibian e.g. Amphiuma Tailless amphibian e.g. Hyla (Tree frog)	
	2.2.2	Class: Reptilia (general characters) Extinct reptile e.g. Ichthyosaurus. Living fossil e.g. Sphenodon (Tuatara) Aquatic reptile e.g. Chelonia (Sea turtle) , Arboreal reptile e.g. Chamaeleon (Chamaeleon)	
	2.2.3	Class: Aves (general characters) Arboreal bird e.g. Melanerpes (Acon Wood pecker) Terrestrial bird e.g. Gallus (Fowl) Swimming bird e.g. Phalacrocorax (Cormorant) Wading bird e.gs. Ardeola (Heron) Birds of prey e.g. Tyto (Owl) Flightless birds e.g. Dromaius (Emu)	
	2.2.4	Class: Mammalia (general characters) Egg-laying mammals e.g. Ornithorhyncus (Duck-billed platypus) Pouched mammals e.g. Macropus (Kangaroo) Insect eating mammals e.g. Sorex (Common shrew) Toothless mammals e.g. Bradypus (Sloth) Gnawing mammals e.g. Funambulus (Squirrel) Primates e.g. Macaca (Monkey) Aquatic mammals: Whale	
III	**Life Processes - I**		15L
	3.1	Movement and Locomotion	
	3.1.1	Pseudopodia in Amoeba (sol gel theory), Cilia in Paramecium (Ciliary movement and structure of cilia- 9+2 arrangement of microtubules)	
	3.1.2	Wings and legs in insects (e.g. Cockroach)	

	3.1.3	Tube Feet in starfish	
	3.1.4	Fins of fish (Types and functions) and swim bladder in fish (types, modifications and functions).	
	3.1.5	Structure of Striated muscle fibre in human and Sliding filament Theory	
	3.2	Nutrition	
	3.2.1	Comparative study of Nutritional Apparatus (structure and function): Amoeba (food vacuole), Hydra (Mouth, hypostome and tentacles), Earthworm (Digestive system), Cockroach (Digestive system), Amphioxus (wheel organ), Pigeon (digestive system), Goat (Digestive system of herbivores), Ruminant stomach.	
	3.2.2	Physiology of digestion in man.	
	3.3	Excretion-osmoregulation	
	3.3.1	Comparative study of Excretory and Osmo-regulatory structures and Function: Amoeba -contractile vacuoles, Planaria -Flame cells, Earthworm –Nephridia, Cockroach-Malpighian tubules and green gland, Bivalve -Organ of Bojanus.	
	3.3.2	Categorization of animals based on principal nitrogenous excretory Products.	
	3.3.4	Structure of kidney, Uriniferous tubule and physiology of urine formation in man.	
	3.3.5	Osmoregulation: Diffusion and osmosis (Definition, types and differences) Types of solutions based on solute concentrations Osmoconformers Osmoregulation in man (Role of hormones in water balance)	

References and Extra Reading:

1. Comparative Anatomy of the Vertebrates; Ninth Edition; Kent, G.C. and Carr R.K.; The McGraw-Hill Companies; 2000.
2. Text book of Chordates; Saras publication.

3. Modern text book of Zoology; Prof. R.L. Kotpal.
4. Vertebrate Zoology Volume I- Jordan and Verma, S. Chand and Co.
5. Invertebrate Zoology Volume II- Jordan and Verma, S. Chand and Co.
6. Invertebrate Zoology- Majupuria T. C., NaginS.and Co.
7. Chordate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
8. Invertebrate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
9. Modern Textbook of Zoology, Invertebrates, Kotpal R. L.
10. Biological Science, Taylor D.J., Stout G.W., Green N.P.O, Soper R,Cambridge University Press.
11. Text book of Zoology, Volume II, Vertebrates – Parker & Haswell (Ed. A. J. Marshall){ELBS Macmillan}
12. Vertebrate life – F. H. Pough & W. N. McFarland (Prentice Hall)
13. The Life of Vertebrates – J. Z. Yong (ELBS Oxford)
14. Vertebrates : Comparative anatomy, function, Evolution – K. V. Kardong (WCB McGraw Hill)
15. Comparative Anatomy of Vertebrates – G.C. Kent & L. Miller (WCB Pub)
16. The Vertebrate body – A. S. Romer & T. S. Parsons (Saunders)

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w.e.f. Academic Year, 2020-21 (CBCS)

S.Y. B.Sc. Zoology, Semester- III

Title: **Molecular Biology, Biochemistry and Genetics**

Course Code: **BUSZOO302** Credits- **02 (100M)**

Course outcome:

1. *Students will learn the molecular aspects of nucleic acids which include types, structure, function and the process of protein synthesis in prokaryotes.*
2. *The students will understand the role of biological macromolecules, their classification and metabolic functions.*
3. *Learners will imbibe the structural morphology of chromosomes and their classification, chromosomal anomalies and sex determination.*

Units	**Title of Unit**		**Lectures (45L)**
I	**MOLECULAR BIOLOGY**		15L
	1.1	RNA as genetic material (Singer's Experiment)	
	1.2	DNA as genetic material (Griffith's experiment, Hershey and Chase Experiment, MacLeod, McCarty and Avery experiment)	
	1.3	Nucleotides and Nucleic acids: DNA and RNA; Chemical composition, molecular structure, types, DNA double helix. Functions of DNA and RNA	
	1.4	Types of DNA - A DNA, B DNA, Z DNA and H DNA	
	1.4.1	DNA in prokaryotes - Chromosomal DNA and Plasmids	
	1.4.2	Extra Nuclear DNA in Eukaryotes - Mitochondria and Chloroplast	
	1.5	Types of RNA	
	1.6	DNA replication in prokaryotes and eukaryotes	
	1.7	Transcription in prokaryotes	
	1.8	Translation in prokaryotes	
II	**BIOCHEMISTRY**		15L
	2.1	Types of chemical bond and their examples. Types of bonds in biomolecules and their examples	
	2.2	Water as biomolecule: Physical and chemical properties of water, Lattice structure of water. Water as universal solvent, biological role of water.	
	2.3	Carbohydrates: Definition, chemical composition and general formula. Classification of carbohydrates. Formation of Disaccharides	
	2.3.1	Biological role of carbohydrates. Glucose as monosaccharide (Chemical structure and properties). Starch and Chitin as polysaccharide (Chemical structure and properties)	
	2.4	Proteins: Definition, Chemical composition, Classification, Dipeptide formation	
	2.4.1	Biological role of proteins: Structural and functional proteins. Keratin and haemoglobin as example	

	2.5	Lipids: Chemistry of fatty acids, fatty acid nomenclature, triacylglycerol composition, Classification	
	2.5.1	Biological role of lipids. Cholesterol as example.	
III	**GENETICS**		15L
	3.1	Structure and classification of chromosomes, heterochromatin and euchromatin	
	3.2	Special chromosomes: Endomitosis Giant chromosome: Polytene chromosome, Lamp brush chromosome	
	3.3	Sex Determination.	
	3.3.1	Sex determination by chromosomes- XX-XY , XX-XO, ZZ-ZW , Haplodiploidy	
	3.3.2	Sex determination in Drosophila- Genic balance theory	
	3.3.3	Gynandromorphs, Parthenogenesis	
	3.3.4	Hormonal influence in sex determination	
	3.3.5	Role of environmental factors in sex determination	
	3.4	Barr bodies- Lyon's hypothesis	
	3.5	Karyotyping : Method Karyotype analysis of structural and numerical variations in humans	

References and extra reading:

1. Principles of Genetics. Gardner, E.J., Simmons, M.J and Snustad, D.P. John Wiley and Sons.
2. Biochemistry, L Stryer, 3rd/4th/5th ed, 1989 , Freeman and Co. NY
3. Harper's Biochemistry,1996, 26th edition, Murray R.K. Granner D.K. Mayes P.A. Rodwell V.M. Hall international USA
4. A Textbook of Biochemistry, 9th edition, Dr. Rama Rao A.V.S.S and Dr A Suryalakshmi.
5. Cell Biology, Genetics, Molecular Biology Evolution and Ecology. Verma P.S. and Agrawal P.K., 9th edition, S. Chand Publication, New Delhi.
6. Molecular Biology - Bios Instant Notes; Fourth Edition; Alexander McLennan, Andy Bates, Phil Turner & Mike White; Garland Science; 2013
7. Genetics, Third Edition, Monroe W. Strickberger
8. Genetics A Mendelian approach Peter J. Russel, Pearson Benjamin Cummings
9. Current Protocols in Molecular Biology; Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, Seidman J. G., John A. Smith and Kevin Struhl; John Wiley& Son, Inc.2003.
10. Genetics- Weaver, Hedrick, third edition, McGraw Hill Education

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

S.Y. B.Sc. Zoology, Semester- III

Title: **Parasitology, Fishery and Research Methodology**

COURSE CODE: **BUSZOO303** Credits**- 02 (100M)**

Course Outcome:

1. *Learners will understand the general epidemiological aspects of parasites that affect humans and apply simple preventive measures for the same and comprehend the life cycle of specific parasites, the symptoms of the disease and its treatment.*
2. *Students will understand and learn about the use of different crafts and gears, breading of fishes and making value added products and develop the skills in fishery related cottage industries will develop qualities such as critical thinking and analysis.*
3. *The students will develop the skills of Research methodology and scientific communication and will understand research ethics*

Units	**Title of Unit**		**Lectures (45L)**
I	**Parasitology**		15L
	1.1	Definitions: parasitism, host, parasite, vector-biological and mechanical Types of parasites- Ectoparasites, Endoparasite and their subtypes	
	1.2	Parasitic adaptations in Ectoparasites and Endoparasites	
	1.3	Types of hosts: intermediate and definitive, reservoir	
	1.4	Host-parasite relationship-Host specificity: Definition, structural specificity, physiological specificity and ecological specificity.	
	1.5	Morphology, mode of infection, life cycle, Pathogenicity, prophylaxis and Treatment : *Entamoeba histolytica, Leishmania donovani , Trypanosoma brucei, Fasciola hepatica, Taenia solium, Wuchereria bancrofti* , Head louse (*Pediculus humanus capitis*), Mite (*Sarcoptes scabei*), Bed bug (*Cimex lectularis*)	
	1.6	Parasitological significance: Zoonosis- Bird flu, Anthrax, Rabies and Toxoplasmosis	
II	**Fishery**		15L
	2.1	Introduction to Fisheries: Definition and scope of fishery	
	2.1.1	Introduction to Indian Coast line and major rivers of India; Eastern and western coast. (Geographical features, climate, estuaries etc.), Major rivers of India (Two major rivers flowing North-east, Two major rivers flowing North-west and two rivers flowing west-east).	
	2.1.2	Economic importance of fishes, crabs, prawns, lobsters and molluscs	
	2.2	Crafts and Gears	
	2.2.1	Catamaran, Plank-built canoes, Dug-out canoes, Masula boats, Built-up boats, Gill, Trawl, Purse seine Nets, Hooks and Lines	
	2.3	Ornamental fishes - Breeding and rearing of Angel, Discus, Neon Tetra	
	2.3.1	Aquarium setting and its Maintenance	
	2.3.3	Bivalve Mollusca: Pearl culture	

	2.4	Types of Fishery	
	2.4.1	Inland Fishery (Example: Indian Carps)	
	2.4.2	Offshore Fisheries: (Example: Pomfrets, Bombay duck, Sybium, Mackerel, Oil sardines, Shark)	
	2.4.3	Shell Fishery: (Non Penaeid Prawn: *Macrobrachium rosenbergii*, Penaeid Prawn: *Penaeus monodon*, Crab: *Scylla serrata*, *Charybdis cruciata*.)	
	2.4.4	Fish preservation Techniques: Drying, Salting, smoking etc.	
III	**Research Methodology**		15L
	3.1	Objectives and types of research	
	3.1.1	Motivation and objectives, research methods vs methodology.	
	3.1.2	Types of research – descriptive vs analytical, applied vs fundamental, quantitative vs qualitative, conceptual vs empirical	
	3.2	Research formulation	
	3.2.1	Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem	
	3.2.2	Literature review - primary and secondary sources, reviews, monographs, patents, research databases, web as a source, searching the web	
	3.2.3	Critical literature review, identifying gap areas from literature review and research databases, development of working hypothesis.	
	3.3	Thesis writing	
	3.3.1	Thesis writing – different steps and software tools (Word processing, etc.) in the design and preparation of thesis	
	3.3.2	Layout, structure (chapter plan) and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes.	
	3.4	Research ethics, IPR and Plagiarism	
	3.4.1	Ethics – ethical issues, ethical committees (human & animal)	
	3.4.2	IPR - intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS), plagiarism, reproducibility and accountability.	

References:

1. Parasitology: Protozoology &Helminthology, K.D Chatterjee, CBS Publishers and Distributors
2. Medical Parasitology- Arora, D. R. Arora, CBS Publishers and Distributors

3. Textbook of Medical Parasitology, C.K. Jayaram Paniker, Jaypee Brothers Medical Publishers; 6th Ed. Edition
4. A Textbook of Parasitology, S. K. Kochhar, Dominant Publishers & Distributors Pvt Ltd India, 2009.
5. Essentials of Parasitology Spiral-bound – Import, Gerald D. Schmidt (Author), Marvin C. Meyer (Editor), O. Wilford Olsen (Editor), Brown (William C.) Co, U.S.; 5th Revised edition
6. Introduction to Parasitology, Asa Crawford Chandler , Clark Phares Read, John Wiley & Sons Inc; 10th revised edition
7. A Hand Book on Economic Zoology, Jawaid Ahsan (Author), Subhas Prasad Sinha, S.Chand (G/L) & Company Ltd
8. Economic Zoology, Biostatistics and Animal Behaviour Paperback – Import, G. S. Shukla (Author), V.B. Upadhyay (Author), Reena Mathur (Author), Rastogi Publications
9. Introduction to Fishes, S.S.Khanna, Central Book Depot, Allahabad
10. Aquaculture: Principles and Practices, T.V.R. Pillay, M.N. Kutty, Wiley India Pvt Ltd, Second edition
11. Course Manual in Fishing Technology, Shenoy Latha, Bombay Central Institute of Fisheries Education, Versova, Mumbai.
12. Basics of Fisheries Science: Vol III Fishing Craft & Gear Technology, K C Badapanda, Narendra Publishing House; 1ST edition
13. Crafts and Gear of India, Y. Shrikrishnan and Latha Shenoy, ICAR Pub.
14. Sea Shells of India, Deepak Apte, Oxford University Press
15. Modern Fishing Gear Technology, M. Shahul Hameed, M. R. Boopendranath, Daya Publishing House
16. Prawns and Prawn Fisheries of India, C. V. Kurian, V. O. Sebastian, Hindustan Publishing Corporation, 1993
17. Fisheries Bioeconomics – Theory, Modelling and Management, J. C. Seijo, O. Defeo, S. S. Salas, FAO Fisheries Technical Paper 368 FAO, 2001.
18. Practical research: Planning and design, Paul D Leedy; Jeanne Ellis Ormrod, Harlow: Pearson Education
19. Research Methodology: Methods and Techniques, C. R. Kothari, New Age International

SEMESTER-III
PRACTICAL: I Credit- **01 (50M)**
Course Code: BUSZOO301

Sr. No.	**Practical**

1	a) **Phylum: Protochordata**: • Subphylum: Urochordata : Class Larvacea e.g. *Oikopleura* (Sea squirt) Class Ascidiacea e.g. *Ciona* (Transparent Sea squirt) Class Thaliacea e.g. *Salpa* (Common salp) • Subphylum: Cephalochordata: Class Leptocardii e.g. *Branchiostoma* (*Amphioxus*), b) Phylum: Euchordata • Subphylum Vertebrata: Division Agnatha: Class Ostracodermi e.g. *Pharyngolepis* Class Cyclostomata e.g. *Petromyzon* (Lamprey)
2	Division: Gnathostomata Superclass Pisces: Class Placodermi e.g. *Bothriolepis* Class Chondrichthyes e.g. Scoliodon, Sting Ray Class Osteichthyes e.g. *Labeo, Clarius* (Catfish) Superclass Tetrapoda: Class Amphibia e.g. *Alytes* (Midwife toad), Caecelian and *Triton* (Salamander)
3	Study of food and feeding habits in fish
4	Study of external characters and fins of bony fish and scales in fishes
5	Urine analysis—Normal and abnormal constituent
6	Detection of ammonia in water excreted by fish, uric acid from excreta of Birds.
7	Mounting of legs of insect.
8	Study of parental care in Fishes
9	Identify and describe a) Locomotary apparatus: Pseudopodia in amoeba, Cilia in Paramecium, legs and wings in insects, wings in birds b) Nutritional apparatus: Amoeba (food vacuole), Hydra (Mouth, hypostome and tentacles), Earthworm (Digestive system), Cockroach (Digestive system), Amphioxus (wheel organ), Pigeon (digestive system), Ruminants stomach. c) Types of excretory organs: contractile vacuoles, Organ of Bojanus, T.S. of Kidney of mammals, Flame cells, Nephridia, Malpighian tubules and green gland

PRACTICAL – II Credit- **01 (50M)**
Course Code: BUSZOOP3

Sr. No.	**Practical**

1.	Quantitative and qualitative estimation of RNA
2.	Quantitative and qualitative estimation of DNA
3.	DNA Separation by AGE (demonstration and identification)
4.	Quantitative estimation glucose from given sample by GOD – POD method
5.	Quantitative estimation of protein by Folin's method
6.	Quantitative estimation of total lipids
7.	Temporary preparation of giant chromosomes from salivary glands of Chironomous Larva
8.	Temporary preparation of cheek epithelial cells to show Barr Body
9.	Problems based on Sex linked inheritance
10.	Problems based on Molecular Biology with the help of triplet codon chart
11.	Identification Types of Chromosomes based on centromere position.
12.	Identification of normal karyotype based on groups of chromosomes
13.	Karyotype analysis of structural and numerical variations in humans

NOTE: Project based Karyotype analysis of structural and numerical variations in humans can be given to each student for internal (cutting, pasting and arranging karyotypes submission in the form of project) (20M)

PRACTICAL – III Credit**- 01 (50M)**
Course Code: BUSZOOP3

Sr. No.	Practical

1	Study of Protozoan parasites: *a. Trypanosoma gambiense, b. Giardia intestinalis, c. Ancylostoma duodenale d. Dracunculus medinensis* Parasitic adaptations: Scolex and mature proglottid of Tapeworm Study of Ectoparasites: a. Leech b. Tick c. Mite
2	Fish morphometry – Length weight relationship of a suitable fish.
3	Preparation of formulated feed for fish and prawn.
4	Preparation of Chitin – Chitosan, Pearl essence.
5	Identification of marine fishes. a. *Stromateus cinereus* (Silver pomfret) b. *Stromateus argenteus* (White pomfret) c. *Stromateus niger* (Black pomfret) d. *Polynemus tetradactylus* (Threadfin) e. *Scomber microlepidotus* (Mackerel) f. *Cybium guttatum* (Seerfish or Surmai) g. *Sardinella longiceps* (Indian Oil Sardine) h. *Herpedon neherieus* (Bombay duck) i. *Scoliodon sorrahkowah* (Shark)
6	Identification of Crustaceans and Molluscs. a. *Penaeus monodon* (Giant Tiger Prawn) b. *Macrobrachium rosenbergii* (Shrimp) c. *Acetes indicus* (Jawala paste shrimp) d. *Palinurus polyphagus* (Mud spiny lobster) e. *Charybdis cruciata* (Rock crab) f. *Scylla serrata* (Giant mud crab) g. *Crassostrea* spp. (Oyster) h. *Sepia pharaonis* (Pharaoh cuttlefish) i. *Loligo duvauceli* (Indian squid)
7	Estimation of calorific value proteins / carbohydrates / lipids from fish meat
8	Estimation of fecundity.
9	Study of Structural components of thesis
10	Review of literature
11	Visit to fish market / Aquarium / Zoo/ National Park / Local Gardens / Local available niche / Sanctuaries / and such other places in Maharashtra and / or India and / or abroad to observe chordates and prepare a report. College may conduct more than one field visit for wide exposure, if feasible. However, at least one field visit should be such that it is affordable to every student

Internal submission for 20 marks

1. Participation in workshop on ornamental fish rearing, Aquarium setting and maintenance and submission of its report.
2. Participation in workshop on pearl culture techniques and submission of its report.
3. Participation in workshop on Intellectual property right / copy right/ research methodology and submission of its report.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
S. Y. BSc. Semester-III
Skeleton Question paper Practical-I (BUSZOOP3)

Time: 2.30 hrs **Marks: 50**

Q.1 Study the feed and feeding habit of given fish and make a comment 10

OR

Q.1 Identify the normal and abnormal constituents from given urine sample 10

OR

Q. 1 Identify the type of nitrogenous waste products from given excretory material (all three types) 10

Q. 2 Make a temporary slide preparation from the given muscle tissue , identify its type and draw neat and labelled diagram 06

OR

Q.2 Explain different types of fins from the given fish and based on the fin structure identify the class to which it belongs 06

OR

Q.2 Make temporary preparation of fish scales

OR

Q.2 Mount the legs of given insect 06

Q. 3. Identify and describe. (Any Six) 12

a) Locomotory apparatus: Pseudopodia in amoeba, Cilia in Paramecium, legs and wings in insects, wings in birds
b) Nutritional apparatus: Amoeba (food vacuole), Hydra (Mouth, hypostome and tentacles), Earthworm (Digestive system), Cockroach (Digestive system), Amphioxus (wheel organ), Pigeon (digestive system), Ruminants stomach.
c) Types of excretory organs: contractile vacuoles, Organ of Bojanus, Kidney in mammals (T.S), Flame cells, Nephridia, Malpighian tubules and green gland

Q.4 Identify and describe (Any six) 12

a) Urochordata: *Oikopleura* (Sea squirt), *Ciona* (Transparent Sea squirt), *Salpa* (Common salp)
b) Cephalochordata: *Branchiostoma* (*Amphioxus*)
c) Agnatha: *Pharyngolepis*, *Petromyzon* (Lamprey)
d) Gnatostomata: Pisces: *Bothriolepis*, Scoliodon, Sting Ray, *Labeo, Clarius* (Catfish)
e) Amphibians: *Alytes* (Midwife toad), Caecelian and *Triton* (Salamander)
f) Parental care in amphibians.
g) Parental care in fishes

Q.5 Journal 05

Q.6 Viva – Voce 05

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
S. Y. BSc. Semester-III
Skeleton Question paper Practical-II (BUSZOOP3)

Time: 2.30 hrs **Marks: 50**

Q. 1	Quantitative and qualitative estimation of RNA	12
	OR	
Q. 1	Quantitative and qualitative estimation of DNA	12
Q. 2	Quantitative estimation glucose from given sample by GOD – POD method	10
	OR	
Q. 2	Quantitative estimation of protein by Folin's method	10
	OR	
Q.2	Quantitative estimation of Total Lipids by colorimetric method	10
Q. 3	Problems based on Genetics and Molecular Biology (one each) (Compulsory)	08
	a. Sex linked inheritance	
	b. Problems based on Molecular Biology with the help of triplet codon chart	
Q.4	a. Temporary preparation of giant chromosomes from salivary glands of Chironomous Larva	05
	OR	
	b. Temporary preparation of cheek epithelial cells to show Barr Body	
Q.4	Identify and Describe	05
	a. Identification Types of Chromosomes based on centromere position	
	b. Identification of given karyotype based on structural and numerical variations in humans	
Q. 5	Viva-voce	05
Q. 6	Journal	05

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
S. Y. BSc. Semester-III
Skeleton Question paper Practical-III (BUSZOOP3)

Time: 2.30 hrs **Marks: 50**

Q. 1	Estimation of calorific value of protein /carbohydrate / lipids from fish meat	12
Q. 2	Calculate the fecundity by counting eggs in the *ovary* of fish from preserved samples	10
	OR	
Q.2	Calculate the length weight relationship from given fish population	
Q. 3	Prepare fish food for fish / prawn	08
Q.4	Identify and Describe	10

a. Identification of protozoan parasite
b. Identification of ectoparasite
c. Marine Fishes
d. Prawn / lobster
e. Molluscans / crustaceans

Q. 5	Viva-voce	05
Q. 6	Field report	05

SEMESTER IV

B. K. Birla College of Arts, Science and Commerce, Kalyan (W.)

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

S. Y. BSc. Zoology, Semester- IV

Title: **Chordate Life and Life Processes II and III**

Course Code: **BUSZOO401** Credits- **02(100M)**

Course *outcome:*

1. *Learners will understand the special features and unique characteristics among various classes of Phylum chordata such as bioluminescence, Migration and parental care*
2. *Learners will understand the comparative aspects of vital life processes like respiration, circulation, control and coordination and reproduction.*
3. *Students will learn to correlate the vital processes with each other.*

Units	**Title of Unit**		**Lectures (45L)**
I	**Chordate Life**		15L
	1.1	Special features in fishes:	
	1.1.1	Bioluminescence in fish	
	1.1.2	Parental care in fish	
	1.1.3	Migration in fish (e.g. Great migratory salmon)	
	1.2	Special features in amphibians:	
	1.2.1	Neoteny in amphibians	
	1.2.2	Metamorphosis in amphibians	
	1.2.3	Parental care in amphibians	
	1.3	Special features in Reptiles:	
	1.3.1	Venomous and non-venomous snakes (Types and differentiation)	
	1.3.2	Jacobson's organ in snakes	
	1.3.3	Camouflaging mechanism in chameleon	
	1.3.4	Parental care in reptiles	
	1.4	Special features in Aves:	
	1.4.1	Types of feathers, claws and beaks	
	1.4.3	Bird migration.	

	1.5	Special features in Mammals:	
	1.5.1	Aquatic mammals: Dolphin, Whales (Blue whale, Baleen whale), Seals, Walrus, Dugongs	
II	**Life Processes –II**		15L
	2.1	Respiration	
	2.1.1	Comparative study of Respiratory organs (structure and function), Earthworm, cockroach (Spiracles and trachea), Rohu (Structure and T. S. of gills), Frog (T. S. of lungs and skin) and Pigeon (Respiratory system including air sacs).	
	2.1.2	Structure of lungs (Respiratory system, T.S. of lungs) mechanism of breathing and physiology of respiration in man.	
	2.1.3	Swim Bladder: Accessary respiratory organs in fishes - Types, Functions and Significance.	
	2.1.4	Respiration in lung fish.	
	2.1.5	Haemoglobin as a respiratory pigment in mammals.	
	2.2	Circulation	
	2.2.1	Comparative study of circulation: Open and closed - single and Double	
	2.2.2	Comparative study of Hearts (Structure and function) Earthworm, Cockroach, Shark, Frog, Crocodile and Pigeon.	
	2.2.3	Types of circulating fluids- Water, coelomic fluid, haemolymph, lymph and blood.	
	2.2.4	Structure and mechanism of working of mammalian heart	
III	**Life Processes – III**		15L
	3.1	Control and coordination	
	3.1.1	Irritability –Paramecium, Nerve net in Hydra, Nerve ring and nerve cord in earthworm,	
	3.1.2	Types of neurons on the basis of structure and function.	
	3.1.3	Conduction of nerve impulse; Resting potential, action potential and refractory period, Synaptic transmission and reflex action.	
	3.1.4	Endocrine regulation: Hormones as chemical messengers, feedback, Mechanisms.	
	3.1.5	Types of mammalian nervous system: Structure and types (Central, Sympathetic and parasympathetic	
	3.2	Reproduction	

	3.2.1	Asexual Reproduction- Fission (all types), Conjugation, fragmentation, gemmule formation, Budding	
	3.2.2	Sexual reproduction: Gametogenesis, Structure of human gametes. Types of fertilization, Oviparity, viviparity, ovo-viviparity.	
	3.2.3	Male and female reproductive system in mammals e.g. Rat (Structure and function)	

Reference: (refer the list given for COURSE CODE: BUSZOO 301 semester III)

1. Vertebrate Zoology Volume I- Jordan and Verma, S. Chand and Co.
2. Invertebrate Zoology Volume II- Jordan and Verma, S. Chand and Co.
3. Invertebrate Zoology- Majupuria T. C., Nagin S.and Co.
4. Chordate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
5. Invertebrate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
6. Introduction to Vertebrates- Moore Cambridge University- Low Priced Edition.
7. Zoology- Miller S. A. and Harley J. B., Tata McGraw Hill.
8. Modern Textbook of Zoology, Invertebrates, Kotpal R. L.
9. Biological Science, Taylor D.J., Stout G.W., Green N.P.O, Soper R. Cambridge University Press.

B. K. Birla College of Arts, Science and Commerce, Kalyan (W)

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

S. Y. BSc. Zoology, Semester- IV

Title: **Biotechnology, Cell biology and Embryology**

Course Code: **BUSZOO402** Credits**- 02 (100M)**

Course outcome:

1. *Learners will get the idea of Biotechnology, Cell biology and Embryology and their applications for further study*
2. *Students will understand the types of biological databases, their retrieval and classification*
3. *The students will understand working principles of various instruments required to perform the relevant practical in biotechnology and cell biology.*

Units	Title of Unit		Lectures (45L)
I	**Biotechnology and Bioinformatics**		15L
	1.1	Introduction to biotechnology: Definition and Scope	
	1.2	Instruments used in biotechnology.	
	1.2.1	*Electrophoresis (AGE and PAGE), Real-* time PCR, Spectrometer and Flow-cytometer.	
	1.3	Sterilization techniques and aseptic techniques.	
	1.4	Culture media (Liquid and solid): Their role in microbial culture, plant and animal tissue culture and their types.	
	1.5	Culture methods: Suspension culture, anchor dependent culture. Flask Culture, Cover-slip culture.	
	1.6	Introduction to bioinformatics: scope and applications	
	1.7	Biological databases	
	1.8	Sequence alignment	
II	**Cell Biology**		15L
	2.1	Cell division: types and functions (Mitosis and Meiosis).	
	2.2	Plasma membrane: Structure and function	
	2.2.1	Transportation of solutes across the membrane: Osmosis, Bulk Flow, Simple diffusion, Facilitated Diffusion, Passive transport, Active transport, Endocytosis	
	2.3	Nucleus; Structure of eukaryotic nucleus and its function.	
	2.4	Introduction to endomembrane system: Structure and functions	

	2.5	Endoplasmic reticulum, Mitochondria, Golgi Complex, Lysosomes, Microtubules and micro fibrils.	
III	**Embryology**		15L
	3.1	Types of eggs and sperms	
	3.2	Types of fertilization	
	3.3	Types of cleavage	
	3.4	Types of blastulae	
	3.5	Morphogenetic movements	
	3.6	Coelom formation	

References:

1. Basic cell culture - A practical approach; J. M. Davis; Oxford University Press; Indian edition; 2005.
2. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, R. Ian Freshney, Sixth Edition, Wiley-Blackwell Publication.
3. Animal cell culture - Biotechnology Series: Vol.1; Bina Mishra, B. P. Mishra, Pran P.
4. Animal cell culture - Concept and Applications; Shweta Sharma; Oxford book Company; 2012.
5. Biotechnology of Animal Tissues; Dr. P. R. Yadav and Dr. Rajiv Tyagi; Discovery Publishing House, New Delhi; 2006.
6. Cell and Molecular Biology E.D.P De Robertis and E.M.R Robertis, CBS Publishers and Distributors.
7. The Cell: A molecular Approach Goeffrey M. Coper ASM Press Washington D.C.
8. Cell Biology, Pawar C.B. Himalaya publication.
9. Developmental Biology- Berril N.J., Tata Mc Graw –Hill Publication.
10. Chick Embryology- Bradley M. Pattern
11. Embryology- Mohan P. Arora.

B. K. Birla College of Arts, Science and Commerce, Kalyan (W)

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

S. Y. BSc. Zoology, Semester- IV

Title: **Applied Entomology, Animal Husbandry, Wild life management and Zoogeography**

Course Code: **BUSZOO403** Credits**- 02(100M)**

Course outcome:

1. *Learner will understand the geographic distribution of animals, the threats to the wildlife and methods for wildlife conservation and management*
2. *Learner will gain the knowledge and the skills in applied entomology and Animal husbandry.*
3. *Students will be able to develop business startup or poultry / cattle farm and commercialization of biological products*

Units	Title of Unit		Lectures (45L)
I	**Applied Entomology**		**15L**
	1.1	Definition , introduction and scope of entomology	
	1.1.1	Apiculture	
	1.1.2	An introduction to different species of honey bees used in apiculture, Morphology of honey bee , Life cycle of honey bee, Traditional and modern methods of apiculture, Pests and Bee enemies- Wax moth, wasp, black ants, bee-eaters, king crow and disease control, Chemical composition of honey and wax, Economic importance of apiculture – Honey , bee wax , pollination	
	1.2	Sericulture	
	1.2.1	Types of silk moths, host plants, used in sericulture and geographical distribution of silk moths, Morphology of *Bombyx mori*, Life cycle of *Bombyx mori* - morphology of egg, larva, pupa and adult, Method of sericulture and Silk production, Cocoon production. Number of reeling units (Charka, Cottage, Basin, Filature basin, Handlooms and Power looms).	
	1.3	Lac culture	
	1.3.1	Lac cultivation in India, Morphology *Kerria lacca* (lac insect), Life cycle, *Kerria lacca*, Major lac host plants in India, Method of lac cultivation, Natural enemies of lac insects, Chemical composition of lac, Processing of raw lac to Shellac, Economic importance of lac culture	
	1.4	Agricultural pest and its management	
	1.4.1	Introduction and concept of Pest	

	1.4.2	Major insect pests of agricultural importance (Life cycle, nature of damage and control measures): Brinjal fruit bore, Aphids, Rice weevil, Cotton bollworm	
	1.4.3	Pest control practices: Cultural control, Physical control, Mechanical control, Chemical control, Biological control, Concept of IPM.	
II	**Animal Husbandry**		**15L**
	2.1	Poultry	
	2.2	Indian Cattles	
	2.3	Indian Sheep and Goat	
	2.4	Integrated farming: Paddy cum fish culture and goat and fish farming	
	2.5	Dairy science: Role of Dairy development in rural economy	
	2.6	Composition of milk,	
	2.7	Milk and Milk products: Skimmed milk, Milk Powder, Cheese, Curd, Yogurt, Paneer, Khoya, Butter, Ghee, Ice cream	
	2.8	Cattle Breeds: Two Indian and two Exotic	
III	**Wildlife Management and Zoogeography**		**15L**
	3.1	Habit, Habitat, Territory and Niche of Wild Animals: Herbivores, carnivores, solitary, social (flock, pod, community), pack and herd, types of habitats and territories, niche concept	
	3.2	Threats to Wildlife: Poaching and hunting, deforestation, encroachment, competition (intra -specific and inter-specific), overgrazing and climate change, diseases (zoonosis and reverse zoonosis), Tourism and Human wildlife conflict	
	3.3	Wildlife Conservation: Techniques and methods used for wildlife census: Aerial counts, camera trap, line transect census and track surveys, capture mark recapture method, wildlife radio telemetry	
	3.4	Animal Distribution and Barriers: Isolating Mechanisms, Patterns of animal distribution - continuous, discontinuous and bipolar, Barriers of distribution -Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habit (homing instinct), Means of dispersal - land bridges, natural rafts and drift wood, favouring gales, migration by host, accidental transportation and by human agencies	
	3.5	Biogeographical Realms: Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic	

References:

1. Plant and Animal Geography, Marion Newbigin, Egmont Books Ltd
2. Vertebrate Paleontology 3rd Edition, Alfred Sherwood Romer, the University of Chicago Press
3. Fundamentals of World Zoogeography, S. K. Tiwari, Ivy Publishing House
4. Zoogeography of India and South East Asia, S. K. Tiwari, CBS Publishers and Distributors, Delhi
5. Zoogeography of Indian Amphibians, S. K. Tiwari, Today and Tomorrows Printers and Publishers
6. Wildlife Management and Conservation, M. M., Ranga, Agrobios
7. Ecological Census Techniques A Handbook, William J. Sutherland, Cambridge University Press
8. CRC Handbook of Census Methods for Terrestrial Vertebrates, Davis, CRC Press
9. Selecting wildlife census techniques (Monograph), R. F. H. Collinson, Institute of Natural Resources, University of Natal (1985)
10. Forest Measurements, Fifth Edition 5th Edition, Thomas Eugene Avery, Harold E. Burkhart, Waved land Press Inc.
11. Techniques for Wildlife Investigation and Management 6th Edition, Clait Braun, Bethesda, Md.: Wildlife Society, 2005.
12. A Textbook of Applied Entomology Paperback, K.P. Srivastava , G.S. Dhaliwal, Kalyani Publishers
13. A Textbook of Applied Entomology Paperback Volume 2, K.P. Srivastava , G.S. Dhaliwal, Kalyani Publishers
14. Applied Entomology, Manju Yadav, Discovery Publishing Pvt. Ltd
15. Entomology at a Glance, Saxena, R.C. and Srivastava, R.C., Agrotech Publishing House, Udaipur
16. Applied Entomology, Fenemore, P.G. and Alka Prakash, New Age International (P) Ltd. Publishers, New Delhi
17. Study Material for Insect Ecology and Integrated Pest Management, Raghavaiah, G. and Ramesh Babu, T. (2012), Department of Agricultural Entomology, Acharya N.G. Ranga Agricultural University, Hyderabad
18. A Textbook of Animal Husbandry, Banerjee G. C., Oxford; 8th revised edition edition
19. Textbook of Animal Husbandry, Manoj Kumar Rai, Oxford Book Company

SEMESTER-IV

PRACTICAL – I Credit- **01(50M)**

Course Code: BUSZOO401 P IV

Sr. No.	Practical
1.	Identification of a) Bioluminescence in fish (e.g. Angler fish) b) Parental care in fish (types of nests, mouth breeding) c) Parental care in amphibians. d) Parental care in reptiles (Turtle sand nest, Crocodile sand nest, Foliage nest of king cobra) e) Parental care in mammals (roosts, burrow, dens etc.) f) Stages in metamorphosis of amphibians g) Venomous and non-venomous snakes h) Types of feathers i) Types of beaks j) Types of claws k) Air sacs in pigeon l) Jacobson's organ
2.	Study of migration in fish (salmon and mahseer), bird (Bar headed geese), Mammals (Elephant and Wilder Beast) Identify the animal, mark its migration route on given map and comment on its pattern of migration.
3.	Study of Chemotaxis and trichosis release in paramecium.
4.	Earthworm dissection (demonstration or cultured earthworms purchased from nursery) for digestive system, nervous system and reproductive system. (Show videos only)
5.	Mounting: Spermatheca, ovary, testis in earthworm (Show videos only)
6.	Respirometer using insect.
7.	Measurement of respiratory rate in fish
8.	Measurement of blood pressure in humans using sphygmomanometer.
9.	Study of human blood smear.

10.	Study of permanent slides. a. Sponge gemmule b. Hydra budding c. T.S. of mammalian testis d. T.S. of mammalian ovary e. Lungs of Frog f. Lungs of Man g. Fission and conjugation h. Human egg i. Human sperm j. Spiracles and trachea of insects. k. Air sacs in birds. l. T.S. of frog skin m. Types of heart n. T.S. of mammalian spinal cord. o. Mammalian brain. p. Parts of the male and female reproductive system of rat
11.	Mounting of cardiac muscles (Chicken or goat heart can be purchased from Butcher's shop)
12.	Study of heart beat of daphnia
13.	Excursion (Study tour / Visit) to Zoo / Sanctuary / National park / Research institute, etc. and submit a report. College may conduct more than one field visit for wide exposure, if feasible. However, at least one field visit should be such that it is affordable to every student. (Internal)

Parental care and Nest in birds (20M) Internal

PRACTICAL – II Credit- **01(50M)**

Course Code: BUSZOOP4

Sr. No.	**Practical**
1	Identification based on instruments used in biotechnology
2	Wrapping of glassware for sterilization
3	Aseptic transfer and preparations of glassware
4	Streaking techniques
5	Preparations of slants and culture plates
6	Explore the databases (Nucleotide, Protein) at NCBI for querying a nucleotide or protein sequence.
7	Study of osmosis using RBC
8	Identification based on study of Cell organelles
9	Identification based on Study of types of eggs and sperms

10	Identification based on Types of cleavage
11	Identification based on Types of blastula and gastrula
12	Morphogenetic movements in chick embryo (Demonstration)

NOTE: Project based on Bioinformatics can be given to each student for internal (20M)
Explore the databases (Nucleotide, Protein) at NCBI for querying a nucleotide or protein sequence.

PRACTICAL – III Credit- **01(50M)**
Course Code: BUSZOO403 P4

Sr. No.	**Practical**
1.	Study of life cycle of honey bee, silk moth, Lac Insect
2.	Mounting of types of legs, mouth parts and sting apparatus of honey bee
3.	Mounting of mouth parts of cockroach, housefly, mosquito
4.	From photographs/models/ pictures study of various tools used in insect collection - insect net, killing jar, spreading board, oven
5.	Types of pests –Agricultural-Aphids, Household-cockroaches, ants, structural-termites, stored grains-grain borer,
6.	Extraction of casein from milk and its qualitative estimation
7.	Preparation of paneer from milk sample
8.	Measurement of density of milk
9.	Detection of milk adulterants
10.	Estimation of reducing sugars, total reducing sugars and sucrose in honey
11.	Comparison of cholesterol content from two different varieties of egg
12.	Study of population density by Line transact and quadrant method and calculate different diversity indices a. Index of dominance b. Index of frequency c. Index of species diversity
13.	Indicate the fauna on the world map with respect to its realm and comment Palearctic: Giant Panda and Japanese Macaque, Ethiopian: Common ostrich and African bush elephant, Oriental: Indian one-horned Rhinoceros and Gharial, Australian: Platypus and Red Kangaroo, Neotropical: Guanaco and South American Tapir, Nearctic: Virginia opossum and Sea otter, Antarctic: Emperor Penguin and Antarctic Minke Whale
14.	Identification a. Poultry birds - Plymouth Rocks, leghorn, broiler b. Goat – Jamunapari , Beetal, Sirohi , Osmanabadi c. Sheep -Neelagiri, Coimbatore, Gaddi, Dorset, Merino, Rambouillet d. Cattles (Indian and Exotic) Sahiwal, Gir, Red Sindhi, Tharparkar, Holstein, Jersey

15.	Field visit to Dairy Industry / Apiculture / Sericulture farm/ Goat / Sheep farm

Internal for 20 Marks

1) Submission of Report on Milk Adulterant of different milk samples
2) Submission of Report on various Indian cattle
3) Submission of Report on various Indian poultry bird
4) Submission of Report on various Indian Sheep / goats
5) Survey of household insect pest, photographic documentation and identification and write report on it
6) Survey of Agricultural insect pest, photographic documentation and identification and write report on it
7) Survey of Stored grain insect pest, photographic documentation and identification and write report on it

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
S. Y. BSc. Semester-IV
Skeleton Question paper Practical-I (BUSZOOP4)

Time: 2.30 hrs **Marks: 50**

Q.1 Study of heart beat in Daphnia – a. The rate of normal and b. upon exposure to given chemical. Make a report. 10

OR

Q. 1 Study the rate of respiration in given fish exposed to cold/hot stress

Q. 2 Make a temporary mounting of cardiac muscles from given sample. Draw and write its function. 05

OR

Q.2 Draw the digestive/ Nervous system/ Reproductive system , label and write the functions of the parts of earthworm

Q. 3 Assemble the respirometer from the given glassware and calculate the rate of respiration of insect from the given data. 05

OR

Q. 3 Demonstrate irritability in paramecium either with the help of chemotaxis or trichosis release.

OR

Q.3 Study the given permanent slide of human blood smear and report the types of cells visible, draw and write their functions.

OR

Q.3 Measure the blood pressure of the volunteer and make the report.

OR

Q.3 Identify the given animals, mark their route of migration on the given map and comment on their migration pattern

Q.4 Identify and describe the following: (Any five) 10

a) Bioluminescence in fish (e.g. Angler fish)
b) Parental care in fish (types of nests, mouth breeding)
c) Parental care in amphibians.
d) Parental care in reptiles (Turtle sand nest, Crocodile sand nest, Foliage nest of king cobra)
e) Parental care in birds (nesting in birds)
f) Parental care in mammals (roosts, burrow, dens etc.)
g) Stages in metamorphosis of amphibians
h) Venomous and non-venomous snakes
i) Types of feathers
j) Types of beaks
k) Types of claws
l) Air sacs in pigeon
m) Jacobson's organ

Q. 5 Identify and describe the following: (Any five) 10

Study of permanent slides.

a. Sponge gemmule
b. Hydra budding
c. T.S. of mammalian testis
d. T.S. of mammalian ovary
e. Lung of Frog
f. Lung of Man
g. Fission and conjugation
h. Human egg
i. Human sperms
j. Spiracles and trachea of insects
k. Air sacs in birds
l. T.S. of frog skin
m. Types of heart
n. T.S. of mammalian spinal cord.
o. Mammalian brain.
p. Mammalian reproductive system - Rat

Q.6 Journal and Viva – Voce 10

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
S. Y. BSc. Semester-IV
Skeleton Question paper Practical-II (BUSZOOP4)

Time: 2.30 hrs **Marks: 50**

Q. 1	Demonstrate streaking techniques (any 2) (Continuous , T- streak, pentagonal, quadrant)	12
	OR	
	Identify the given types of streaking techniques. Comment on their significance (3 types)	
	OR	
Q. 1	Demonstrate phenomenon of osmosis using RBC	12
Q. 2	Demonstrate aseptic transfer (any two) (flask to test tube / flask to flask / flask to Petri dish / pipette to test tube) Can be also included in Q.1	10
	OR	
Q.2	Preparations of glassware for sterilization (any two) (flask, test tubes, Petri plates, pipettes)	10
	OR	
Q. 2	Preparations of slants and culture plates (one each)	10
Q. 3	Identify and describe	18
	a. Identification based on instruments used in biotechnology (Autoclave, Laminar flow, incubator, oven. CO_2 incubator)	
	b. Identification based on instruments used in biotechnology (Electrophoresis (AGE and PAGE), Real- time PCR, Spectrometer, Flow-cytometer)	
	c. Study of Cell organelles (plasma membrane, nucleus, mitochondria)	
	d. Study of Cell organelles (Golgi apparatus, lysosome, microtubules and microfibrils)	
	e. Types of eggs and sperms	
	f. Types of cleavage / Types of blastula and gastrula	
Q. 4	Viva-voce	05

Q. 5 Journal 05

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
S. Y. BSc. Semester-IV
Skeleton Question paper Practical-III (BUSZOOP4)

Time: 2.30 hrs **Marks: 50**

Q. 1	Estimate reducing sugars / total reducing sugars / sucrose in given honey sample	12
	OR	
Q.1	Isolation of casein from milk and its qualitative identification	
	OR	
Q.1	Estimate and compare the cholesterol content of the given egg samples	
Q.2	Calculate the density of milk samples (any two)	10
	OR	
Q.2	Extract and quantify the amount of paneer from given milk sample	
	OR	
Q.2	Detect Milk adulterants from milk samples (Glucose, Sucrose, Urea, Ammonia etc.)	
Q.3	Calculate Index of dominance, Index of frequency, Index of species diversity on given chart by Line transect / Quadrant method	08
	OR	
Q.3	Mount Mouth parts of Honey bee / Cockroach / House fly / Mosquito / Legs of Honey bee / Sting apparatus of Honey bee	
Q.4	Identify and Describe	10
	a. Identification of insect pest b. Identification of collection tool c. Identify given realm / representative animal d. Identify Poultry birds e. Identify Sheep / goat / cattle	
Q.5	Viva-voce	05
Q. 6	Field report	05

B. K. BIRLA COLLEGE OF ARTS, SCIENCE AND COMMERCE (AUTONOMOUS), KALYAN (W)

Syllabus for T.Y. B.Sc.

Program B.Sc.

Course: Zoology

Semester V and VI

(With effect from 2020-21)

B.Sc.

Programme outcomes

PO	PO Description **A student completing graduation in Science (B.Sc.) will be able to attain the following**
PO1	Students will acquire basic knowledge of principles and processes underlying Life Sciences.
PO2	Graduates will develop essential skill to conduct independent research in Botany, Biotechnology, Chemistry, Biochemistry, Applied Mathematics, Bioanalytical Sciences, Environmental Science, Microbiology, Physics, and Zoology
PO3	Students will be able to demonstrate proficiency in sciences and develop scientific temper
PO4	To demonstrate professional and ethical attitude with enormous responsibility to serve the society
PO5	Problem Analysis: Identify, formulate, review research literature, and analyze complex Subject related problems reaching substantiated conclusions and solutions
PO6	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO7	Life-long Learning: Recognize the need and develop ability to be lifelong learner in the broadest context of Subject or beyond, via Online platforms.
P08	Students will acquire eligibility for higher studies
PO9	Students will be able to understand regulatory norms and will adopt ethical practices in the pursuit and application of science
PO10	Students will acquire soft skills to hone their personalities.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan (w).
Department of Zoology
Program: Bachelor of Science (B.Sc.)
(F.Y. B.Sc., S.Y. B.Sc., T.Y. B.Sc.)
Program Specific Outcome (PSO)

B.K. Birla College offers any one of the two combinations such as Chemistry, Botany and Zoology (CBZ) or Chemistry, Zoology and Microbiology at F.Y. B.Sc. level (Semester 1 and 2) for B.Sc. program. Students select any two subject combination for their S.Y. B.Sc. class (Semester 3 and 4). These combinations can be Chemistry, Zoology or Botany, Zoology. Students interested in learning Zoology opt for the single subject for their T.Y. class (Semester 5 and 6). At F.Y. and S.Y. levels along with the science subjects students also learn foundation course (FC) as one of the subjects. In T.Y. class along with Zoology the department offers Environmental Science as a subject of Applied Component.
As per the new norms laid by UGC, students at undergraduate level should earn 132 credits instead of 120. At B.K. Birla College students will be offered courses in English Language Proficiency and Digital Literacy of four credits as electives in semester I and II to begin with. Discipline specific electives will be offered in semester III and III and core subject specific electives of four credits will be offered in semester V and VI. Such electives added in the syllabus as a mandate will enhance the skill sets of the students and also enrich their subject knowledge. This will make the students ready for higher education at national and international levels.
Courses offered under Zoology in the program from F.Y. B.Sc. to T.Y. B.Sc. aim at providing fundamental knowledge of the subject along with the updates of the recent advances. It also aims to empower students to understand the challenges of society and the country that falls into the realms of Zoology, such as health and epidemiology, animal behavior, forest management and conservation, immunology and cancer biology , animal pathology, zoonosis , Microbiome and their roles in health and diseases, Bioremediation of pollutants and pesticides, etc.
The syllabus is in sync with the requirements of the modern society and industry hence the syllabus will be providing the knowledge and skills in the fields of genetic engineering, biotechnology, nanobiotechnology, developmental biology, research methodologies, enzymology etc.
Total number of credits allotted for hands on training and the practical skills are 22. The skills learnt in the hematology and genetics laboratory will help students in obtaining jobs in the fields of pathology and cytogentics, while those which are learnt in the molecular biology laboratories will give them a flavor of recent technology.
The program gives more emphasis on learning the invertebrate and vertebrate systems using virtual class rooms and does not use the real specimens unnecessarily. This approach instills the concept of animal rights and ethics among the students.

T.Y. B.Sc. Zoology Semester – V

Course code	Unit	Topics	**Proposed changes under autonomy**	Credits	Lectures/week
BUSZOO501 (100M)	I	Principles of Taxonomy	**Study of Animal Type: Non-chordata -Sepia**	2.5	1
	II	Kingdom Animalia - I	**Mammalian Histology**		1
	III	Kingdom Animalia - II	**Development Biology- Frog**		1
	IV	Type Study Sepia	**Human Osteology**		1
BUSZOO502 (100M)	I	Basic Hematology	**Hematology – I**	2.5	1
	II	Applied Hematology	**Immunology – I**		1
	III	Basic Immunology	**Enzymology – I**		1
	IV	Applied Immunology	**Homeostasis and Regulation – I**		1
BUSZOO503 (100M)	I	Mammalian Histology	**Molecular Biology**	2.5	1
	II	Toxicology	**Genetic Engineering- I**		1
	III	General Pathology	**Toxicology – I**		1
	IV	Biostatistics	**Biotechnology – I**		1
BUSZOO504 (100M)	I	Integumentary system and derivatives	**Bioprospecting and Zoopharmacognosy**	2.5	1
	II	Human Osteology	**General Pathology**		1
	III	Muscles of long bones of Human limbs	**Biostatistics**		1
	IV	Developmental biology of Chick	**Nanobiotechnology**		1
BUSZOOP5 (50M+50M+ 50M+50M)			**Practical component**	5	16

Note: Credits for T. Y. BSc. Zoology – 10+5 = 15
Credits for Applied Component – 4+1 = 5

T.Y. B.Sc. Zoology Semester – VI

Course Code	Unit	Topics	**Proposed Changes under Autonomy**	Credits	Lectures/Week
BUSZOO601 (100M)	I	Phylum Chordata: Group Protochordata and Group Euchordata	**Study of Animal Type: Chordata e.g. Shark**	2.5	1
	II	Group Euchordata- II	**Mammalian Endocrinology**		1
	III	Group Euchordata-III	**Developmental Biology Chick**		1
	IV	Type Study: Shark	**Muscles of Long Bones of Human Limbs**		1
BUSZOO602 (100M)	I	Enzymology	**Hematology – II**	2.5	1
	II	Homeostasis	**Immunology – II**		1
	III	Endocrinology	**Enzymology – II**		1
	IV	Animal Tissue Culture	**Homeostasis and Regulation – II**		1
BUSZOO603 (100M)	I	Molecular Biology	**Genetics and Molecular Evolution**	2.5	1
	II	Genetic Engineering	**Genetic Engineering – II**		1
	III	Human Genetics	**Toxicology – II**		1
	IV	Bioinformatics	**Biotechnology – II**		1
BUSZOO604 (100M)	I	Environment Management	**Population Ecology**	2.5	1
	II	Wildlife Management	**Principle of Epidemiology**		1
	III	Bioprospecting and Zoopharmacognosy	**Infectious Diseases of Pet and Domestic Animals**		1
	IV	Zoogeography	**Bioinformatics**		1
BUSZOOP6 (50M+50M+ 50M+50M)			**Practical Component**	5	16

Note: Credits for T. Y. BSc. Zoology –10+5 = 15
Credits for Applied Component – 4+1 = 5

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

T.Y. B.Sc. Zoology, Semester- V

Title: **Structural, Functional and Developmental Aspects of Animal Life-I.**

Course Code: **BUSZOO501 Credits- 2.5 (100M)**

Objectives:

1. *Classification of animals is taught in lower classes. Detailed studies of at least one type of non-chordate with respect to its habit, habitat and structures- functions of various system is covered in this semester*
2. *Several organs present in mammalian body in various systems have their own and coordinated functions. Unit on histology deals with the study of these organs.*
3. *It is important to learn development of a vertebrate and appreciate several embryological processes. The unit on embryology deals with these processes.*
4. *Each bone in human body is important and has its characteristic structure and function. Osteology gives the knowledge of these bones. The unit is not only relevant to professionals but also to common people.*

Learning outcome:

Students would learn to understand and appreciate the structure function relationship of various parts of animal body, their developmental processes and use the knowledge not only professionally but also in day to day life.

Units		Title of Unit	Lectures (60)
I	**Study of Animal Type: Non-chordata - Sepia**		15L
	1.1	General characters and classification, habit and habitat, external characters, mantle cavity, locomotion, economic importance	
	1.2	Digestive system, respiratory system, circulatory system, excretory system, nervous system, sense organs and reproductive system	
II	**Mammalian Histology.**		15L
	2.1	Histology of organs of digestive system: Tooth, Tongue, stomach, small intestine, large intestine.	
	2.2	Histology of digestive glands: Salivary glands, Liver, Pancreas.	
	2.3	Histology of respiratory and excretory organs: Histology of lungs, Skin, Kidney	
	2.4	Study of blood vessels: T. S. of Artery, T.S. of Vein, T. S. of capillary.	
	2.5	Study of Muscles: Striated, non-striated and cardiac muscles	
III	**Developmental Biology- Frog**		15L
	3.1	Gametogenesis in frog	
	3.2	Structure of egg and sperm of frog Fertilization and formation of grey crescent area.	
	3.3	Cleavage, Blastulation and Fate map and Gastrulation	
	3.4	Neurulation	
	3.5	Development of Notochord- Notogenesis	
	3.6	Development of Brain and eye	
	3.7	Post embryonic development	
IV	**Human Osteology**		15L

	4.1	Introduction: Bone structure (Histology), physical properties, chemical composition and general functions of bones.	
	4.2	Cartilage: General structure, functions	
	4.3	Axial skeleton: Skull: General characteristics of skull bones - Cranial and facial bones, Vertebral column: General characteristics of a vertebra, structure of different types of vertebrae (cervical, thoracic, lumbar, sacrum and coccyx), Ribs and sternum: General skeleton of ribs and sternum, Hyoid bone: Structure and function.	
	4.4	Appendicular skeleton: Pectoral girdle and bones of forelimbs, Pelvic girdle and bones of hind limbs	
	4.5	Types of joints: Saddle joint, Synovial joint, Gliding joint, Pivotal joint, Hinge joint, Ball and socket joint	

PRACTICAL I Credit- 1.25 (50M)
Course Code: BUSZOO501 P5

Sr. No.	Practical
1	Mounting of striated, non-striated and cardiac muscles.
2	Identification of a. Frog egg/ fertilized egg b. Blastula c. Gastrulation- yolk plug stage d. Post embryonic stages
3	Draw the fate map of blastula and mark the following parts. a. Animal pole b. vegetal pole c. Neural plate d. Notochord e. Blastopore f. Visceral pouches g. Limb buds
4	Study of Human Axial Skeleton - Skull (whole) and Vertebral column (axis, atlas, typical cervical, typical thoracic, typical lumbar, sacrum, coccyx)
5	Study of Human Appendicular Skeleton - Pectoral and pelvic girdle with limb bones
6	Study of types of joints: Saddle joint, Synovial joint, Gliding joint, Pivotal joint, Hinge joint, Ball and socket joint
7	Identification of histology slides (Slides and pictures) Tongue, T.S. of Tooth, salivary glands, stomach, small intestine, large intestine, liver, pancreas, lungs, skin, kidney, artery , vein, capillary
8	Dissections: Digestive system, Reproductive system, Nervous system Mountings: Jaws, Radula, Chromatophores, Spermatophores, Statocyst Or Study of *Sepia* with the help of diagram / Photograph / Simulation whichever possible: Digestive system, Reproductive system, Nervous system, Jaws, Radula, Chromatophores, Spermatophores, Statocyst

References:

1) Modern text book of Zoology - Invertebrates; Eleventh; Edition Professor R.L. Kotpal; Rastogi publication
2) Invertebrate Zoology by E. L. Jordan & P. S. Verma Rev. edition,2009, Chand publications
3) Developmental Biology- Gilbert
4) Developmental Biology- Wolpert
5) Text book of embryology- N. Arumugam
6) Chordate Embryology- P. S. Verma and V.K. Agarwal
7) Developmental Biology - T. Subramoniam
8) Human Physiology by Chatterjee and Chatterjee.
9) Principals of Anatomy and Physiology by Tortora
10) B.D. Chaurasia Human Anatomy – Volume 1 and 2

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Department of Zoology

T. Y. BSc. Semester-V

Skeleton Question paper Practical-I (BUSZOOP5)

Duration: 3hrs Marks: 50

Q. 1	Dissect the given animal so as to expose it's Digestive /Reproductive /Nervous system and draw its neat and labelled diagram	12
Q.2	Make a temporary mounting of Jaws /Radula / Chromatophores / Spermatophores / Statocyst	06
Q.3	Make a temporary mounting out of the material 'a' and 'b' provided. Identify and draw the diagram.	06
Q. 4	Identify and describe (a to d) Two bones from **a and b-**axial skeleton, **c -** bones from appendicular skeleton **and d-** one type of joint	08
Q.5	Identify and describe (a to d) a- One specimen from digestive organs, b- One specimen from digestive glands, c- One specimen from excretory organs, d- One specimen from blood vessels.	08
Q. 6	Viva-voce and Journal	10

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

T. Y. B.Sc. Zoology, Semester- V

Title: **Regulatory Aspects of Animal Life-I**

Course Code: **BUSZOO502 Credit: 2.5 (100M)**

Objectives:

1. *Hematology is the science related to blood and its related functions. It is necessary to have the knowledge on body fluids and their importance in healthy life.*
2. *The unit Immunology deals with the method by which our body fight away the diseases and develop lifelong immunity in certain cases*
3. *Units on enzymology deals with several enzymatic or chemical processes and their regulations are the key to the life.*
4. *Homeostasis and regulation deals with control systems with respect to thermoregulation and osmotic and ionic regulation*

Learning outcome:

1. *Students shall have the comprehensive knowledge of hematology which would help them in understanding the physiology of circulatory fluids and understand the diseases related to it.*
2. *Enzymology and Immunology would increase the knowledge on defiance system in general and body's internal communication in general. These units are promising in specific as they would help the learners in improving their laboratory skills and precision in using chemicals.*

Units	Title of the Unit		Lectures 60
I	**Hematology-I**		15L
	1.1	Composition of blood	
	1.1.1	Plasma proteins	
	1.1.2	Inorganic constituents	
	1.1.3	Respiratory gases	
	1.1.4	Organic constituents – secretions, antibodies and enzymes	
	1.2	Erythrocytes	
	1.2.1	Structure and Function of Erythrocytes	
	1.2.2	Erythropoiesis	
	1.2.3	Total count and variation in number	
	1.2.4	ESR	
	1.2.5	Abnormalities in form	
	1.3	Structure and function of Haemoglobin	
	1.3.1	Formation and degradation Haemoglobin	
	1.3.2	Abnormalities in Haemoglobin (Sickle cell and Thalassemia)	
	1.3.3	Haemolysis (Fragility test)	
	1.3.4	Anaemia	
	1.4	Volume of blood	
	1.4.1	ABO Blood group and Rh Factor	
	1.4.2	Total quantity and regulation	
	1.4.3	Haemorrhage	
	1.5	Blood Bank: Collection, storage & preservation of blood components	
II	**Immunology-I**		15L
	2.1	Introduction to Immunology and historical perspective	
	2.2	Components of Immune system	
	2.2.1	Innate immunity – Factors affecting innate immunity Mechanisms of innate immunity – Physical barriers, chemical barriers and cellular barriers	

	2.2.2	Adaptive or Acquired immunity – Active Acquired immunity – Natural and Artificial; Passive Acquired immunity – Natural and Artificial	
	2.3	Cells and Organs of Immune system	
	2.3.1	Cells of immune system – Lymphoid cells: B lymphocytes (Humoral immunity), T lymphocytes (Cell-mediated immunity) and Natural killer cells; Mononuclear phagocytes; Dendritic cells and Mast cells	
	2.3.2	Organs of immune system – Primary – Thymus and bone marrow Secondary – Lymph node and spleen	
	2.4	Hypersensitivity, Autoimmunity and Immunodeficiency	
	2.4.1	Introduction to hypersensitivity, brief account of types of hypersensitivity	
	2.4.2	Introduction to autoimmunity, brief account of autoimmune diseases	
	2.4.3	Introduction to immunodeficiency, brief account of primary immunodeficiency, e.g. SCID; brief account of secondary immunodeficiency, e.g. AIDS	
III	**Enzymology-I**		15L
	3.1	Definition, nomenclature and classification (based on Enzyme Commission) of enzymes	
	3.1.1	Chemical structure of enzymes, non-protein enzyme-ribozyme	
	3.1.2	Cofactors and coenzymes	
	3.1.3	The concept and properties of active site	
	3.1.4	Enzyme specificity	
	3.1.5	Mechanism of enzyme action	
	3.2	Concept of activation energy	
	3.3	Enzyme kinetics, concept of steady state, enzyme assay	
	3.3.1	Derivation of Michaelis - Menten equation and Lineweaver-Burk plot	
	3.3.2	Concept and significance of km, Vmax and kcat	
	3.4	Factors affecting enzyme activity – pH, temperature, enzyme concentration, substrate concentration, inhibitors	
	3.5	Enzyme inhibitors – Reversible: Competitive, non-competitive, mixed inhibitors and Irreversible inhibitors and their kinetics	
IV	**Homeostasis and Regulation-I**		15L
	4.1	Homeostasis	
	4.1.1	External and internal environment	
	4.1.2	Control systems in biology: Feedback mechanisms – Negative feedback and positive feedback mechanisms and examples of each	
	4.2	Thermoregulation	
	4.2.1	Endothermy, ectothermy (relation between temperature and biological activities), temperature balance	
	4.2.2	Heat production – Shivering and non-shivering thermogenesis; brown fat – special thermogenic tissue in mammals, mechanisms of heat loss	
	4.2.3	Acclimation and acclimatization	
	4.2.4	Adaptive response to temperature – daily torpor, hibernation, aestivation, cold necrosis	
	4.3	Osmotic and Ionic regulation	
	4.3.1	Maintaining water and electrolyte balance	
	4.3.2	Ionic regulation in iso-osmotic environment	
	4.3.3	Living in hypo-osmotic and hyper-osmotic environment	

	4.3.4	Problems of living in terrestrial environment	
	4.3.5	Water absorption	
	4.3.6	Salt water ingestion and salt excretion, salt glands	
	4.3.7	Metabolic water	
	4.3.8	Role of kidney in ionic regulation	
	4.3.9	Behavioural adaptation	

Practical-II Credit-1.25 (50M)
PRACTICAL BASED ON BUSZOO502
BUSZOOP5

SR. NO.	PRACTICAL
1	Enumeration of total count of erythrocytes
2	Estimation of haemoglobin by Sahli's acid haematin method
3	Erythrocyte sedimentation rate (ESR)
4	Determination of blood group and Rh factor
5	Effect of varying pH on enzyme Acid Phosphatase
6	Effect of varying temperature on enzyme Acid Phosphatase
7	Effect of varying enzyme concentration on enzyme Acid Phosphatase
8	Effect of substrate concentration on enzyme Acid Phosphatase
9	Effect of inhibitor on enzyme Acid Phosphatase
10	Identify and describe ((with slides/diagrams/charts)
	a. Thymus
	b. Bone marrow
	c. Lymph node
	d. Spleen
	e. Cells of immune system: B lymphocytes, T lymphocytes, Natural killer cells, Mononuclear phagocytes, Dendritic cells and Mast cells

REFERENCES

1. Manual of Transfusion Medicine- Ramadas Nayak, Rakshatha Nayak, Jaypee Brothers Medical Publishers (2020)
2. Hematopathology Pearls, Da Zhang, Jaypee Brothers Medical Publishers; Second edition (2017)
3. Essentials of Hematology, Shirish M. Kawthalkar, Jaypee Brothers Medical Publishers; Third edition (2020)
4. C. C. Chatterjee's Human Physiology 12ed Vol 1 (Pb 2018), Chatterjee C.C., CBS; 12 edition (2018)
5. Immunology - Introductory Textbook; Shetty N.; New Age International; 2005
6. Immunology - Essential and Fundamental; Pathak S., & Palan U.; Science Publishers 2005
7. Immunology: A textbook; Rao C. V.;Alpha Science Int'l Ltd.; 2005
8. Ananthanarayan and Paniker's textbook of Microbiology; C. J. Paniker (Ed.); Ananthanarayan R.; Orient Blackswan; 2005
9. Textbook of Immunology; Haleem Khan, Rajendra Sagar, Sadguna
10. Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood & Christopher J. Woolverton; McGraw-Hill Education; 2014
11. Immunology; Third Edition; Janis Kuby; W.H. Freeman; 1997
12. Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne & Janis Kuby; W.H. Freeman; 2007
13. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
14. Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014
15. Cellular and Molecular immunology; Abbas A. K., Lichtman A. H. & Pillai S.; Elsevier Health Sciences; 2014

16. Roitt's Essential Immunology – Vol. 20; Delves P. J., Martin S. J., Burton D. R., & Roitt I. M.; John Wiley & Sons; 2011
17. The Elements of Immunology; Khan F.H.; Pearson Education, India; 2009
18. Janeway's Immunobiology; Murphy K. & Weaver C.; Garland Science; 2016
19. Fundamental Immunology; Paul W. E.; Philadelphia: Lippincott-Raven; 1999
20. Lehninger's Principles of Biochemistry: David Lee Nelson, A.L. Lehninger, Michael M Cox; W.H. Freeman, New York; 2008
21. Biochemistry: Fifth Edition; J. M. Berg, J. L. Tymoczko and Lubert Stryer ;W.H. Freeman, New York; 2002
22. Biochemistry: Second Edition; Donald Voet and Judith G. Voet; J.Wiley and Sons, New York; 1995
23. Biochemistry: Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013
24. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
25. Medical Biochemistry: Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier), 2014
26. Biochemistry: Fifth Edition; Reginald H. Garrett & Charles M. Grisham; Brooks/ Cole (Cengage Learning); 2013
27. Comparative Animal Physiology: Knut Schmidt Nielson; Cambridge Press
28. Comparative Animal Physiology: Prosser and Brown
29. Comparative Animal Physiology: William S Hoar
30. Text book of Comparative Physiology: R Nagabhushanam, Ms Kodarkar, Sarojini R, India Book House Pvt. Ltd.
31. Animal Physiology: N. Arumugam, A. Mariakuttikan; Saras Publication

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
T. Y. BSc. Semester-V
Skeleton Question paper Practical-II (BUSZOOP5)
Duration: 3hrs Marks: 50

Q. 1	Enumeration of total count of erythrocytes	14
	OR	
Q.1	Effect of varying enzyme concentration on enzyme Acid Phosphatase	
	OR	
Q.1	Effect of substrate concentration on enzyme Acid Phosphatase	
	OR	
Q. 1	Effect of inhibitor on enzyme Acid Phosphatase	
Q.2	Estimation of haemoglobin by Sahli's acid haematin method	10
	OR	
Q. 2	Effect of varying pH on enzyme Acid Phosphatase	
	OR	
Q.2	Effect of varying temperature on enzyme Acid Phosphatase	
Q.3	Erythrocyte sedimentation rate (ESR)	08
	OR	
Q.3	Determination of blood group and Rh factor	
Q.4	Identify and describe (any 4) Thymus, bone marrow, Lymph node, spleen, B lymphocytes, T lymphocytes, Natural killer cells, Mononuclear phagocytes, Dendritic cells and Mast cells	08
Q. 5	Viva-voce and Journal	10

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

T. Y. B.Sc. Zoology, Semester- V

Title: **Modern Aspects of Biological Sciences-I**

Course Code: **BUSZOO503 Credit: 2.5 (100M)**

Objectives:

1. Molecular biology, toxicology, genetic engineering and biotechnology are comparatively new areas of biological sciences and were introduced in late 20th century.

2. These units are incorporated here with an objective of making the students acquainted with new developments in the biological research.

Learning outcome:

1. Students shall learn to understand the underlying principles of molecular mechanisms behind the control over the life.

2. The knowledge acquired can help the students in writing JAM and other equivalent examinations. Students can find writing GRE examination easy for admissions in foreign universities.

Units	Title of the Unit		Lectures 60
I	**Molecular Biology**		15L
	1.1	Mechanism of Transcription in eukaryotes, Transcription factors. Difference between prokaryotic and eukaryotic transcription.	
	1.1.1	Post Transcriptional Modifications and Processing of Eukaryotic RNA. Capping, splicing and Poly A tail formation in mRNA	
	1.1.2	Translation: Mechanism of protein synthesis in eukaryotes.	
	1.2	Mutations, Mutagenesis and DNA repair mechanisms	
	1.2.1	Types of mutations: Point mutations - substitution, deletion and insertion Substitution mutations - silent, missense and nonsense mutations, Transition and transversion Deletion and Insertion mutations frameshift mutations. Tri-nucleotide repeat expansions - Fragile X syndrome, Huntington disease Spontaneous mutation - tautomeric shifts, spontaneous lesions.	
	1.2.2	Induced mutations Physical agents, Ionizing radiation (X-rays, α, β and γ rays) Non-ionizing radiation (UV light)	
	1.2.3	Chemical agents: Base analogs (5-bromouracil) Intercalating agents (ethidium bromide) Deaminating agents (nitrous acid) Hydroxylating agents (hydroxylamine) Alkylating agents (mustard gas) Aflatoxin (aflatoxin B1)	
	1.3	Preventative and repair mechanisms for DNA damage	
	1.3.1	Mechanisms that prevent DNA damage - superoxide dismutase and catalase	
	1.3.2	Post replication Repair- recombination repair, mismatch repair and. SOS repair	
II	**Genetic Engineering I**		15L
	2.1	Introduction, Concept and Scope off Genetic Engineering	
	2.2	Enzymes involved in Genetic Engineering	

	2.2.1	Introduction and nomenclature	
	2.2.2	Types of restriction enzymes with examples Ligases - E. coli DNA ligase, T4 DNA ligase, polynucleotide kinase, phosphatases, DNA polymerases, reverse transcriptase, terminal transferase.	
	2.3	Vectors for gene cloning	
	2.3.1	General properties, advantages and disadvantages of cloning vectors	
	2.3.2	plasmid vectors (pBR322), phage vectors (λ Phage), cosmid vectors (c2XB)	
	2.4	Host cells for cloning	
	2.4.1	Prokaryotic hosts- *Escherichia coli, Bacillus subtilis*	
	2.4.2	Eukaryotic hosts - *Saccaromyces cerevisiae*	
	2.5	Cloning techniques	
	2.5.1	Cloning after restriction digestion - blunt and cohesive end ligation	
	2.5.2	Creation of restriction sites using linkers and adapters	
	2.5.3	Cloning after homopolymer tailing	
	2.6	Cloning of a foreign gene into pBR 322 and pUC 9	
	2.7	Methods of gene transfer Transformation, Transduction, By using chemicals (Calcium phosphate), Electroporation, Liposome -mediated gene transfer, microinjection.	
	2.8	Selection of recombinants Insertional inactivation, Replica Plating	
III	**Toxicology-I**		15L
	3.1	Introduction to toxicology	
	3.1.1	Brief history of toxicology	
	3.1.2	Different areas of toxicology	
	3.1.3	Principles and scope of toxicology	
	3.2	Toxins and Toxicants	
	3.2.1	Phytotoxins e.g. caffeine, nicotine	
	3.2.2	Mycotoxins e.g. aflatoxins	
	3.2.3	Zootoxins e.g. cnidarian toxin, bee venom, scorpion venom, snake venom	
	3.3	Characteristics of Exposure	
	3.3.1	Duration of exposure	
	3.3.2	Frequency of exposure and site of exposure	
	3.3.3	Routes of exposure	
	3.4	Types of toxicity	
	3.4.1	Acute toxicity, subacute toxicity	
	3.4.2	Chronic toxicity, sub-chronic toxicity	
	3.4.3	Immediate toxicity, delayed toxicity, reversible toxicity, irreversible toxicity, local toxicity, systemic toxicity	
	3.5	Concept of LD50, LC50, ED50	
	3.6	Dose Response relationship – Individual/ Graded dose response, Quantal dose response, shape of dose response curves, Therapeutic index, Margin of safety	
	3.7	Dose translation from animals to human – Concept of extrapolation of dose, NOAEL (No Observed Adverse Effect Level), Safety factor, ADI (Acceptable Daily Intake)	
IV	**Biotechnology I**		15
	4.1	Animal Cell Biotechnology	
	4.1.1	Animal cell culture techniques, types of cell culture, primary, secondary, anchorage dependent and suspension culture	
	4.1.2	Established cell lines. Examples of established mammalian cell lines	
	4.1.3	Advantages and limitations of cell culture	
	4.1.4	Common culture media used in animal cell culture	
	4.1.5	Process of cell dissociation- Trypsinization	

	4.2	Somatic hybridization- monoclonal antibody production and its therapeutic applications	
	4.3	Animal Biotechnology: Scope and achievements of animal biotechnology	
	4.4	Food Biotechnology: Preparation of bread, beer, wine, cheese and yogurt using biotechnological methods	
	4.5	Cloning of Animals: Cloning procedure of Dolly the Sheep, Examples of cloned animals. Ethical issues of cloned animals	

Practical-III Cradit-1.25 (50M)
PRACTICAL BASED ON BUSZOO503
BUSZOOP5

SR. NO.	PRACTICAL
1	Problems based on transcription and translation
2	Problems based on Restriction enzymes
3	Problems based on Plasmids
4	Wrapping of glassware for sterilization for cell culture.
5	Preparation of culture media.
6	Cell dissociation- Trypsinization and viable cell count
7	Preparation of genomic DNA from E. coli/animals/ human.
8	Plasmid DNA isolation (KIT) and DNA quantitation using agarose gel electrophoresis (Demonstration)
9	Fermentation of fruit juice by yeast extract
10	Study of LC50 using Daphnia culture
11	Identify and describe based on cloning of animals

REFERENCES:

1. Introduction to Molecular Biology; Peter Paolella; Tata McGraw Hill; 2010.
2. Molecular Biology; David Freidfelder; Narosa Publishing House; 2008.
3. Molecular Biology - Academic Cell Update; Update Edition; David Clark; Elsevier, Inc.; 2010.
4. Molecular Biology - Bios Instant Notes; Fourth Edition; Alexander McLennan, Andy Bates, Phil Turner & Mike White; Garland Science; 2013
5. Current Protocols in Molecular Biology; Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, Seidman J. G., John A. Smith and Kevin Struhl; John Wiley& Son, Inc.; 2003.
6. Cell and Molecular Biology; Eighth Edition; E.D.P. De Robertis, E.M.F. De Robertis Jr.; Info-Med Ltd.; 1988.
7. Biotechnology - U Satyanarayana
8. Molecular cloning; Joseph Sambrook, David William Russell; Third. Edition; CSHL Press; 2001.
9. Gene Cloning - An Introduction; Brown .T.A; Fourth Edition; Wiley-Blackwell; 2011.
10. Recombinant DNA - Genes and Genomes- A short course; 3rd Edition; Watson, J.D., Myers, R.M., Caudy A., Witkowski, J.K.; Freeman and Co. NY; 2007.
11. Principles of Gene Manipulation & Genomics; Primrose SB and R. Twyman; Blackwell Science Publications; 2006.
12. Genetic engineering - Principles and Practice; Sandhya Mitra; Macmillan India Ltd., New Delhi.
13. Molecular Biotechnology - Principles and applications of recombinant DNA; Glick, B.R.and Pasternak, J. J.; ASM press, Washington; 2010.
14. Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005.
15. Biotechnology - Expanding Horizons; B.D.Singh; Kalyani Publishers, Ludhiana.
16. A textbook of Biotechnology; R.C.Dubey; S.Chand and Company Ltd., New Delhi.

17. Casarett and Doulls Toxicology – The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill; 2001
18. A Textbook of Modern Toxicology, Ernest Hodgson, Patricia E. Levi, McGraw-Hill International Edition, Second edition ,2000
19. Toxicological testing handbook – Principles, applications and data interpretation; David Jacobson-Kram and Kit Keller; CRC Press; 2006
20. Principles and Methods of toxicology; A. Wallace Hayes; CRC Press; 2007
21. Toxicology – Principles and Methods; M.A. Subramanian; MJP Publishers, Chennai; 2004
22. Fundamentals of Toxicology; Kamleshwar Pandey and J.P. Shukla; New Central book agency Ltd., Kolkata; 2011
23. Elements of Toxicology; Kamleshwar Pandey and J.P. Shukla; Wisdom Press, New Delhi; 2010
24. Principles and Applications of Toxicology; Lahir Y.K.; Seekay Publications; 2013
25. Essentials of Clinical Toxicology; Lall S.; Narosa Publishing House; 1998

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T. Y. BSc. Semester-V

Skeleton Question paper Practical-III (BUSZOOP5)

Duration: 3hrs Marks: 50

Q. 1	Demonstrate the isolation of cells by trypsinization and count the viable cells	14
	OR	
Q.1	Demonstrate LC50 using daphnia culture	
	OR	
Q.1	Preparation of genomic DNA and its isolation by agarose gel electrophoresis	
Q.2	Demonstrate fermentation of fruit juice by yeast extract	06
	OR	
Q. 2	Wrapping of glass ware for sterilization (any three)	
Q.3	Problems based on transcription, translation, restriction enzymes, plasmids (one problem each)	16
Q.4	Identify and describe based on cloning of animals (two)	04
Q. 5	Viva-voce and Journal	10

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

T. Y. B.Sc. Zoology, Semester- V

Title: **General Aspects of Zoology and Bionanotechnology.**

Course Code: **BUSZOO504 Credit: 2.5 (100M)**

Objectives:

1. *To teach the behaviour and methods of self-medication among animals during illness.*
2. *To help the students in understanding the principles of pathology*
3. *To help the students in systematic analysis of data using biostatistics.*
4. *To introduce the most recent and interdisciplinary field of science bionanotechnology to the students.*

Learning outcome:

1. *Students shall learn to segregate and interpret the biological data, learn importance of natural resources in medication.*
2. *Learn and find jobs in field related to pathology and also get acquainted with systems of drug delivery, pollution control etc. using bionanotechnology.*

Units	Title of Unit		Lectures (60)
I	**Bioprospecting and Zoopharmacognosy**		15L
	1.1	Bioprospecting	
	1.1.1	Traditional and modern bioprospecting	
	1.1.2	Economic value of bioprospecting	
	1.1.3	Bioprospecting and conservation	
	1.1.4	Advantages and disadvantages	
	1.2	Zoopharmacognosy	
	1.2.1	Definition and types Self-medication and its mechanism	
	1.2.2	Methods of self-medication through-Ingestion-ants and mammals, Geophagy-invertebrates and birds	
	1.2.3	Absorption and adsorption	
	1.2.4	Applications –birds, mammals, social and trans-generational aspects	
	1.2.5	Contribution to human medicines	
II	**General Pathology**		15L
	2.1	Study of pathology, health and diseases	
	2.2	Morphological and non-morphological pathology	
	2.3	Acute and chronic inflammation	
	2.4	Diseases caused by various pathogens with reference of their effect on host, control measures and pathogenesis	
	2.4.1	Bacteria –whopping cough	
	2.4.2	Fungi – candidiasis, cutaneous superficial Mycosis	
	2.4.3	Endoparasites - amoebiasis, malaria	
	2.4.4	Viruses – herpes zoster (Nagin), rabies	
	2.5	Systemic pathology Arteriosclerosis, Pneumonia, Pulmonary TB, Bronchiectasis, Liver and kidney function test – SGPT, SGOT(ALT, AST), creatinine	
	2.6	Types of tumours and tumour pathology	
	2.6.1	Tumour-like lesions of fibrous tissue – fibromas, keloids, nodular fasciitis, fibromatosis, superficial fibromatoses, fibrosarcoma	
	2.6.2	Tumours of adipose tissue – lipoma, liposarcoma, habdomyosarcoma, meningitis	

III	**Biostatistics**		15L
	3.1	Fundamentals of Biostatistics: Types of data, representation of data, measures of central tendencies, standard deviation	
	3.2	Probability: Addition and multiplication rules and their applications.	
	3.3	Normal distribution: Properties of normal distribution, Z-transformation, p-value.	
	3.4	Parametric test of significance- Two tailed Z test and t-test.	
	3.5	Chi-square test.	
	3.6	Use of Microsoft excel – Preparation of tables, graphs etc.	
IV	**Nanobiotechnology**		15L
	4.1	Nanotechnology definition and scope	
	4.2	Nanomaterial in biology -nanoparticles, quantum dots, nanotubes and nanowires etc.	
	4.3	Biological nanoparticles production – microbial, plants and animal	
	4.4	Nano-biotechnological applications in health and disease- infectious and chronic, Drug delivery	
	4.5	Miniaturized devices in nanobiotechnology - types and applications	
	4.6	Use of nanotechnology in bioremediation	

PRACTICAL IV Credit- 1.25 (50M)
Course Code: BUSZOO504 P5

Sr. No.	Practical
1.	Study of Zoopharmacognosy in ants, cats, elephants and dogs.
2.	Study of Bioprospecting - Anti-cancerous- Sponge, Skin Disease - Aloe vera , Antibiotic from fungi
3.	Characterization of Nanoparticles using UV Spectrophotometer - Iron oxide, CuO, AgO
4.	Synthesis of carbon nano particles using CVD , Ball mill
5.	Identification Instruments used in Nanotechnology – UV Spectrophotometer, Particle Size Analyzer, Scanning Electron Microscope, Transmission Electron Microscope, Atomic Force Microscope, BET- Surface Analyzer, Particle Size Analyzer
6.	Study the given pathology report and submit the analysis of it
7.	Pictorial / drawing for the construction of ideal pathology lab
8.	Pictorial / drawing for the construction of ideal blood bank
9.	Report writing of the blood donation camp conducted in the college/ your own housing society etc.
10.	Visit and report writing of the nearby pathology lab, blood bank, primary health center etc.
11.	Problems Based on measures of central tendencies and Graphical presentation of data.
12.	Problems based on standard deviation.
13.	Problems based on Z test, t- test, chi square test
14.	Tabulation of data and its graphical presentation using Microsoft Excel

Internal submission for 20 marks
Pictorial / drawing for the construction of ideal pathology lab or Pictorial / drawing for the construction of ideal blood bank or Report writing of the blood donation camp conducted in the college/ your own housing society etc. or Visit and report writing of the nearby pathology lab, blood bank, primary health centre etc.

References:

1. Pharmacognosy and Pharmaco biotechnology, Ashutosh Kar, Anshan Ltd; 2 edition (1 April 2008)
2. Trease and Evans Pharmacognosy, Evans, W.C., Elsevier Health - UK; 16 edition (28 May 2009)
3. Practical Pharmacognosy, Gokhale, S. B. and Kokate, C. K, Nirali Prakashan; 13th edition (2009)
4. Pharmacognosy, Kokate, C. K. A. and Purohit, A.P., Nirali Prakashan (6 February 2019)
5. Text book of Pharmacognosy, T. E. Wallis, BSP Books Private Limited; Fourth edition (1 January 2010)
6. Nanobiotechnology: Concepts, Applications andPerspectives (2004), Christof M. Niemeyer Chad A. Mirkin, Wiley VCH
7. Nanobiotechnology - II more concepts and applications (2007), Chad A Mirkin and Christof M. Niemeyer, Wiley VCH.
8. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, Tuan Vo-Dinh, CRC Press; 2 edition (12 October 2017)
9. Fundamentals of Biostatistics, Dutta, N. K. (2004). Kanishka Publishers
10. An Introduction to Biostatistics, Gurumani N. (2005). MJP Publishers.
11. Biostatistics- A Foundation for Analysis in the Health Sciences, Daniel, W. W. (2007). Wiley.
12. Principles of Biostatistics. Pagano, M. & Gauvreau, K. (2007).
13. An Introduction to Probability and Statistics, John Wiley & Sons.Rohatgi, V.K. & Saleh, A. K .Md. (2001)
14. Biostatistics- Mahajan
15. A Textbook of Veterinary and General Pathology; Second edition; J. L. Vagad; IBDC Publishers.
16. Clinical Pathology; Guru G.; NCERT; 1988.
17. Clinical Pathology; BatraNeelam; Vikas Publishing House Pvt. Ltd.; Nov. 1982.
18. Essentials of General Pathology; Dr. Sudha Shivraj, Dr. Satish Kumar Amarnath, Dr. Sheela Devi; exclusively distributed by CBS Publishers & Distributors.
19. Textbook of Pathology; Harsh Mohan; Jaypee Publishers.

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T. Y. BSc. Semester-V

Skeleton Question paper Practical-IV (BUSZOOP5)

Duration: 3hrs Marks: 50

Q. 1 Three Problems based on biostatistics : 12

a. Problems on central tendencies of data
b. Problems based on t- test/Z test/Chi square test/ Standard Deviation
c. Problems based on presentation of data using Microsoft Excel/Regression analysis

OR

Q.1 Synthesize carbon nano particles using CVD or Ball mill from given material. Confirm its presence by UV Spectrophotometer

Q.2 Identify and describe Instruments used in Nanotechnology (any 5) 10

a. UV Spectrophotometer
b. Particle Size Analyzer
c. Scanning Electron Microscope
d. Transmission Electron Microscope
e. Atomic Force Microscope
f. BET- Surface Analyzer
g. Particle Size Analyzer

Q. 3 Study the given pathology report and submit the analysis of it 08

Q.4 Identify and describe 10

a. Zoopharmacognosy (ants, cats, elephants, dogs.) (any 3)
b. Bioprospecting (Anti-cancerous- Sponge, Skin Disease - Aloe vera , Antibiotic from fungi) (any 2)

Q.5 Viva-voce 05

Q. 6 Journal 05

SEMESTER-VI

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

T. Y. B.Sc. Zoology, Semester- VI

Title: **Structural, Functional and Developmental Aspects of Animal Life-II.**

Course Code: **BUSZOO601 Credit: 2.5 (100M)**

Objectives:

1. *Classification of animals is taught in lower classes. Detailed studies of at least one type of chordate with respect to its habit, habitat and structures- functions of various system is covered in this semester*
2. *Endocrine system in vertebrate body exercise a hormonal control over the body. The unit deals with the study of endocrine control and its correlation with the other systems of the body.*
3. *It is important to learn development of a vertebrate and appreciate several embryological processes. The unit on embryology deals with these processes.*
4. *Each muscle in human body is important and has its characteristic structure and function. Study of muscles gives the knowledge of muscular functions of the body. The unit is not only relevant to professionals but also to common people*

Learning outcome:

Students would learn to understand and appreciate the structure function relationship of various parts of animal body, their developmental processes and use the knowledge not only Sq professionally but also in day to day life.

Units	**Title of Unit**		**Lectures 60**
I	**Study of Animal Type: Chordata e.g. Shark**		15L
	1.1	Habit and habitat, distribution, external characters, classification and economic importance	
	1.2	Skin, exoskeleton, endoskeleton, digestive system, respiratory system, blood vascular system, nervous system, receptor organs, urinogenital system, copulation, fertilization and development	
II	**Mammalian Endocrinology**		15L
	2.1	Endocrinology	
	2.1.1	Definition and scope	
	2.1.2	Types of glands: Exocrine, Endocrine and Apocrine (Definition and example)	
	2.1.3	An over view of human endocrine system	
	2.2	Endocrine control	
	2.2.1	Hypothalamus: (Structure, function role in endocrine regulation) Pituitary gland. (Structure, Histology, function and role in endocrine regulation)	
	2.3	Important endocrine glands: (Histology and endocrine functions, related disorders due to hyper and hypo secretions): Thyroid, Parathyroid, Adrenal	
	2.4	Endocrine functions of non-endocrine organs and related hormones	
	2.4.1	Testis (Histology, endocrine functions, clinical significance of hormonal imbalance)	
	2.4.2	Ovary (Histology, endocrine functions, clinical significance of hormonal imbalance)	
	2.4.3	Hormones of Stomach, Small intestine, liver, pancreas, thymus, spleen, heart, kidney and placenta (Only hormones and their functions)	
	2.5	Feedback mechanism. (Two examples Thyroid- Pituitary, glucose metabolism)	
III	**Developmental Biology- Chick**		15L

	3.1	Gametogenesis in chick	
	3.2	Structure of egg and sperm of chick	
	3.3	Fertilization	
	3.4	Cleavage, Blastulation and Fate map	
	3.5	Gastrulation: Formation of Primitive streak and endoderm	
	3.6	Structure of Chick embryo: 24 hrs. 48hrs, 72 hrs. and 96 hrs.	
	3.7	Fetal Membranes in chick	
IV	**Muscles of long bones of Human limbs**		15L
	4.1	Introduction and types of long limb muscles, Flexors, Extensor, Rotator, Abductors, Adductors	
	4.2	Muscles of forelimbs: Muscles that move the arm (Humerus) - Triceps brachii, Biceps brachii, brachialis and brachioradialis, Muscles that move the forearm (Radius-ulna) - Flexor carpi radialis, Flexor carpi ulnaris and Extensor carpi ulnaris, Muscles that move the wrist, hand and fingers - Flexor digitoriumsuperficialis, Extensor carpi radialis and Extensor digitorum	
	4.3	Muscles of hindlimbs: Muscles that move the thigh (Femur) - Sartorius, Adductor group, Quadriceps group (Rectus femoris, Vastuslateralis, Vastusmedialis), Hamstring group (Biceps femoris, Semimembranosus, Semitendinosus), Muscles that move the lower leg (tibia-fibula) - Fibularislongus, Gastrocnemius, Tibialis anterior, Soleus, Extensor digitorumlongus and Fibularistertius, Muscles that move the ankle, foot and toes - Tibialis anterior, Extensor digitorum, Longus and Fibularis muscles	

PRACTICAL I Credit-1.25 (50M)
Course Code: BUSZOO601 P6

Sr. No.	Practical
1	Identification a. Blastula b. Gastrula c. 24hrs d. 48hrs e. 72hrs f. 96 hrs.
2	Draw the fate map of chick blastula and mark the following parts: a. Notochord, b. Neural plate, c. Extra embryonic ectoderm, d. Gut, e. Somites, f. Yolk sac, g. Extra embryonic mesoderm, h. Head mesoderm
3	Candling off eggs to find out fertilized eggs
4	Temporary / Permanent preparations of: 18 hrs. 24hrs, and 48 hrs. Chick embryo slides.
5	Study of muscles of forelimbs - Biceps brachii, Brachialis, Brachioradialis, Triceps brachii, Flexor carpi radialis, Flexor carpi ulnaris and Extensor carpi ulnaris
6	Study of muscles of hind limbs - Sartorius, Adductor group, Quadriceps group Rectus femoris, Vastuslateralis, Vastusmedialis, Hamstring group (Biceps femoris, Semimembranosus, Semitendinosus), Fibularislongus, Gastrocnemius Tibialis anterior, Soleus, Extensor digitorumlongus, Fibularistertius
7	Identification of Endocrinology Slides (all endocrine glands covered in theory)
8	Dissections: Digestive system, Heart and Aortic arches, Urinogenital System, Cranial Nerves Mountings: Scroll valves, Placoid scales Identifications: Endoskeleton of shark: i. Axial - Skull and vertebral column (vertebrae) ii. Appendicular - Pelvic and pectoral fins, pelvic and pectoral girdle. **OR** Study of Shark with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected. Digestive system, Heart and Aortic arches, Urinogenital System, Cranial Nerves, Scroll valves, Placoid scales Identifications: Endoskeleton of shark: i. Axial - Skull and vertebral column (vertebrae)

	ii. Appendicular - Pelvic and pectoral fins, pelvic and pectoral girdle

REFERENCES

1) Modern text book of Zoology - Vertebrates; Professor R.L. Kotpal; Rastogipublication; Third Edition 2012.
2) Chordate Zoology by E. L. Jordan and P. S. Verma, edition,2009, Chand publications
3) Developmental Biology- Gilbert
4) Developmental Biology- Wolpert
5) Text book of embryology- N.Arumugam
6) Chordate Embryology- P.S.Verma and V.K. Agarwal
7) Developmental Biology - T. Subramoniam
8) Development of Chick- pattern
9) Human Physiology by Chatterjee and Chatterjee.
10) Principals of Anatomy and Physiology by Tortora
11) B.D. Chaurasia Human Anatomy – Volume 1 and 2

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Department of Zoology

T. Y. BSc. Semester-VI

Skeleton Question paper Practical-I (BUSZOOP6)

Duration: 3hrs Marks: 50

Q. 1 Dissect open the given animal so as to expose its Digestive system / Heart and Aortic arches / Urinogenital System / Cranial Nerves, 12

OR

Q. 1 Mount the embryo and prepare the permanent slide from the egg provided. Determine the age of the embryo.

Q.2 Make a temporary mounting of Scroll Valve/ Placoid Scales and draw the diagram 06

Q.3 Using an appropriate technique, find out which egg is fertilized out of the two eggs given. 06

OR

Q. 3 Draw the fate map of chick blastula and mark the following parts.

a. Notochord
b. Neural plate
c. Extra embryonic ectoderm
d. Gut
e. Somites
f. Yolk sac
g. Extra embryonic mesoderm
h. Head mesoderm

Q.4 Identify and describe (A to D) – 08

a-Blastula/ Gastrula,
b- Chick embryo of 24/48/72/96 hrs.
c- Pituitary/Adrenal/Thyroid/Parathyroid/ Thymus/ Spleen
d- Ovary/Testis/ Human Placenta

Q. 5 Identify and describe (A to D). 08

a- Muscles of forelimbs (any one)
b- Muscles of hind limbs (any one)
c- Bone of the skull of shark/any one of the vertebra
d- Pelvic girdle / Pectoral girdle of Shark

Q. 6 Viva-voce and Journal 10

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan

Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

T. Y. B.Sc. Zoology, Semester- VI

Title: **Regulatory Aspects of Animal Life -II**

Course Code: **BUSZOO602 Credit: 2.5 (100M)**

Objectives:

1. *Hematology is the science related to blood and its related functions. It is necessary to have the knowledge on body fluids and their importance in healthy life. It also helps in understanding applications of hematology.*
2. *The unit Immunology deals with the method by which our body fight away the diseases and develop lifelong immunity in certain cases. To study various applications of immunology.*
3. *Unit on enzymology deals with several enzymatic or chemical processes. These regulations are the key to the life.*

Learning outcome:

1. *Students shall have the comprehensive knowledge of hematology which would help them in understanding the physiology of circulatory fluids and understand the diseases related to it.*
2. *Enzymology and Immunology would increase the knowledge on defiance system in general and body's internal communication in general.*
3. *These units are promising in specific as they would help the learners in improving their laboratory skills and precision in using chemicals.*

Units	**Title of the Unit**		**Lectures 60**
I	**Hematology-II**		15L
	1.1	Leukocytes	
	1.1.1	Leucopoiesis	
	1.1.2	Total count	
	1.1.3	Total count and variation in number	
	1.1.4	Types of leukocytes and function	
	1.1.5	Differential count	
	1.1.6	Leukaemia and its types	
	1.2	Blood coagulation and lymph	
	1.2.1	Formation of blood platelets (Thrombopoiesis)	
	1.2.2	Clotting mechanism	
	1.2.3	Bleeding and clotting time	
	1.2.4	Anticoagulants	
	1.2.5	Failure of clotting mechanism	
	1.3	Introduction to Applied Haematology and Scope	
	1.4.1	Microscopic examination of blood - For detection of blood cancers (lymphoma, myeloma)	
	1.4.2	Infectious diseases (malaria, leishmaniosis)	
	1.4.3	Hemoglobinopathies (sickle cell, thalassemia)	
	1.4.4	Coagulopathies: Diagnostic methods (haemophilia and purpura)	
II	**Immunology-II**		15L
	2.1	Antigens: Immunogenicity versus Antigenicity, factors that influence immunogenicity, Epitopes, Hapten	
	2.2	Antibodies: Basic structure and function, Antibody classes and biological activities, Antigenic determinants on immunoglobulins	
	2.3	Monoclonal Anti bodies	
	2.4	Antigen-Antibody interaction : General features of antigen-antibody interaction	

	2.4.1	Precipitation reactions: Radial immunodiffusion (Mancini method), Double immunodiffusion (Ouchterlony method), Immunoelectrophoresis	
	2.4.2	Agglutination reactions: Haemagglutination, Agglutination inhibition	
	2.4.3	RIA, ELISA	
	2.5	Vaccines and Vaccination: Introduction to vaccines and vaccination, Introduction to vaccines	
	2.5.1	Vaccination: Development and challenges Brief account of designing vaccines for active immunization	
	2.5.2	Whole organism vaccines, Purified macromolecules as vaccines, Recombinant vector vaccines, DNA vaccines, Subunit vaccines	
	2.5.3	Adjuvants used for human vaccines: Virosomes and Liposomes, Saponins, Water-in-oil emulsions, Vaccines against human pathogens: Polio, Hepatitis A and B, Tuberculosis (BCG)	
	2.6	Cancer and Immune system	
	2.6.1	Oncogenes and cancer induction	
	2.6.2	Tumor antigens	
	2.6.3	Brief account of cancer immunotherapy	
III	**Enzymology-II**		15L
	3.1	Regulation of enzyme activity	
	3.1.1	Allosteric regulation	
	3.1.2	Activation of latent enzymes	
	3.1.3	Compartmentation of metabolic pathways	
	3.1.4	Control of enzyme synthesis	
	3.1.5	Enzyme degradation	
	3.1.6	Isozymes e.g. LDH	
	3.2	Industrial applications of enzymes: Food and detergents	
	3.3	Immobilization of enzymes and its application, Enzymes and immobilized enzymes as analytical reagents	
	3.4	Role of enzymes in diagnosis and prognosis of disease	
	3.4.1	Plasma specific/functional enzymes	
	3.4.2	Non-plasma or plasma non-functional enzymes	
	3.4.3	Decreased plasma enzyme activities	
	3.5	Enzymes as serum markers in the diagnosis of tissue damage e.g. myocardium, pancreas, liver	
	3.6	Enzymes as therapeutic agents	
IV	**Homeostasis and Regulation-II**		15L
	4.1	Regulation of blood circulation	
	4.1.1	Vascular pumps: Suction pump in open circulation and pressure pump in closed circulation	
	4.1.2	Heart size (Heart mass-H_M) in vertebrates	
	4.1.3	Heart rate frequency in vertebrates and invertebrates	
	4.1.4	Cardiac output	
	4.1.5	Pace maker	
	4.1.6	Neurogenic and Myogenic hearts	
	4.1.7	Electrical activity in heart muscles: Electrocardiogram	
	4.1.8	Chemical and nervous regulation of heart	
	4.2	Regulation of breeding cycle	
	4.2.1	Endocrine regulation of male reproductive system	
	4.2.2	Endocrine regulation of female reproductive system	
	4.2.3	Types of female reproductive cycles (estrous and menstrual)	
	4.2.4	Endocrine regulation of pregnancy, parturition and lactation in mammals	

Practical-II Credit-1.25 (50M)
PRACTICAL BASED ON BUSZOO602
BUSZOOP6

Sr. No.	Practical
1	Enumeration of total leucocytes count
2	Differential count of WBC
3	Bleeding and clotting time of blood
4	Study of Leukemic cells from permanent slide / picture
5	Demonstration of agglutination reaction by RA antigen
6	Separation of LDH isozymes by agarose gel electrophoresis
7	Immobilization of enzyme invertase from yeast cells and set up of bioreactor to estimate conversion of sucrose to glucose
8	Demonstrate the effect of enzyme Papain as meat tenderizer
9	Study of electrocardiograms: a. Sinus tachycardia b. Sinus bradycardia c. Ventricular fibrillation
10	Study of estrous cycle in Rats with the help of pictures

REFERENCES

1. Manual of Transfusion Medicine- Ramadas Nayak, Rakshatha Nayak, Jaypee Brothers Medical Publishers (2020)
2. Hematopathology Pearls, Da Zhang, Jaypee Brothers Medical Publishers; Second edition (2017)
3. Essentials of Hematology, Shirish M. Kawthalkar, Jaypee Brothers Medical Publishers; Third edition (2020)
4. C. C. Chatterjee's Human Physiology 12ed Vol 1 (Pb 2018), Chatterjee C.C., CBS; 12 edition (2018)
5. Immunology - Introductory Textbook; Shetty N.; New Age International; 2005
6. Immunology - Essential and Fundamental; Pathak S., & Palan U.; Science Publishers 2005
7. Immunology: A textbook; Rao C. V.;Alpha Science Int'l Ltd.; 2005
8. Ananthanarayan and Paniker's textbook of Microbiology; C. J. Paniker (Ed.); Ananthanarayan R.; Orient Blackswan; 2005
9. Textbook of Immunology; Haleem Khan, Rajendra Sagar, Sadguna
10. Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood & Christopher J. Woolverton; McGraw-Hill Education; 2014
11. Immunology; Third Edition; Janis Kuby; W.H. Freeman; 1997
12. Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne & Janis Kuby; W.H. Freeman; 2007
13. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
14. Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014
15. Cellular and Molecular immunology; Abbas A. K., Lichtman A. H. & Pillai S.; Elsevier Health Sciences; 2014
16. Roitt's Essential Immunology – Vol. 20; Delves P. J., Martin S. J., Burton D. R., & Roitt I. M.; John Wiley & Sons; 2011
17. The Elements of Immunology; Khan F.H.; Pearson Education, India; 2009
18. Janeway's Immunobiology; Murphy K. & Weaver C.; Garland Science; 2016
19. Fundamental Immunology; Paul W. E.; Philadelphia: Lippincott-Raven; 1999
20. Lehninger's Principles of Biochemistry: David Lee Nelson, A.L. Lehninger, Michael M Cox; W.H. Freeman, New York; 2008
21. Biochemistry: Fifth Edition; J. M. Berg, J. L. Tymoczko and Lubert Stryer ;W.H. Freeman, New York; 2002
22. Biochemistry: Second Edition; Donald Voet and Judith G. Voet; J.Wiley and Sons, New York; 1995
23. Biochemistry: Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013
24. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
25. Medical Biochemistry: Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier), 2014
26. Biochemistry: Fifth Edition; Reginald H. Garrett & Charles M. Grisham; Brooks/ Cole (Cengage Learning); 2013
27. Comparative Animal Physiology: Knut Schmidt Nielson; Cambridge Press
28. Comparative Animal Physiology: Prosser and Brown
29. Comparative Animal Physiology: William S Hoar
30. Text book of Comparative Physiology: R Nagabhushanam, Ms Kodarkar, Sarojini R, India Book House Pvt. Ltd.
31. Animal Physiology: N. Arumugam, A. Mariakuttikan; Saras Publication

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Department of Zoology

T. Y. BSc. Semester-VI

Skeleton Question paper Practical-II (BUSZOOP6)

Duration: 3hrs Marks: 50

Q. 1	Enumeration of total leucocytes count	14
	OR	
Q.1	Differential count of WBC	
	OR	
Q.1	Immobilization of enzyme invertase from yeast cells and set up of bioreactor.	
	OR	
Q. 1	Set up of bioreactor with immobilized enzyme invertase and demonstration of conversion of sucrose to glucose	
Q.2	Separation of LDH isozymes by agarose gel electrophoresis	10
	OR	
Q. 2	Bleeding and clotting time of blood	
Q.3	Demonstration of agglutination reaction by RA antigen	08
	OR	
Q.3	Demonstrate the effect of enzyme Papain as meat tenderizer	
Q.4	Identify and describe (any 4) a. Leukemic cells b. Sinus tachycardia c. Sinus bradycardia d. Ventricular fibrillation e. Stages of estrous cycle: proestrous, estrous, metestrous, diestrous	08
Q. 5	Viva-voce and Journal	10

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Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

T. Y. B.Sc. Zoology, Semester- VI

Title: **Modern Aspects of Biological Sciences-II**

Course Code: **BUSZOO603 Credit: 2.5 (100M)**

Objectives:

1. *Post Mendelian Genetics and molecular evolution, toxicology, genetic engineering and biotechnology are comparatively new areas of biological sciences and were introduced in late 20th century.*
2. *These units are incorporated here with an objective of making the students acquainted with new developments in the biological research*

Learning outcome:

1. *Students shall learn to understand the underlying principles of molecular mechanisms behind the control over the life.*
2. *The knowledge acquired can help the students in writing JAM and other equivalent examinations. Students can find writing GRE examination easy for admissions in forging universities.*

Units	**Title of the Unit**		**Lectures 60**
I	**Genetics and Molecular evolution**		15L
	1.1	Post Mendelian genetics	
	1.1.1	Multiple alleles: Drosophila wing pattern, Drosophila Eye coloration, ABO blood group system in human	
	1.1.2	Sex linked inheritance in humans. Colour blindness, Hemophilia.	
	1.1.3	Polygenic inheritance: Two gene polygenic inheritance (Kernel colour in Maize), Three gene polygeneic inheritance (Skin colour in human)	
	1.1.4	Linkage and crossing over- construction of linkage maps	
	1.2	Inborn errors in metabolism in man	
	1.2.1	Glucose-6-Phosphate dehydrogenase deficiency (G-6-PD)	
	1.2.2	Albinism	
	1.2.3	Phenylketonurea (PKU)	
	1.2.4	Alkaptonurea	
	1.3	Population genetics	
	1.3.1	Hardy-Weinberg Law Four important factors disrupting H-W equilibrium a. Genetic Drift b. Migration c. Mutation d. Selection	
	1.3.2	Estimation of allelic and gene frequencies	
	1.4	Molecular evolution	
	1.4.1	History of molecular evolution	
	1.4.2	Protein evolution and amino acid sequence divergence	
	1.4.3	Nucleic acid evolution	
	1.4.4	Molecular clock	
II	**Genetic Engineering II**		15L
	2.1	PCR Technique Principle and application of Polymerase Chain Reaction (PCR)	

	2.2	Sequencing Techniques: Basics of DNA sequencing and protein Sequencing	
	2.2.1	DNA Sequencing Maxam and Gillbert Method Sanger's Dideoxy Chain Termination Method	
	2.2.2	Protein Sequencing Edman's Degradation Method	
	2.3	Detection Techniques	
	2.3.1.	Blotting Techniques and its application	
	2.3.2	Southern Blotting	
	2.3.3	Northern Blotting	
	2.3.4	Western Blotting	
	2.4	DNA Finger printing and its Application	
III	**Toxicology-II**		15L
	3.1	Target organ toxicity	
	3.1.1	Hepatotoxicity: susceptibility of the liver, types of liver injury, examples of hepato-toxicants	
	3.1.2	Neurotoxicity: vulnerability of nervous system, examples of neurotoxicants	
	3.1.3	Nephrotoxicity: susceptibility of kidney, examples of nephrotoxicants	
	3.2	Regulatory Toxicology at home	
	3.2.1	OECD guidelines for testing of chemicals (an overview)	
	3.2.2	CPCSEA guidelines for animal testing center, ethical issues in animal studies	
	3.2.3	Animal models used in regulatory toxicology studies	
	3.3	Alternative methods in toxicology (in vitro tests) page no 442	
	3.3.1	Prokaryote mutagenicity	
	3.3.2	Eukaryote mutagenicity	
	3.3.3	DNA damage and repair	
	3.3.4	Chromosome aberrations	
	3.3.5	Mammalian cell transformation	
	3.3.6	Ecological effects	
	3.3.7	Future of toxicity testing	
	3.4	Basics of environmental toxicology. page no 531	
	3.4.1	Environmental persistence	
	3.4.2	Bioaccumulation	
	3.4.3	Types of environmental toxicity	
IV	**Biotechnology II**		15L
	4.1	Medical Biotechnology	
	4.1.1	Scope and important applications	
	4.1.2	Gene therapy: Ex-vivo and in-vivo. e.g. SCID and Cystic Fibrosis	
	4.1.3	Vaccine Production: Sub-unit vaccine production against Herpes simplex, attenuated vaccines – cholera, salmonella, vector vaccines- rabies	
	4.2	Transgenesis and its application.	
	4.2.1	Methods of transgenesis a. Retroviral vector method	

		b. Nuclear transplantation method c. DNA Microinjection method d. Embryonic stem cell method	
	4.2.2	Ethical issues of transgenesis	
	4.3	Pharmaceutical Biotechnology: Production of Hepatitis vaccine and insulin	
	4.4	Agricultural Biotechnology: Production of nitrogenase gene, cloning of BT plants	

Practical-III Credit-1.25 (50M)
PRACTICAL BASED ON BUSZOO603
BUSZOOP6

Sr. No.	Practical
1	Problems based on multiple allele, sex linked genes and polygenes
2	Construction of linkage maps
3	Calculation of allelic/ gene frequency
4	Identification- Principle and application of: (instruments/ photographs) a. PCR b. DNA finger printing c. Blotting techniques
5	Identification- ex- situ/ in-situ gene therapy: SCID and Cystic fibrosis
6	Identification- a. and b. Methods of Transgenesis and BT cotton
7	To study the effect of CCl4 on the level of enzyme activity of aspartate and alanine amino transferase in liver (in vitro approach).
8	To study the effect of paracetamol on the level of enzyme activity of aspartate and alanine amino transferase in liver (in vitro approach).
9	Effect of heavy metals on heart rate of daphnia
10	Effect of environmental toxicants on developing chick embryo

REFERENCES:

1. Introduction to Molecular Biology; Peter Paolella; Tata McGraw Hill; 2010.
2. Molecular Biology; David Freidfelder; Narosa Publishing House; 2008.
3. Molecular Biology - Academic Cell Update; Update Edition; David Clark; Elsevier, Inc.; 2010.
4. Molecular Biology - Bios Instant Notes; Fourth Edition; Alexander McLennan, Andy Bates, Phil Turner & Mike White; Garland Science; 2013
5. Current Protocols in Molecular Biology; Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, Seidman J. G., John A. Smith and Kevin Struhl; John Wiley& Son, Inc.; 2003.
6. Cell and Molecular Biology; Eighth Edition; E.D.P. De Robertis, E.M.F. De Robertis Jr.; Info-Med Ltd.; 1988.
7. Biotechnology - U Satyanarayana
8. Molecular cloning; Joseph Sambrook, David William Russell; Third. Edition; CSHL Press; 2001.
9. Gene Cloning - An Introduction; Brown .T.A; Fourth Edition; Wiley-Blackwell; 2011.
10. Recombinant DNA - Genes and Genomes- A short course; 3rd Edition; Watson, J.D., Myers, R.M., Caudy A., Witkowski, J.K.; Freeman and Co. NY; 2007.
11. Principles of Gene Manipulation & Genomics; Primrose SB and R. Twyman; Blackwell Science Publications; 2006.
12. Genetic engineering - Principles and Practice; Sandhya Mitra; Macmillan India Ltd., New Delhi.
13. Molecular Biotechnology - Principles and applications of recombinant DNA; Glick, B.R.and Pasternak, J. J.; ASM press, Washington; 2010.
14. Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005.
15. Biotechnology - Expanding Horizons; B.D.Singh; Kalyani Publishers, Ludhiana.
16. A textbook of Biotechnology; R.C.Dubey; S.Chand and Company Ltd., New Delhi.
17. Casarett and Doulls Toxicology – The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill; 2001
18. A Textbook of Modern Toxicology, Ernest Hodgson, Patricia E. Levi, McGraw-Hill International Edition, Second edition ,2000
19. Toxicological testing handbook – Principles, applications and data interpretation; David Jacobson-Kram and Kit Keller; CRC Press; 2006
20. Principles and Methods of toxicology; A. Wallace Hayes; CRC Press; 2007
21. Toxicology – Principles and Methods; M.A. Subramanian; MJP Publishers, Chennai; 2004
22. Fundamentals of Toxicology; Kamleshwar Pandey and J.P. Shukla; New Central book agency Ltd., Kolkata; 2011
23. Elements of Toxicology; Kamleshwar Pandey and J.P. Shukla; Wisdom Press, New Delhi; 2010
24. Principles and Applications of Toxicology; Lahir Y.K.; Seekay Publications; 2013
25. Essentials of Clinical Toxicology; Lall S.; Narosa Publishing House; 1998
26. Genetics - The continuity of life; Daniel Fairbanks and Ralph Andersen; Brooks/ Cole Publishing Company; 1999.
27. Genetics; Robert Weaver and Philip Hedrick; McGraw Hill; 2001.
28. iGenetics - A Molecular Approach; Third Edition; Peter J. Russell; Pearson Education, Inc. (Benjamin Cummings), San Francisco; 2010.
29. Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA; 1978
30. The Science of Genetics - An Introduction to Heredity; Fourth Edition; George W. Burns; Macmillan Publishing Co., Inc., New York; 1980.
31. Principles of Genetics; Eighth Edition; Gardner, Simmons and Snustad; John Wiley and Sons (Asia) Pte. Ltd., Singapore; 2002.

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Department of Zoology
T. Y. BSc. Semester-VI
Skeleton Question paper Practical-III (BUSZOOP6)

Duration: 3hrs Marks: 50

Q. 1	To study the effect of CCl4 on the level of enzyme activity of aspartate amino transferase / alanine amino transferase in liver OR To study the effect of paracetamol on the level of enzyme activity of aspartate amino transferase / alanine amino transferase in liver	13
Q.2	Effect of heavy metals (02) on heart rate of daphnia	08
Q. 3	Problems based on genetics on multiple allele, sex linked genes, polygenes (three)	09
Q.4	Construction of linkage maps OR allelic/ gene frequency	04
Q.5	Identify and describe a. PCR / DNA finger printing / Blotting techniques b. ex- situ/ in-situ gene therapy: SCID and Cystic fibrosis c. Methods of transgenesis / BT cotton	06
Q. 6	Viva-voce	05
Q. 7	Journal	05

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Syllabus w. e. f. Academic Year, 2020-21 (CBCS)

T. Y. B.Sc. Zoology, Semester- VI

Title: **General Aspects of Zoology and Bioinformatics.**

Course Code: **BUSZOO604 Credit: 2.5 (100M)**

Objectives:

1. *To teach the dynamics of population and its ecological correlation*
2. *To help the students in understanding the principles of epidemiology*
3. *To help the students in understanding the diseases of pet and domestic animals and understand their early symptoms so as to help the animal in faster recovery*
4. *To introduce the most recent and interdisciplinary field of science bionanotechnology to the students.*

Learning outcome:

1. *Students shall learn to understand and interpret the data on population and correlate that with demography and ecology.*
2. *They will be able to understand the principles of epidemiology and also understand the diseases which take the toll over the health of livestock and pets.*
3. *Bioinformatics the new and interdisciplinary science shall help the students in understanding proteomics and genomics which shall help them in higher studies.*

Units	Title of the Unit		Lectures 60
I	**Population Ecology**		15L
	1.1	Concept of Dynamic Nature	
	1.1.1	Factors influencing Population dynamics: Natality, Mortality, Fecundity, Age structure, Sex ratio , Survivorship curves, Population dispersal and distribution patterns	
	1.1.2	Life tables	
	1.2	Population growth regulation	
	1.2.1	Intrinsic mechanism –Density dependent fluctuations and oscillations.	
	1.2.2	Extrinsic mechanism-Density independent, environmental and climate factors, population interactions	
	1.3	Population growth pattern : Sigmoid, J Shaped, Human census (India) –Concept, mechanism and significance	
	1.4	Community Ecology: Concept of Ecological Niche and Ecological Succession.	
	1.5	Environmental Quality assessment of River:	
	1.5.1	Introduction, Geography, Status, Economic and ecological importance, Pollutant sources and pathways, Anthropogenic impacts on water quality	
	1.5.2	Chemical Parameters: Methods and Significance- COD, BOD, Organic content, pH, Hardness, heavy Metals	
	1.5.3	Physical Parameters :Temperature, conductivity and Turbidity	
	1.5.4	Biodiversity	
	1.5.5	Commercial and Ecological Utility, Economic development and water quality	
II	**Principles of Epidemiology**		15L
	2.1	Aims and epidemiological approach	
	2.1.1	Epidemiological methods	
	2.1.2	Disease prevention and control disinfection	

	2.2	Epidemiology of communicable disease	
	2.2.1	Respiratory infection – Tuberculosis	
	2.2.2	Intestinal infections – Amoebiasis, Hookworm infection, Dracunculiasis	
	2.2.3	Arthropod-brain infections – Dengue syndrome, Malaria, Lymphatic filariasis	
	2.2.4	Viral – Leptospirosis	
	2.2.5	Parasitic – Taeniasis, Leishmaniasis	
	2.3	Epidemiology of chronic non-communicable disease and conditions	
	2.3.1	Diabetes	
	2.4	Health programs in India	
	2.5	Hospital waste management	
III	**Infectious Diseases of Pet and Domestic Animals**		15L
	3.1	Infectious diseases of Pet and Domestic animals: Biology of causative agent, symptoms of the disease, mode of transmission, treatment and control measures, zoonosis and reverse zoonosis of the disease (if any)	
	3.2	Bacterial Disease : Anthrax, Leptospirosis, MRSA, Tuberculosis, Piglet diarrhea, Salmonella	
	3.3	Viral diseases in animals: H1N1, Foot and mouth disease, Rabies, Brucellosis, Rinderpest, SARS- Covid	
IV	**Bioinformatics**		15L
	4.1	Definition and scope of bioinformatics	
	4.2	Data bases: Primary and Secondary data bases, DNA and Protein data bases	
	4.3	Literature data base: PubMed (Public Medline), Human genetics: OMIM (Online Mendelian Inheritance in Man).	
	4.4	Bioinformatics services: Sequence search tools, FASTA & BLAST (Basic Local Alignment Search Tool), data retrieval system Entrez, SRS (Sequence Retrieval System), Uniprot-KB, ExPASy.	
	4.5	Cladistics	
	4.6	Pharmacogenomics	

PRACTICAL IV Credit-1.25 (50M)
Course Code: BUSZOO604 P6

Sr. No.	Practical
1	Calculation of Natality , Mortality , Population density from given data
2	Interpretation of growth curve J shaped and Sigmoid
3	Interpretation of given graph / tables and comment on pattern of population nature , dispersal- survivorship curve, life table, fecundity table, sex ration and age structure
4	Estimation of BOD from Ulhas river water
5	Estimation of COD from Ulhas river water
6	Estimation of Phosphates from Ulhas river water
7	Estimation of Nitrates from Ulhas river water
8	Visit any hospital nearby and prepare the report of biomedical waste management
9	Study the effect of household disinfectants on bacteria and fungi
10	Study of Bacterial Disease and Viral diseases in animals: Anthrax, Leptospirosis, MRSA, Tuberculosis, Piglet diarrhea, Salmonella and H1N1, Foot and mouth disease, Rabies, Brucellosis, Rinderpest, SARS- Covid
11	Campus survey of epidemiologically important drives and giving suggestions for its improvement

12	Retrieval of the protein/gene sequences from suitable search tool in FASTA format, save it on Notepad and take its screen shot.
13	Sequence alignment of the proteins/genes using BLAST and comparing their percentage analogy.
14	Draw phylogenetic tree for the organisms given using protein/gene sequence.

Internal submission for 20 marks

1. Visit any hospital nearby and prepare the report of biomedical waste management practiced there
2. Knowing own's epidemiological status by different epidemiological methods (asking questions, survey, medical checkup etc.)
3. Campus survey of epidemiologically important drives and giving suggestions for its improvement

References:

1. Fundamental of ecology, Eugene P. Odum (Author), Gary W. Barrett, Brooks/Cole; 5th Revised edition edition (27 July 2004)
2. Introduction to Population Ecology, Larry L. Rockwood, Wiley-Blackwell (17 January 2006)
3. Fundamental of Ecology: M. Dash (Author), S. Dash, McGraw Hill Education; 3 edition
4. Population Ecology: A Unified Study of Animals and Plants, Michael Begon (Author), Martin Mortimer (Author), David J. Thompson, Wiley-Blackwell; 3rd edition
5. Basic Populus Models of Ecology: Donald Alstad, Pearson; Sp. edition (24 October 2000)
6. Ecology: Subramaniam, Narosa Publcation House
7. Bioinformatics - Concepts, Skills, and Applications; S.C. Rastogi& others; CBS Publishing; 2003.
8. Bioinformatics - A practical guide to analysis of Genes & Proteins; Andreas D Baxevanis& B F Francis; John Wiley; 2000.
9. Introduction to Bioinformatics;1st Edition; T K Attwood, D J parry-Smith; Pearson Education, 11th Reprint; 2005.
10. Bioinformatics; 1st Edition; C S V Murthy; Himalaya Publishing House; 2003.
11. Bioinformatics sequence and genome analysis; David W. Mount; Cold spring Harbor Laboratory Press; 2004.
12. Basic Bioinformatics; S. Ignacimuthu, S.J.; Narosa Publishing House; 1995.
13. An Introduction to Bioinformatics Algorithms; Neil C. Jones and Pavel A. Pevzner; MIT Press, First Indian Reprint; 2005.
14. Bioinformatics - Managing Scientific Data; Zoe Lacroix, Terence Critchlow; Morgan Kaufmann Publishers (Elsevier Science); 2003 (for the V unit).
15. Public Health & Sanitation Part I &II: The All India Institute of Local Self Government. Sthanikraj Bhavan, C. D .Barfiwala Marg, Andheri (W), 400058,
16. Park's Textbook of Preventive & Social Medicine, 7th E.d: K.Park, M/S Banarsidas Bhanot Publishers, 1167, Premnagar, Jabalpur, 482001.
17. Infectious Diseases of Domestic Animals by S.M Mohiuddin.
18. Disease investigation in domestic animals by P.R. Jatkar

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
T. Y. BSc. Semester-VI
Skeleton Question paper Practical-IV (BUSZOOP6)
Duration: 3hrs Marks: 50

Q.1	Retrieve the protein/gene sequences from suitable search tool in FASTA format, save it on Notepad and take its screen shot.	12
	OR	
Q.1	Draw phylogenetic tree for the organisms given using protein/gene sequence.	
Q. 2	Estimation of COD / BOD / Phosphates / Nitrates from given river sample water	10
Q. 3	Identify and comment on the disease causing agents to animals (A and B): A. Bacterial: Anthrax/Leptospirosis/MRSA/Tuberculosis/Piglet diarrhoea/Salmonella (any2) B. Viral: H1N1/Foot and mouth disease/Rabies/Brucellosis/Rinderpest/SARS- Covid (any 2)	08
Q.4	Solve the given problems based on Natality , Mortality, Population density from given data (any 1)	05
Q.5	Interpret and comment on given growth curve J shaped / Sigmoid shaped OR Interpretation of given graph / tables and comment on pattern of population nature , dispersal- survivorship curve, life table, fecundity table, sex ration and age structure	05
Q. 6	Viva-voce	05
Q. 7	Journal	05