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

Syllabus for M.Sc. Part-I

Program M.Sc.

Course: Zoology (Cell Biology)

Semester I and II

(With effect from 2021-22)

M.Sc.

Programme outcomes

PO	PO Description A student completing postgraduation in Science (M.Sc.) will be able to attain the following
PO1	Due to individual Research projects, research orientation and temperament will be enhanced.
PO2	Advanced Applied papers will upgrade the students' knowledge essential in the field.
PO3	Postgraduates with varied but interrelated and interdisciplinary academic background will be produced to serve as human resources. The knowledge of basic and applied/novel disciplines of the subject will aid in professional growth
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 probably solutions
PO6	Responsible execution of their roles in society as professionals, employers, and employees in various industries as regulators, researchers, educators and managers.
PO7	Life-long Learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of Subject and beyond through various Online platforms.

Program Specific Outcome

M.Sc. Zoology with Cell Biology as specialization will help students in acquiring in-depth knowledge of theoretical and practical aspects of cell biology. The syllabus will provide the insight not only in classical aspects of the subject but also the most recent and the modern aspects. The program will equip the students with the set of skills which are required to obtain the high profile jobs in the industries and research institutions of national and international repute.

The variety of skill sets practiced by the students will enable them in learning practical aspects of cell biology. This specialization will provide overabundance of knowledge to the students in the field of cell biology and will present ample opportunities in job sectors. Students will also be able to create their own niche in fields of super specialization such as genetic counseling, cancer biology and stem cell biology as they will be gaining an adequate knowledge of necessary techniques such as chromosomal banding, karyotyping, cell culture and maintenance of cell line, patent writing etc. where scholars with expertise are in demand.

Visits to the different institutions planned during this program will help students in understanding these organizations better and also provide them with opportunities to have firsthand experience of witnessing the functioning of these institutions. This will encourage students further to complete the program with greater force.

Project assigned for 150 marks will be extensive enough to provide opportunities to the students to use all the techniques which they will be learning in their practical sessions. Students will be able to publish their worthwhile findings.

Continuous internal assignment is a part of the evaluation system in this program; it will maintain the continuity in teaching and learning process.

If the program is completed with zeal, enthusiasm and dedication students will be able to incept their own start up and become job providers than the job seekers.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –I Zoology Semester I

Proposed Course Code	Unit	Topics	Proposed Changes in Topics	Credits	Lectures/ Week
BPSZOO101 Essentials of Zoology-I	I	Phylogeny Systematics of non-chordates and assorted topicsI	Comparative Anatomy- I	04	1
	II	Phylogeny, systematics of non-chordates, Hemichordata& Assorted Topics	Developmental Biology –I		1
	III	Phylogeny, systematic of chordates and Assorted topics –I	Systematics, Taxonomy and Phylogeny		1
	IV	Comparative vertebrate osteology- I	Laboratory Culture of Small Organisms		1
BPSZOO102 Biochemistry and Physiology-I	I	Biomolecules-a structural and functional approach- I	Biochemistry	04	1
	II	Biochemical Thermodynamics	Bioenergetics		1
	III	Metabolic Pathways and integration of Metabolism- I	Metabolism –I		1
	IV	Regulation of metabolism	Mammalian Physiology –I		1
BPSZOO103 Modern Concepts in Zoology-I	I	Genetics–Chromosome theory of inheritance and Mendelism- I	Molecular Biology – I	04	1
	II	Genetics Extension of Mendelian Genetics and Non-Mendelian inheritance-I	Animal Cell Biotechnology		1
	III	Evolution- I	Genetics		1
	IV	Developmental Biology- I	Recombinant DNA Technology		1
BPSZOO104 Techniques and Methodologies in Zoology-I	I	Principles and applications of Microtomy, microscopy, centrifugation	Instrumentation-I	04	1
	II	Principle and applications of radioisotopes & extraction techniques	Histopathological and Biochemical Techniques		1
	III	Principles and applications of spectroscopy	Introduction to Nano-Biotechnology		1
	IV	Good laboratory practices & research methodology-I	Ecotoxicology		1

B. K. Birla College of Arts, Science and Commerce, (Autonomous), Kalyan
M.Sc. –I Zoology Semester- II

Proposed Course Code	Unit	Topics	Proposed Changes	Credits	Lectures /Week
BPSZOO201 Essentials of Zoology-II	I	Phylogeny, systematics of non-chordates and assorted topics-II	Comparative Anatomy- II	04	1
	II	Phylogeny of Protochordates, Agnatha& Assorted Topics	Developmental Biology –II		1
	III	Phylogeny, systematics of chordates and assorted topics- II	Fundamentals of Histology and Endocrinology		1
	IV	Comparative vertebrate osteology- II	Fundamentals of Cell Biology		1
BPSZOO202 Biochemistry and Physiology-II	I	Biomolecules- a structural and functional approach- II	Enzymology	04	1
	II	Enzymes and Enzyme kinetics	Chemical Messengers and Cell Signaling		1
	III	Metabolic Pathways and integration of Metabolism- II	Metabolism –II		1
	IV	Inborn errors of Metabolism	Mammalian Physiology –II		1
BPSZOO203 Modern Concepts in Zoology-II	I	Genetics–Chromosome theory of inheritance and Mendelism - II	Molecular Biology – II	04	1
	II	Genetics- Extension of Mendelian Genetics and Non-Mendelian inheritance- II	Genome Projects		1
	III	Evolution- II	Genetic Counseling		1
	IV	Developmental Biology-II	Bioinformatics		1
BPSZOO204 Techniques and Methodologies in Zoology-II	I	Principles and applications of chromatography- I	Instrumentation-II	04	1
	II	Principles and applications of chromatography-II (Gel chromatography and affinity chromatography)	Intellectual Property Rights and Patents		1
	III	Principles and applications of chromatography & Electrophoresis (GC, HPTLC, Electrophoresis	Biostatistics		1
	IV	Good laboratory practices & Research methodology- II	Research Methodology		1

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –I Zoology
Syllabus

Semester -I			
Paper Number	**Title of the Paper**	**Course Code**	**Credit**
Paper I	**Essentials of Zoology-I**	**BPSZOO101**	04
I	Comparative Anatomy- I	**(100M)**	
II	Developmental Biology –I		
III	Systematics, Taxonomy and Phylogeny		
IV	Laboratory Culture of Small Organisms		
Practical I		**BPSZOOP1 (50M)**	02
Paper II	**Biochemistry and Physiology-I**	**BPSZOO102**	04
I	Biochemistry	**(100M)**	
II	Bioenergetics		
III	Metabolism –I		
IV	Mammalian Physiology –I		
Practical II		**BPSZOOP1 (50M)**	02
Paper III	**Modern Concepts in Zoology-I**	**BPSZOO103**	04
I	Molecular Biology – I	**(100M)**	
II	Animal Cell Biotechnology		
III	Genetics		
IV	Recombinant DNA Technology		
Practical III		**BPSZOOP1 (50M)**	02
Paper IV	**Techniques and Methodologies in Zoology-I**	**BPSZOO104**	04
I	Instrumentation-I	**(100M)**	
II	Histopathological and Biochemical Techniques		
III	Introduction to Nano-Biotechnology		
IV	Ecotoxicology		
Practical IV		**BPSZOOP1 (50M)**	02

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –I Zoology
Syllabus

Semester –II			
Paper Number	**Title of the Paper**	**Course Code**	**Credit**
Paper I	**Essentials of Zoology-II**	**BPSZOO201**	04
I	Comparative Anatomy- II	**(100M)**	
II	Developmental Biology –II		
III	Fundamentals of Histology and Endocrinology		
IV	Fundamentals of Cell Biology		
Practical I		**BPSZOOP2 (50M)**	02
Paper II	**Biochemistry and Physiology-II**	**BPSZOO202**	04
I	Enzymology	**(100M)**	
II	Chemical Messengers and Cell Signaling		
III	Metabolism –II		
IV	Mammalian Physiology –II		
Practical II		**BPSZOOP2 (50M)**	02
Paper III	**Modern Concepts in Zoology-II**	**BPSZOO203**	04
I	Molecular Biology – II	**(100M)**	
II	Genome Projects		
III	Genetic Counseling		
IV	Bioinformatics		
Practical III		**BPSZOOP2 (50M)**	02
Paper IV	**Techniques and Methodologies in Zoology-II**	**BPSZOO204**	04
I	Instrumentation-II	**(100M)**	
II	Intellectual Property Rights and Patents		
III	Biostatistics		
IV	Research Methodology		
Practical IV		**BPSZOOP2 (50M)**	02

SEMESTER-I

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

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

M.Sc. Zoology, Semester- I

Title:**Essentials of Zoology-I**

COURSE CODE: **BPSZOO101 Credit: 4(100M)**

Course Outcome:

1. Students will be acquiring the knowledge on comparative anatomy and will be able to understand the development and evolution of various systems across the vertebrate classes.
2. In developmental biology students will understand the intricacies of developmental process. They will be able interpret the fate map and the morphogenetic movements etc.
3. Students will understand the principle of classification and systematic. They will be able to identify the animals based on their characters and also to construct the cladogram.
4. Students will learn to maintain and culture the small animals in the laboratory.

Unit	Title of the unit		Total Lectures (60)
I	**COMPARATIVE ANATOMY of Vertebrates- I**		15L
	1.1	Integumentary system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.1.1	Structure of amphibian skin	
	1.1.2	Structure of mammalian skin	
	1.1.3	Derivatives of integuments: Scales, feathers, hair, beak, claws, nails, hoofs, horns, antlers and glands associated with skin.	
	1.2	Digestive system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.2.1	Digestive tube and its evolution	
	1.2.2	Primary divisions of the tube	
	1.2.3	Tooth structure and position, teeth in lower vertebrates, mammalian dentition	
	1.2.4	Study of digestive system in aves (Pigeon)	
	1.2.5	Study of digestive system in mammals (Rat/Rabbit/Cattle/Man)	
	1.3	Circulatory system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.3.1	Evolution of heart	
	1.3.2	Types of heart	
	1.3.3	Aortic arches	
	1.3.4	Venous, portal (Hepatic portal and renal portal systems, e.g. Frog) and Lymphatic systems in vertebrates.	
	1.3.5	Open and closed circulation. Single and double circulation	
II	**DEVELOPMENTAL BIOLOGY –I**		15L
	2.1	Basic concepts in developmental biology:	
	2.1.1	Cell fate, cell lineage and commitment	
	2.1.2	Mosaic and regulatory development	
	2.1.3	Pattern formation and compartments	

	2.1.4	Morphogenesis and cell adhesion: Differential cell affinity, cadherins and catenins, sorting out of embryonic tissue and cell recognition, cell differentiation and totipotency, stem cell.	
	2.2	Factors affecting cellular differentiation:	
	2.2.1	Nucleo-cytoplasmic interaction	
	2.2.2	Mechanism of gene action during cell differentiation	
	2.2.3	Maintenance of differentiation	
	2.3	Cell Specialization: RBC, secretory cells, retinal rod cells	
	2.4	Organizer and its role in embryonic development	
	2.5	Primary embryonic induction	
	2.6	Developmental gradients: Developmental gradients in hydra, Maternal effect genes and axial gradients in drosophila development.	
III	**SYSTEMATICS, TAXONOMY AND PHYLOGENY**		15L
	3.1	Systematics: Definition and types (Numerical systematics, Biochemical Systematics and experimental systematics).	
	3.2	Taxonomy: Definition and taxonomic characters (morphological, physiological, molecular, behavioral, ecological and geographical characters).	
	3.3	Basis of Classification (Five fundamental basis), six kingdom classification, rules of binomial nomenclature.	
	3.4	Phylogeny: Definition, significance in evolutionary studies, Cladistics, molecular phylogeny	
IV	**LABORATORY CULTURE OF SMALL ORGANISMS**		15L
	4.1	Use of live animals in laboratory- Ethical issues. Need of small culturing small organisms in laboratory.	
	4.2	Bacterial culture- *E. coli* culture, Types of Culture Media required, doubling time, use of *E. coli* in experiments.	
	4.3	Paramecium Culture:Collection and isolation of paramecium from the sample water, Establishing the pure culture of paramecium.	
	4.3	Hydra culture: Hydra Biology: Ecology and behavior Types of Culture media and other laboratory conditions, doubling time, use of *hydra* in experiments,	
	4.4	Vermiculture: Earthworm biology: Ecology, behavior and types of earthworms used in culture, Methods of culture, Use of earthworm in experiments, commercial use	
	4.5	Drosophila Culture: Drosophila Biology: Ecology, behavior, species Methods of culture, use in experiments.	
	4.6	Daphnia Culture: Daphnia Biology: Ecology, behavior, species Methods of culture, use in experiments, commercial use	

References:

1. Chordate Zoology by Jordan and Verma
2. Chordate Zoology by Kotpal
3. Chordate Zoology by Dhami and Dhami.
4. Systematics and Origin of species by Ernst Mayer
5. Introduction to Bioinformatics by Arther M. Lesk
6. Phylogenetic Systematics by Willi Henning

7. Essential developmental biology by J.M. W. Slack
8. Developmental Biology : Introduction by Scott F. Gilbert
9. Invertebrate Zoology by Jordan and Verma
10. Biology of Protozoans by D.R. Khanna.
11. Hydra Research methods by Howard M. Lenhoff
12. Drosophila: A laboratory Handbook: Michael Ashbumer, Kent Golic and R. Scott Hawley.
13. Vermiculture Technology: Earthworms, Organic Wastes and Environmental management by Clive A. Edwards, Norrman Q Arancon and Rhonda Sherman.
14. Laboratory methods in Microbiology by W.F. Harrigan and Margaret E. McCance
15. Manual for the Culture of Selected Freshwater Invertebrates by Lawrence, S.G.

M.Sc.-1, Semester -1 BPSZOOP1 , Paper I Practical-I Credit-2 (50M)	
Sr. No.	Title of the experiment
1.	Study of types of fish scales (Mounting): Placoid, Ctenoid and cycloid scales
2.	Study of types of feathers and their arrangement as per their position (Diagrams/ Students should collect the fathers) and other integumentary derivatives: beak, claws, nails, hoofs, horns, antlers, glands associated with skin and T.S. of skin of frog and mammals (Rat or human)
3.	Study of T.S. of tooth, ruminant stomach of cattle, gizzard in birds.
4.	Study of types of heart and Study of L.S. of avian heart (Chicken heart)
5.	Study of aortic arches and portal systems
5.	Study of morphogenetic movements in chick embryo
6.	Mounting of 72 hrs. Of chick embryo for study of development of eye vesicle.
7.	Retrieval of data for the given protein and construction of cladogram
8.	Study of given cladogram and finding the phylogenetic relation between the organisms
9.	Study of binomial nomenclature
10.	Study of growth curve in *E.coliI*.
11.	Study of cyclosis, irritability and chemotaxis in paramecium.
12.	Study of Morphological characters of drosophila.
13.	Study of different species of earthworms used in vermiculture and study of cocoon.

Suggestions for 40 marks internals:

1. Observe ten birds around your residential area and make a report on their food and feeding habits and adaptations to the surrounding based on the types of their feathers, beaks and claws and submit the report.
2. Make permanent slides of chick embryo for 24, 48, 72 and 96 hrs. and make a report on their special developmental features.
3. Construct the cladogram for given animals (any four) based on the specific protein sequences provided.
4. Establish and maintain the culture of Paramecium/Earthworm/E. coli/Drosophila/Daphnia. Write the methodology and make the presentation.
5. Presentations on any topic from comparative anatomy-1, six kingdom classification, binomial nomenclature etc.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
MSc. Semester-I
Skeleton Question paper Practical-I (BPSZOOP1)

Duration: 5 hrs Marks: 50

Q.1	Make a permanent mounting of the chick embryo and comment on its developmental status	12
	OR	
Q.1	Retrieve the data of the given protein and trace the phylogeny of the given animals using appropriate tool for drawing the cladogram	12
	OR	
Q.1	Identify (Giving reasons) and arrange the given specimens of heart as per their evolutionary sequence. Take the L.S. of the specimen given and draw its neat and labeled diagram.	12
Q.2	Identify the type of feathers provided and arrange them in the order of their position and write their functions	06
	OR	
Q.2	Mount the scales from the given specimen/material identify their type and draw the diagrams	06
	OR	
Q.2	Demonstrate morphogenetic movement in the given chick embryo	06
Q.3	Demonstrate cyclosis/ Irritability/Chemotaxis in paramecium	06
	OR	
Q.3	Mount the given organism (daphnia) and locate its heart	06
	OR	
Q.3	Identify the morphological variants of drosophila and describe their phenotypic characters	06
	OR	
Q.3	Study the given cladogram and answer the questions asked.	06
Q.4	Identify and describe the given specimens/material/Picture etc**. (any 8)**: beak, claws, nails, hoofs, horns, antlers, glands associated with skin and T.S. of skin of frog and mammals (Rat or human), T.S. of tooth, ruminant stomach of cattle, gizzard in birds, aortic arches and portal systems, cocoon	16
Q.5	Viva-voce and Journal	10

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

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

M.Sc. Zoology, Semester- I

Title:**Biochemistry and Physiology-I**

COURSE CODE: **BPSZOO102 Credit: 4 (100M)**

Course Outcome:

1. Students will understand the principles of biochemistry, methods of buffer preparation, importance of physiological buffers and their role in maintaining homeostasis.
2. Students will understand the importance of electron transport system and oxidative phosphorylation and its importance in the production of high energy compounds
3. Students will understand carbohydrate metabolism in detail and its regulation
4. Students will learn about the structure and physiology of digestive system and excretory systems.

Unit	Title of the unit		Total Lectures (60)
I	**BIOCHEMISTRY**		15L
	1.1	Water: the basic molecule of Life	
	1.1.2	Ionization of water, weak acids and weak bases	
	1.2	Henderson-Hasselbalch equation	
	1.3	Dissociation constant of weak acids and weak bases	
	1.4	Titration curve and pKa of weak acids	
	1.5	Biological buffers- maintenance of blood pH	
	1.5.1	Blood buffers-1. Bicarbonate buffer, 2. Phosphate buffer, 3. Protein buffer	
	1.6	Water balance	
	1.6.1	Water - turn over and balance	
	1.7	Electrolyte balance	
	1.7.1	Osmolarity and osmolality of body fluids, regulation of electrolyte balance	
	1.8	Acid-base balance	
	1.8.1	Disorders of acid-base balance	
II	**BIOENERGETICS**		15L
	2.1	High energy compounds: ATP, ADP, ATP-ADP cycle, ATP-AMP ratio	
	2.2	Biological oxidation: Electron transport chain and mitochondria	
	2.3	Oxidative phosphorylation - Mechanism, uncoupling of oxidative phosphorylation and its significance.	
	2.4	Bioenergetics, coupled reaction, group transfer, biological energy transducers	
	2.5	Free radicals, antioxidants and antioxidant system	
III	**METABOLISM–I**		15L
	3.1	Metabolism: Concept, Definitions, Catabolism, Anabolism.	
	3.2	Integration of Metabolism	
	3.2.1	Energy demand and supply; Integration of major metabolic pathways of energy metabolism	
	3.2.2	Overview of intermediary metabolism; organ specialization and metabolic integration, metabolism in starvation	
	3.3	Carbohydrate Metabolism	

	3.3.1	Glycolysis: Reaction sequence, flow of carbon, conversion of pyruvate to lactate AndAcetyl coenzyme-A, significance of pyruvate- lactate interconversion	
	3.3.2	Aerobic and anaerobic glycolysis and energetics of glycolysis; Regulation of glycolysis	
	3.3.3	Gluconeogenesis: Reaction sequence from pyruvate, gluconeogenesis from amino acids, glycerol, propionate, lactate. Regulation of gluconeogenesis.	
	3.3.4	Glycogen metabolism: Glycogenesis, Glycogenolysis. Regulation of two pathways	
	3.3.5	Significance of following pathway; Hexose monophosphate shunt as a multifunctio nal pathway;Uronic Acid Pathway; Glyoxalate cycle.	
	3.4	Regulation of metabolism	
	3.4.1	Regulation of metabolic flux by genetic mechanisms Control of enzyme synthesis, regulatory proteins-Helix turn Helix, Zinc Fingers, Leucine Zippers	
	3.4.2	Regulation of metabolism by extracellular signals: nutrient supply, nutrient transport,Endocrine control, neural control.	
IV	**MAMMALIAN PHYSIOLOGY–I**		**15L**
	4.1	Digestive system	
	4.1.1	Gastrointestinal tract and accessory digestive organs	
	4.1.2	Phases of digestion; deglutition	
	4.1.3	Digestion in mouth, stomach, small intestine and large intestine	
	4.1.4	Absorption in small intestine and large intestine; regulation of digestive functions	
	4.2	Excretory system	
	4.2.1	Kidneys and Nephron	
	4.2.2	Urine formation- Glomerular filtration, tubular reabsorption and tubular secretion	
	4.2.3	Hormonal regulation of Urine formation	
	4.2.4	Urine concentration- countercurrent multiplication and countercurrent exchange	
	4.2.5	Micturition, regulation of blood pressure, blood volume and acid base balance	
	4.3	Reproductive system	
	4.3.1	Male Reproductive organs	
	4.3.2	Female Reproductive organs	
	4.3.3	Spermatogenesis and oogenesis	
	4.3.4	Hormonal control of reproduction	
	4.3.5	Menstrual cycle and its regulation	

REFERENCES

1. Lehninger's Principles of Biochemistry: David Lee Nelson, A.L. Lehninger, Michael M Cox; W.H. Freeman, New York; 2008
2. Biochemistry: Fifth Edition; J. M. Berg, J. L. Tymoczko and LubertStryer ;W.H. Freeman, New York; 2002
3. Biochemistry: Fourth Edition; U. Satyanarayana& U. Chakrapani; Elsevier; 2013
4. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
5. Biochemistry: Fifth Edition; Reginald H. Garrett & Charles M. Grisham; Brooks/ Cole (Cengage Learning); 2013
6. Principles of Anatomy and Physiology, Gerard J. Tortora, Bergen Community College , Bryan Derrickson Valencia Community College, John Wiley & Sons, Inc, Twelfth Edition
7. TextBook of Medical Physiology, Arthur C. Guyton and John E. Hall , Elsevier Saunders, Eleventh Edition
8. C. C. Chatterjee's Human Physiology 12ed Vol 1& 2 (Pb 2018), Chatterjee C.C.,CBS; 12 edition (2018)

9. Comparative Animal Physiology: Knut Schmidt Nielson; Cambridge Press
10. Comparative Animal Physiology: Prosser and Brown
11. Comparative Animal Physiology: William S Hoar
12. Text book of Comparative Physiology: R Nagabhushanam, MsKodarkar, Sarojini R, India Book House Pvt. Ltd.
13. Animal Physiology: N. Arumugam, A. Mariakuttikan; Saras Publication

MSc. PART-I SEMESTER-I
PRACTICAL-IICredit-2 (50M)
BPSZOOP1

1.	Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter
2.	Titration curve of strong acid v/s strong base
3.	Determination of pKa of weak acid
4.	Qualitative tests for carbohydrates and identification of the nature of carbohydrates in the given sample: a. Molisch's test b. Anthrone test c. Iodine test d. Barfoed's test e. Seliwanoff's test f. Fehling's test g. Benedict's test h. Picric acid test i. Mucic acid test j. Bial's test.
5.	Determination of glucose by Benedict's method (volumetric method)
6.	Determination of reducing sugars by 3,5-dinitrosalicylic acid (colorimetric) method
7.	Determination of glycogen in the given tissue (liver/ skeletal muscle/ kidney/ brain)
8.	Acid and enzyme hydrolysis of glycogen and colorimetric estimation of the products by 3,5-DNSA method
9.	Isolation of starch from potato
10	Determination of creatinine in serum and urine

Suggestions for 40 marks internals:

1. Project based on various natural antioxidants and effect
2. Presentations based on all 4 units

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. Part-I Semester-I
Skeleton Question paper Practical-II (BPSZOOP1)

Duration: 5hrs Marks: 50

Q. 1	Determination of glycogen in the given tissue (liver/ skeletal muscle/ kidney/ brain)	12
	OR	
Q.1	Acid and enzyme hydrolysis of glycogen and colorimetric estimation of the products by 3,5-DNSA method	12
Q.2	Qualitative tests for carbohydrates and identification of the nature of carbohydrates in the given sample:	10
	OR	
Q.2	Isolation of starch from potato	10
Q.3	Determination of reducing sugars by 3,5-dinitrosalicylic acid (colorimetric) method	10
	OR	
Q.3	Determination of glucose by Benedict's method (volumetric method)	10
	OR	
Q.3	Determination of pKa of weak acid	10
Q.4	Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter	08
	OR	
Q.4	Titration curve of strong acid v/s strong base	08
	OR	
Q.4	Determination of creatinine in serum and urine	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, 2021-22 (CBCS)

M.Sc. Zoology, Semester- I

Title:**Modern Concepts in Zoology-I**

COURSE CODE: **BPSZOO103 Credit: 4 (100M)**

Course Outcome:

1. *Students will understand the central dogma, protein synthesis and gene regulation in prokaryotes. They will also acquire the knowledge of gene mutation.*
2. *The students will understand the methods of animal cell culture and its requirement. They will learn to maintain the aseptic conditions in the laboratory.*
3. *Students will learn the genetics of popular laboratory models. They will also learn the techniques of karyotyping and banding techniques. Students will understand the genome organization of virus and bacteria.*
4. *Students will learn details about the gene cloning methods.*

Unit		Title of the unit	Total Lectures (60)
I	**MOLECULAR BIOLOGY –I**		15L
	1.1	Molecular Biology-I	
	1.1.2	Transcription in Prokaryotes	
	1.1.3	Enzymatic synthesis of RNA	
	1.1.4	Classes of RNA molecules	
	1.2	Translation in Prokaryotes	
	1.2.1	Outline of Translation, Genetic code, Codons, The decoding system- tRNA and Aminoacyl Synthetases The cloverleaf structure of tRNA The codon- anti-codon interactions	
	1.2.2	Chemical composition and physical structure of Prokaryotic Ribosomes	
	1.2.3	Protein synthesis- initiation, chain elongation and chain termination. Post translational modification of protein, polysomes, couples transcription and translation in prokaryotes.	
	1.3	Gene regulation in Prokaryotes	
	1.3.1	General aspects of gene regulation, general mechanisms of metabolic regulation in bacteria, types of regulation of transcription	
	1.3.2	Operon Models- Lac operon, tryptophan operon	
	1.4	DNA mutation : Types, Mutagens	
II	**Animal Cell Biotechnology**		15L
	2.1	Aseptic Techniques: General sterilization of glass ware and working place Aseptic transfer of Media	
	2.2	Animal Cell culture	
	2.2.1	Introduction	
	2.2.2	Isolation of cells for cell culture- Trypsinization	
	2.2.3	Types of Culture: Primary, secondary , anchorage dependent and independent cell lines and established cell lines	
	2.2.4	Cell culturing and dilution techniques: Spreading, viable count	
	2.2.5	Examples of established cell lines and mammalian cell lines	

	2.3	Culture Media: Natural, chemical, complex	
	2.3.1	Commonly used culture media	
	2.4	Hybridoma technology	
	2.5	Application of cell lines	
III	**GENETICS**		15L
	3.1	Model systems in Genetic Analysis: Life cycle and advantages of Bacteriophage, *E. coli*, yeast, Drosophila, *C. elegans* and Zebra fish	
	3.2	Cytoplasmic inheritance – Basis and mechanism, role of organellar genes.	
	3.3	Chromatin structure: Histones, DNA, nucleosome morphology and higher level organization	
	3.4	Techniques in the study of chromosomes and their applications:	
	3.4.1	Short term (lymphocyte) and long term (fibroblast) cultures	
	3.4.2	Chromosome preparations	
	3.4.3	Karyotyping	
	3.4.4	Chromosome Banding	
	3.5	Genome organization in viruses, prokaryotes and eukaryotes:	
	3.5.5	Transposons.	
IV	**Recombinant DNA Technology**		15L
	4.1	Enzymes involved in DNA recombination Techniques Restriction enzymes with examples Ligases - E. coli DNA ligase and T4 DNA ligase Polynucleotide kinase, Phosphatases, DNA polymerases, Reverse Transcriptase, Terminal Transferase.	
	4.1.2	Vectors: General properties, advantages and disadvantages of cloning vectors. plasmid vectors (pBR322), phage vectors (λ Phage), cosmid vectors, Yeast Artificial chromosomes, Retrovirus,, SV 40 vectors	
	4.1.3	**Special purpose vectors:** Expression vectors, Secretion vectors, Bi-functional vectors (Shuttle vectors)	
	4.1.4	Host cells for cloning: Prokaryotic hosts- Escherichia coli, Bacillus subtilis Eukaryotic hosts - Saccharomyces cerevisiae	
	4.2.1	Cloning techniques: Cloning after restriction digestion - blunt and cohesive end ligation Creation of restriction sites using linkers and adapters, Cloning after homopolymer tailing,	
	4.2.2	Methods of gene transfer: Transformation, Transduction, By using chemicals (Calcium phosphate), Electroporation, Liposome -mediated gene transfer, microinjection.	
	4.2.3	Selection of recombinants: Insertional inactivation, Replica Plating	

MSc. PART-I SEMESTER-I
PRACTICAL-IIICredit-2 (50M)
BPSZOOP1

1.	Isolation of Genomic DNA / E.coli DNA and its quantitative estimation
2.	Setting Agarose gel for electrophoresis.
3.	Isolation of Plasmid DNA / Genomic DNA of E.coli from the given strain of bacteria (KIT Method) and show the purity of the isolate by Agarose Gel electrophoresis (Southern blotting Demonstration)
4.	Culturing of Lymphocyte and Fibroblast
5.	Aseptic transfer of media and wrapping techniques.
6.	Preparation of LB agar plate, slant and butt
7.	Determination of viable cell count in the culture of bacteria by dilution and spreading method
8.	Isolation of cells by Trypsinization
9.	Problems based on: a. Transcription b. Translation c. Restriction Digestion
10.	Growth curves –*E. coli*
11.	Identification based on genetics: life cycles of bacteriophage/ *E. coli/ C. elegans* / drosophila/ zebra fish. Chromosome banding- And G banding
12.	Identifying the genetic syndrome from the given Karyotype
13.	Estimation of number of bacteria in the given culture- nephalometry
14.	Replica plating technique

Suggestions for 40 marks internals:
Presentations based on all 4 unit

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M.Sc. Semester-I
Skeleton Question paper Practical-III (BPSZOOP1)
Duration: 5.00 hrs Marks: 50

Q.1	Isolate and quantify the genomic DNA / E.coli DNA from the given sample	14
	OR	
Q.1	Determine the purity of the given plasmid DNA / Genomic DNA of E.coli by AGE and demonstrate the technique of southern blotting	
	OR	
Q.1	Determine the number of viable cell in the given culture of bacteria by dilution and spreading method	
	OR	
Q.1	Estimate the number of bacteria in the given culture bynephalometry	
Q.2	Demonstrate the aseptic transfer of media and wrapping technique.	10
	OR	
Q. 2	Separate the fibroblast cells from the given tissue by trypsinization	
Q.3	Identification: (Any 04) Life cycles of bacteriophage/ *E. coli/ C. elegans* / drosophila/ zebra fish / Chromosome banding and G banding / genetic syndrome from the given Karyotype	08
Q. 4	Solve the given Problems A and B (Transcription / Translation / Restriction Digestion)	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, 2021-22 (CBCS)

M.Sc. Zoology, Semester- I

Title:**Techniques and Methodologies in Zoology-I**

COURSE CODE: **BPSZOO104 Credit: 4 (100M)**

Course Outcome:

1. *Students will understand the principles of microscopy and spectroscopy. They will also lean to use these instruments in their practical.*
2. *Students will learn the techniques and acquire the practical skills of histochemoical preparation and localization of cell organelle and biomolecules.*
3. *Students will understand the concept in nanotechnology and learn to prepare the bionanomaterial and their applications.*
4. *Students will become aware of the effects of anthropological interference with environment and their mitigation.*

Unit	Title of the unit		Total Lectures (60)
I	**INSTRUMENTATION-I**		15L
	1.1	Microscopy: Principle and applications of Microscopy	
	1.1.1	Light microscopy	
	1.1.2	Phase contrast microscopy	
	1.1.3	Fluorescence microscopy	
	1.1.4	Polarization microscopy	
	1.1.5	Confocal scanning microscopy	
	1.1.6	Transmission electron microscopy	
	1.1.7	Scanning electron microscopy	
	1.2	Spectroscopy: Principle and applications of Spectroscopy	
	1.2.1	Ultraviolet and visible absorption spectroscopy	
	1.2.2	Fluorescence spectroscopy	
	1.2.3	Nuclear magnetic resonance spectroscopy	
	1.2.4	IR and FTIR	
	1.2.5	Mass spectroscopy	
	1.2.6	Atomic absorption spectroscopy (AAS) and Atomic emission spectroscopy (AES)	
II	**HISTOPATHOLOGICAL AND BIOCHEMICAL TECHNIQUES**		15L
	2.1	Microtomy: Tissue fixation, dehydration, clearing, infiltration, embedding for paraffin method, sectioning, mounting, staining- differential and specific.	
	2.2	Principles and methods of histochemical localization and identification of the following: Carbohydrate moieties, Glycogen and glycoproteins with oxidizable vicinal diols by periodic acid Schiff method	
	2.3	Protein end groups General protein localization by bromophenol blue method. NH2 groups by ninhydrin-Schiff method SS- groups by performic acid –Schiff	
	2.4	Lipids moieties General lipids by Sudan black B method	

		Neutral lipids by Sudan III and Sudan IV methods. Differentiation of neutral lipids from acidic lipids by Nile blue sulphate method	
	2.5	Nucleic acids: Methyl green pyronin-Y for DNA and RNA Feulgen reaction for DNA	
III	**INTRODUCTION TO NANO-BIOTECHNOLOGY**		15L
	3.1	Nanobiotechnology: Introduction, history, and Nano scale dimensions	
	3.1.1	Nanostructures: Types and composition Carbon Based- Carbon nano-tubes, graphene, fullerene Metal based, Protein based- and green nanoparticles	
	3.1.2	Preparation and characterization of bionanomaterials Grindig/ high energy ball milling	
	3.1.3	Microfluidics in nanosciences Nanopainting of DNA, RNA ,Protein , Biochips	
	3.1.4	Medical Applications of nano biotechnology Drug delivery, bioimaging, anti- microbial properties	
	3.1.5	Bio-nano composites: Nanoparticles and microorganisms, Microbial synthesis of nano- material, Biological Methods for Synthesis of nano-emulsions using bacteria, Fungi and Actinomycetes	
	3.2	Characterization techniques: X-ray diffraction technique,Scanning Electron Microscopy, Transmission Electron Microscopy including high-resolution imaging,Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS, Nano-indentation, Small-angle X-ray and neutron scattering, DLS Ellipsometer, Confocal microscopy	
IV	**ECOTOXICOLOGY**		15L
	4.1	Definition and scope	
	4.2	Common Ecotoxicants -Natural and Artificial: (Source, chemical nature and their effects)	
	4.2.1	Molds and Mycotoxins	
	4.2.2	Pesticides. (Organophosphates and organochlorides)	
	4.2.3	Heavy metals (Lead, Mercury, cadmium, Arsenic)	
	4.2.4	Chemicals used in personal hygiene, fragrance chemicals and domestic detergents	
	4.2.5	Plasticizers (Phthalates)	
	4.2.6	Asbestos	
	4.2.7	Radioactive elements.	
	4.3	Major ecotoxicity related phenomena the chemicals involved:	
	4.3.1	Global Warming	
	4.3.2	Green House effect	
	4.3.3	Bioaccumulation and biomagnifiction	
	4.3.4	Acid Rain	
	4.4	Major international accidents having ecotoxicological effects	
	4.4.1	Chernobyl Incidance of Russia	
	4.4.2	Minamata incidence of Japan	
	4.4.3	Bhopal gas tragedy of India	
	4.4.4	Red tide incidence of Florida	
	4.5	Ecotoxicity testing and its prevention	
	4.5.1	Acute and chronic toxicity studies, LD50, LC50 and EC50 studies	

	4.5.2	OECD guidelines	
	4.5.3	Endocrine disruptor screening program.	
	4.5.4	Endangered species assessment	
	4.5.5	Ecotoxicity preventive majors	

REFERENCES

1. ModernExperimentalBiochemistry: 3rdEd.RodneyBoyer,PearsonEducation.
2. PrinciplesandTechniquesofPracticalBiochemistry.WilsonandWalker,CambridgeUniv.Press.
3. BiologicalScience;3rdEd.D.J.Taylor,N.P.O.Green,G.W.Stou,CambridgeUniv.Press
4. CellandMolecularBiologyConceptsandExperiments,GeraldKarp.JohnWiley&Co.
5. Analytical Biochemistry, 3 edition, (1998), David Holmes, H.Peck, Prentice Hall, UK.
6. Bancroft & Stevens: Theory and Practice of Histological techniques (2002, Churchill-Livingstone)
7. Casselman: Histochemical techniques (1959, John Wiley)
8. Pearse: Histo-chemistry: Theoretical and Applied (Vol. I, II & III) (4th ed 1980-1993, Churchill- Living stones)
9. Biological Science; 3rd Ed. D. J. Taylor, N.P.O. Green, G.W. Stou, Cambridge Univ. Press
10. Introductory Practical Biochemistry; S. K. Swahney, Randhir Singh. Narosa Publ.
11. An Introduction to Practical Biochemistry; 3rd Ed. David Plummer. Tata McGrawHill
12. Casarett and Doulls Toxicology – The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill; 2001
13. A Textbook of Modern Toxicology, Ernest Hodgson, Patricia E. Levi, McGraw-Hill International Edition, Second edition ,2000
14. Toxicological testing handbook – Principles, applications and data interpretation; David Jacobson-Kram and Kit Keller; CRC Press; 2006
15. Principles and Methods of toxicology; A. Wallace Hayes; CRC Press; 2007
16. Toxicology – Principles and Methods; M.A. Subramanian; MJP Publishers, Chennai; 2004
17. Fundamentals of Toxicology; Kamleshwar Pandey and J.P. Shukla; New Central book agency Ltd., Kolkata; 2011
18. Elements of Toxicology; Kamleshwar Pandey and J.P. Shukla; Wisdom Press, New Delhi; 2010
19. Principles and Applications of Toxicology; Lahir Y.K.; Seekay Publications; 2013

PRACTICAL IVCredit-2 (50M)
Course Code: BPSZOOP1

Sr.No.	Practicals based on **BPSZOO104**
1.	Study of Microtomy: a. Tissue preservation and fixation b. Dehydration, infiltration, paraffin embedding c. Block preparation and section cutting d. Staining of sections/ribbon
2.	Histochemical staining of the given specimens: a. For carbohydrates using Periodic acid/Schiff's method for neutral glycoproteins b. For acidic glycoprotein using Alcian blue pH 2.5 method c. For lipids using Sudan black B method / Sudan III method / Sudan IV method d. For protein localization by bromophenol blue method e. For Nucleic acids by Methyl green pyronin- Y for DNA and RNA f. For DNA by Feulgen reaction
3.	Verification of Beer Lamberts law and calculation of molar extinction coefficient of a coloured chemical compound of known molecular weight
4.	Use of UV spectrophotometry to determine the concentration of protein
5.	Extraction of Heavy metals from fish tissue and Analysis of heavy metal using AAS and UV spectrophotometer
6.	Demonstration of IR and FTIR
7.	Principle and working of compound microscopy with the help of permanent slides
8.	Synthesis of nano particles by sonochemical method (TiO2/ ZnO / CdS)
9.	Determination of surface area of nanoparticles by Methylene blue technique
10.	Synthesis of nanoparticles by nsawball milling from biomaterial
11.	Biogenesis of nano-particles by bacteria/ fungi–for development of Microbial Emulsion.
12.	Identification and characterization of nanoparticles by XRD, SEM, TEM, TG-DTA (only output analysis)
13.	Effects of heavy metal on heart beats of Daphnia.
14.	Effects of heavy metal /pesticides on daphnia /Zebra fish – LC 50 studies
15.	Effects of heavy metal/ Pesticides on structure function relation of gills, fish liver, fish kidney, fish muscles etc. (Using permanent slides – comparative studies of Normal and treated samples)
16.	Study of water quality from aneutrophicated pond or river (BOD, COD, Acidity, Alkalinity, organic content, Nitrate-Nitrogen and Nitrite-Nitrogen contents).

Internal 40 Marks:

1. Writing a research proposal for the given topic
2. Writing a Research paper by using given data

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M.Sc. Semester-I
Skeleton Question paper Practical-IV (BPSZOOP1)
Duration: 5.00 hrs Marks: 50

Q.1	Extraction of Heavy metals from fish tissue and Analysis of heavy metal using AAS and UV spectrophotometer	12
	OR	
Q.1	Verification of Beer lamberts law and calculation of molar extinction coefficient of a coloured chemical compound of known molecular weight	
	OR	
Q.1	Demonstrate the effect of given heavy metal /pesticides on daphnia /Zebra fish – LC 50 studies	
Q.2	Demonstrate synthesis of nano particles by sonochemical method (TiO2/ ZnO/ CdS)	10
	OR	
Q.2	Determination of surface area of nanoparticles by Methylene blue technique	
	OR	
Q.2	Demonstrate synthesis of nanoparticles by nsawball milling from biomaterial	
	OR	
Q.2	Demonstrate biogenesis of nano-particles by bacteria/ fungi–for development of Microbial Emulsion.	
Q.3	Process the given tissue for **a/b/c** and submit report to the examiner a. Embedding and block preparation b. Trimming and preparation of ribbon c. Staining the given slide	08
	OR	
Q.3	Histochemical staining of the given paraffin sections for **(Any two)** a) acidic glycoprotein using Alcian blue pH 2.5 method b) protein localization by bromophenol blue method c) DNA by Feulgen reaction d) Nucleic acids by Methyl green pyronin- Y for DNA and RNA	
	OR	
Q.3	Demonstrate thermal Denaturation of DNA and Protein	
	OR	
Q.3	Demonstrate the effect of heavy metal on heart beats of Daphnia.	
Q.4	Estimate BOD / COD / Acidity / Alkalinity / Organic content / Nitrate-Nitrogen / Nitrite-Nitrogen contents of given eutrophicated pond or river water	10
Q.5	Journal and viva-voce	10

SEMESTER-II

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –I Zoology
Syllabus

Semester –II			
Paper Number	**Title of the Paper**	**Course Code**	**Credit**
Paper I	**Essentials of Zoology-II**	**BPSZOO201**	04
I	Comparative Anatomyof Vertebrates- II	**(100M)**	
II	Developmental Biology –II		
III	Fundamentals of Histology and Endocrinology		
IV	Fundamentals of Cell Biology		
Practical I		**BPSZOOP2 (50M)**	02
Paper II	**Biochemistry and Physiology-II**	**BPSZOO202**	04
I	Enzymology	**(100M)**	
II	Chemical Messengers and Cell Signaling		
III	Metabolism –II		
IV	Mammalian Physiology –II		
Practical II		**BPSZOOP2 (50M)**	02
Paper III	**Modern Concepts in Zoology-II**	**BPSZOO203**	04
I	Molecular Biology – II	**(100M)**	
II	Genome Projects		
III	Genetic Counseling		
IV	Bioinformatics		
Practical III		**BPSZOOP2 (50M)**	02
Paper IV	**Techniques and Methodologies in Zoology-II**	**BPSZOO204**	04
I	Instrumentation-II	**(100M)**	
II	Intellectual Property Rights and Patents		
III	Biostatistics		
IV	Research Methodology		
Practical IV		**BPSZOOP2 (50M)**	02

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

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

M.Sc. Zoology, Semester- II

Title: **Essentials of Zoology-II**

COURSE CODE: **BPSZOO201 Credit: 4 (100M)**

Course Outcome:

1. Students will be acquiring the knowledge on comparative anatomy and will be able to understand the development and evolution of various systems across the vertebrate classes.
2. In developmental biology students will understand the intricacies of developmental processes, programme cell death, mechanism of aging, metamorphosis and its hormonal control.
3. Students will learn the structure and function of major apocrine, exocrine and endocrine glands.
4. Students will understand the fundamentals of cell biology and structure-function of cell organelle.

Unit	**Title of the unit**		**Total Lectures (60)**
I	**COMPARATIVE ANATOMY of Vertebrates- II**		15L
	1.1	Respiratory system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.1.1	Gills in cartilaginous and bony fish	
	1.1.2	Lungs of frog, birds and mammals	
	1.1.3	Mechanism of respiration in man	
	1.1.4	Accessory respiratory organs	
	1.1.5	Swim bladder	
	1.2	Nervous system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.2.1	Central nervous system in vertebrates	
	1.2.2	Development of brain in vertebrates	
	1.2.3	Peripheral nervous system	
	1.3	Urogenital system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.3.1	Types and development of kidneys	
	1.3.2	Structure of nephron	
	1.3.3	Urogenital ducts	
	1.3.4	Urinary bladder	
II	**DEVELOPMENTAL BIOLOGY –II**		15L
	2.1	Metamorphosis, regeneration and aging:	
	2.1.1	Metamorphosis: Retrogressive metamorphosis in ascidians and amphibians, incomplete and complete metamorphosis in insects and their hormonal control, metamorphosis in amphibians and its control.	
	2.1.2	Apoptosis : The programmed cell death	
	2.1.3	Aging: Senescence, life span and causes of aging	
	2.2	Developmental cycle and morphogenesis	
	2.2.1	Developmental cycle and morphogenesis	

		Dictyosteliumdiscoideum, life cycle, polarity, pattern formation and morphogenesis, role of mitochondria in growth/ differentiation transition, gene expression during cell growth.	
	2.2.2	Developmental cycle and morphogenesis of *Drosophila melanogaster*	
	2.2.3	Embryogenesis, gastrulation, larvae and metamorphosis	
	2.2.4	Maternal effect on genes and establishment of body plan, role of bicoid, hunch back, nano and caudal genes.	
	2.2.5	Zygotic genes and establishment of anterior/ posterior body pattern Parasegments- Gap genes, pair rule genes Segmentation- segment polarity genes, homeotic and selector genes.	
III	**FUNDAMENTALS OF HISTOLOGY AND ENDOCRINOLOGY**		15L
	3.1	Types of glands: Apocrine, Exocrine and endocrine (Definition and functions)	
	3.2	Histology of digestive organs and associated digestive glands: Stomach, Small intestine, large intestine, Salivary gland, liver, pancreas	
	3.3	Endocrine glands of human body: Position , histology and functions	
	3.4	Feedback mechanism: Hypothalamus- Pituitary – Thyroid axis	
	3.5	Histology of human skin, kidney, lungs, spleen, thymus	
	3.6	Histology of male and female reproductive organs and accessary reproductive organs (Testis, ovary, seminal vesicles, prostate gland, epididymis, placenta, uterus, mammary glands)	
IV	**FUNDAMENTALS OF CELL BIOLOGY**		15L
	4.1	Types of cells and their structures	
	4.2	Cell wall formation and its functions	
	4.3	Cell membrane: Sandwich model, fluid mosaic model, functions of cell membrane	
	4.4	Types of cell organelles of eukaryotic cells and their functions.	
	4.5	Endomembrane system	
	4.6	Eukaryotic nucleus and nuclear organizers	
	4.7	Giant Chromosomes	

References:

1. Chordate Zoology by Jordan and Verma
2. Chordate Zoology by Kotpal
3. Chordate Zoology by Dhami and Dhami.
4. Essential developmental biology by J.M. W. Slack
5. Developmental Biology : Introduction by Scott F. Gilbert
6. Invertebrate Zoology by Jordan and Verma
7. Drosophila: A laboratory Handbook: Michael Ashbumer, Kent Golic and R. Scott Hawley.
8. Cell biology by C.B. Pawar.
9. Essential Cell biology by Bruce Alberts, Karen Hopkin, Alexander D Johnson
10. Electron Microscopy: Principles and fundamentals by S Amelinckx, D Van Dyck, J Van Landuyt.
11. Vertebrate Endocrinology by David O Norris.

M.Sc.-1, Semester –II BPSZOOP2, Paper 1 Practical-I **Credit-2(50M)**	
Sr. No.	Title of the experiment
1.	Study of respiratory organs: T.S. of gills of cartilaginous and bony fishes (Slides/diagrams/Photographs). T.S. Lungs of Birds, T.S. of lungs of mammals (Rat/human), Study of air sacs of pigeon (Videos and photographs)
2.	Study of Brain of shark, frog, lizard, pigeon and rat and T.S. of Spinal Cord of Frog and Mammals (Rat/Human) Using preserved slides or photographs.
3.	Study of types of kidneys (Photographs). T.S. of avian Kidney, T.S. of mammalian kidney.
4.	Study of life cycle of *Dictyosteliumdiscoideum*(Using diagrams/Photographs)
5.	Study of retrogressive metamorphosis in ascidians and salamander
5.	Study of metamorphosis in frog and insects
6.	Study of viable and dead cells from fibroblast culture.
7.	An observational assessment method for aging laboratory rats from the given data
8.	Study of stages in embryogenesis in drosophila (with help of pictures or culture if available)
9.	Study of T.S. of Salivary gland, liver, pancreas, endocrine glands, Testis, ovary, placenta, prostate gland, seminal vesicles, epididymis, uterus , placenta, mammary glands, kidney, skin, spleen, thymus, small and large intestine, stomach, lungs etc.
10.	Mounting of bacterial cells from the given culture / Curd
11.	Mounting of leucocytes to study eukaryotic cells.
11.	Mounting of plant cells from dead and live regions of the plant to study the differences in the cell wall.
12.	Study of membrane permeability using suitable cells.
13.	Study of electron micrographs to observe cell organelles.
14.	Study of polytene chromosome (Identify and describe)

Suggestions for 40 marks internals:

1. Presentations on the topics of Comparative anatomy -II
2. Make the permanent slides of Liver tissue from various animals (Fish, chicken and Goat) and submit the report.
3. Make the permanent slides of Gills of cartilaginous fishes and bony fishes and submit the report.
4. Make the permanent slides lungs of birds and mammals and submit the report.
5. Make the permanent slides of Kidneys from fish, birds and mammals and submit the report.

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Department of Zoology
MSc. Semester-II
Skeleton Question paper Practical-I (BPSZOOP2)

Duration: 5 hrs Marks: 50

Q.1	Mount the cells from the two cultures provided, make viability cell count and find which culture is older. Show the dead cells under high power of compound microscope.	10
	OR	
Q.1	Demonstrate membrane permeability for the given tissue sample	10
	OR	
Q.1	Make an observational assessment for aging laboratory rats from the given data and write its analysis and plot the histograms.	10
Q.2	Mount the bacterial cells from the given culture	08
	OR	
Q.2	Mount the eukaryotic cells from the given sample of blood and comment on the structure of nuclear morphology observed.	08
Q.3	Make the temporary mounting of given tissue and focus the cell membrane	04
	OR	
Q.3	Identify the cells and describe the status of the cell organelles in the given micrograph	04
	OR	
Q.3	Identify and describe the given giant chromosome	04
Q. 4	Identify and describe (**any seven**): T.S. of gills of cartilaginous and bony fishes (Slides/diagrams/Photographs). T.S. Lungs of Birds, T.S. of lungs of mammals (Rat/human), Study of air sacs of pigeon (Videos and photographs), Brain of shark, frog, lizard, pigeon and rat and T.S. of Spinal Cord of Frog and Mammals (Rat/Human) Using preserved slides or photographs, types of kidneys (Photographs), T.S. of avian Kidney, T.S. of mammalian kidney, T.S. of Salivary gland, liver, pancreas, mammalian endocrine glands	14
Q.5	Identify and describe **(any two):**Stages in the life cycle of *Dictyosteliumdiscoideum*(Using diagrams/Photographs), retrogressive metamorphosis in ascidians and salamander, metamorphosis in frog and insects, stages in embryogenesis in drosophila (with help of pictures or culture if available).	04
Q.5	Viva and Journal	10

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

M.Sc. Zoology, Semester- II

Title:**Biochemistry and Physiology-II**

COURSE CODE: **BPSZOO202 Credit: 4 (100M)**

Course Outcome:

1. *Students will learn the classification, mechanism of action and kinetics of enzymes.*
2. *Students will understand the types of chemical messengers and their role in signaling.*
3. *Students will understand lipid and protein metabolism and their regulation and they will also learn about inborn errors of metabolism.*
4. *Students will learn about the structure and physiology of nervous system and reproductive systems.*

Unit	Title of the unit		Total Lectures (60)
I	**ENZYMOLOGY**		15L
	1.1	Definition, nomenclature and classification (based on Enzyme Commission) of enzymes, non-protein enzyme-ribozyme	
	1.2	Cofactors and coenzymes	
	1.3	The concept and properties of active site	
	1.3.1	Mechanism of enzyme action	
	1.4	Concept of activation energy	
	1.5	Enzyme kinetics, concept of steady state, enzyme assay	
	1.5.1	Derivation of Michaelis-Menten equation and Lineweaver-Burk plot	
	1.5.2	Concept and significance of km, Vmax and kcat	
	1.6	Factors affecting enzyme activity – pH, temperature, enzyme concentration, substrate concentration, inhibitors	
	1.7	Enzyme inhibitors – Reversible: Competitive, non-competitive, mixed inhibitors and Irreversible inhibitors and their kinetics	
	1.8	Regulation of enzyme activity	
	1.8.1	Allosteric regulation	
	1.8.2	Activation of latent enzymes	
	1.8.2	Compartmentation of metabolic pathways	
	1.8.3	Control of enzyme synthesis	
	1.8.4	Enzyme degradation	
	1.9	Isozymes e.g. LDH	
II	**CHEMICAL MESSSENGERS AND CELL SIGNALLING**		15L
	2.1	Chemical Messengers	
	2.1.1	Introduction, concept and classification	
	2.2	Neurotransmitters ad Neurosecretory substance	
	2.2.1	Acetyl catecholamine, Gama-amino butyric acid (GABA), Aspartic acid, Purine ATP	
	2.3	Mode of working of transmitters and its regulation	
	2.4	Neurosecretory substances and a brief account of Neurosecretory system.	
	2.5	Cell Signaling	
	2.5.1	Hormones and their receptors, cell surface receptors	
	2.5.2	Second messenger hypothesis	
	2.5.3	G-protein coupled receptors, signal transduction pathway, regulation of signaling pathway	

	2.5.4	Receptor tyrosine kinases.	
	2.6	Cellular communication	
	2.6.1	General principles of cell communication	
	2.6.2	Cell adhesion molecules, Integrin	
III	**METABOLISM–II**		15L
	3.1	Lipid metabolism	
	3.1.1	Lipid digestion, absorption and transport	
	3.1.2	Biosynthesis of fatty acids and triacylglycerols	
	3.1.3	Fatty acid oxidation and regulation of fatty acid metabolism	
	3.1.4	Ketone bodies and their oxidation	
	3.1.5	Biosynthesis of phospholipids and cholesterol	
	3.2	Protein metabolism	
	3.2.1	Amino acid pool, amino acid biosynthesis	
	3.2.2	Transamination; oxidative and non-oxidativedeamination; metabolism of branched chain amino acids; fate of carbonskeleton of amino acids.	
	3.2.3	Urea cycle	
	3.3	Inborn errors of metabolism	
	3.3.1	Carbohydrate metabolism: Glycogen storage disease, G-6-PD deficiency	
	3.3.2	Lipid metabolism: Metabolic disorders of cerebrosides	
	3.3.3	Protein metabolism: PKU, Albinism, Cysteinurea	
	3.3.4	Purine metabolism: Primary Gout	
IV	**MAMMALIAN PHYSIOLOGY–II**		15L
	4.1	Nervous system	
	4.1.1	Gross neuroanatomy of brain and spinal cord	
	4.1.2	Neurons and electrical signals and transmission in synapses	
	4.1.3	Central and peripheral nervous system	
	4.1.4	Reflex and reflex arcs	
	4.1.5	Blood brain barrier and CSF	
	4.1.6	Sense organs- vision, hearing and tactile response	
	4.2	Respiratory system	
	4.2.1	Respiratory organs	
	4.2.2	Mechanics of pulmonary ventilation	
	4.2.3	Lung volume and capacity	
	4.2.4	Transport and exchange of gases	
	4.2.5	Control of respiration- respiratory center and its regulation	
	4.3	Cardiovascular system	
	4.3.1	Heart- anatomy, valves, circulation of blood and cardiac conduction.	
	4.3.2	ECG- principle and significance	
	4.3.3	Cardiac cycle, Cardiac output	
	4.3.4	Blood vessels ,blood pressure and control and hormonal regulation of blood pressure	
	4.3.4	Lymphatic system	

REFERENCES

1. Lehninger's Principles of Biochemistry: David Lee Nelson, A.L. Lehninger, Michael M Cox; W.H. Freeman, New York; 2008
2. Biochemistry: Fifth Edition; J. M. Berg, J. L. Tymoczko and LubertStryer ;W.H. Freeman, New York; 2002
3. Biochemistry: Fourth Edition; U. Satyanarayana& U. Chakrapani; Elsevier; 2013
4. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
5. Biochemistry: Fifth Edition; Reginald H. Garrett & Charles M. Grisham; Brooks/ Cole (Cengage Learning); 2013
6. Principles of Anatomy and Physiology, Gerard J. Tortora, Bergen Community College , Bryan Derrickson Valencia Community College, John Wiley & Sons, Inc, Twelfth Edition
7. TextBook of Medical Physiology, Arthur C. Guyton and John E. Hall , Elsevier Saunders, Eleventh Edition
8. C. C. Chatterjee's Human Physiology 12ed Vol 1& 2 (Pb 2018), Chatterjee C.C.,CBS; 12 edition (2018)
9. Comparative Animal Physiology: Knut Schmidt Nielson; Cambridge Press
10. Comparative Animal Physiology: Prosser and Brown
11. Comparative Animal Physiology: William S Hoar
12. Text book of Comparative Physiology: R Nagabhushanam, MsKodarkar, Sarojini R, India Book House Pvt. Ltd.
13. Animal Physiology: N. Arumugam, A. Mariakuttikan; Saras Publication

MSc. PART-I SEMESTER-II
PRACTICAL-II V Credit-2(50M)
BPSZOOP2

1	Determination of acid value of fats/ oils
2	Determination of saponification value of fats/ oils
3	Determination of total cholesterol and HDL cholesterol from serum
4	Qualitative tests for amino acids and Proteins: a. Ninhydrin test b. Xanthoproteic test c. Millon's test d. Biuret test
5	Colorimetric estimation of protein by Peterson-Lowry method
6	Quantitative estimation of amino acids using ninhydrin reagent
7	Isolation of casein from milk and its confirmatory test
8	Detection of conformation of BSA by viscosity measurement and effect of varying concentration of urea on viscosity of BSA
9	Determination of specific activity of enzyme succinate dehydrogenase (SDH)
10	

Suggestions for 40 marks internals:

1. Isolation and assay of some naturally occurring enzymes
2. Presentations based on all 4 units

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. Part-I Semester-II
Skeleton Question paper Practical-II (BPSZOOP2)

Duration: 5hrs Marks: 50

Q. 1	Colorimetric estimation of protein by Peterson-Lowry method	12
	OR	
Q.1	Quantitative estimation of amino acids using ninhydrin reagent	12
	OR	
Q.1	Determination of specific activity of enzyme succinate dehydrogenase (SDH)	12
Q.2	Detection of conformation of BSA by viscosity measurement and effect of varying concentration of urea on viscosity of BSA	10
	OR	
Q.2	Determination of saponification value of fats/ oils	10
Q.3	Qualitative tests for amino acids and Proteins	08
Q.4	Determination of acid value of fats/ oils	10
	OR	
Q.4	Isolation of casein from milk and its confirmatory test	10
	OR	
Q.4	Determination of total cholesterol and HDL cholesterol from serum	10
Q. 5	Viva-voce and Journal	10

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

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

M.Sc. Zoology, Semester- II

Title:**Modern Concepts inZoology-II**

COURSE CODE: **BPSZOO203 Credit: 4 (100M)**

Course Outcome:

1. *Students will understand the protein synthesis and gene regulation in eukaryotes. They will also acquire the knowledge of DNA damage and its repair.*
2. *Students will understand the history and learn about the findings of human genome sequencing and its application.*
3. *Students will learn the methods and importance of genetic counseling and also learn the use of modern methods in pedigree analysis.*
4. *Students will come to know about the various data bases, methods of retrieving the data, its analysis and interpretation. Students will learn to construct a phylogenetic tree.*

Unit	**Title of the unit**		**Total Lectures (60)**
I	**Molecular Biology –II**		15L
	1.1	Molecular Biology-II	
	1.1	Transcription in Eukaryotes	
	1.1.1	The transcription unit concept	
	1.1.2	Classes of RNA molecules, RNA polymerases and promoters	
	1.1.3	Hypersensitive sites, upstream activation sites, enhancers	
	1.1.4	Post transcriptional modifications- structure of 5’ - 3’ termini of eukaryotic mRNA molecules, Caps and Tails Splicing	
	1.2	Translation in Eukaryotes	
	1.2.1	Differences between Protein synthesis in Eukaryotes and prokaryotes	
	1.3	Gene regulation in Eukaryotes	
	1.3.1	Important differences in the genetic organization of prokaryotes and eukaryotes	
	1.3.2	Regulatory strategies of genes in Eukaryotes- at transcriptional and translational level	
	1.4	DNA damage and repair.	
II	**Genome Projects**		15L
	2.1	Human Genome Project:	
	2.1.1	Scopes and Goals of the project. The features of human genome	
	2.2	Techniques used in human genome project	
	2.2.1	Genetic linkage maps, sequencing of DNA- chromosome walking	
	2.2.2	Restriction mapping	
	2.2.3	Physical Maps and sequence tagged sites	
	2.2.4	RFLPs and its uses	
	2.3	Mapping human diseases	
	2.4	Variations in human Genome- HapMap Project	

	2.5	The 1000 genome project: To focus genetic variation and diseases	
	2.6	ENCODE Project: To find out the functional elements	
III	**Genetic Counseling**		15L
	3.1	Introduction and scope of genetic counseling	
	3.2	Genetic counseling – Processes	
	3.3	Genetic testing – Carrier testing , prenatal testing , preimplantation testing	
	3.4	Pedigree analysis – Symbols and preparation of Pedigree chart for autosomal and sex linked dominant and recessive traits.	
	3.5	Role of RFLP in pedigree analysis	
	3.6	Problems in pedigree	
IV	**Bioinformatics**		15L
	4.1	Introduction to bioinformatics:	
	4.1.1	Nature, scope and Branches of Bioinformatics	
	4.2	Biological Databases in Bioinformatics	
	4.2.1	Sequence databases and Structure databases	
	4.2.2	General overview of NCBI , Genbank , DDBJ , EMBL , UNI-PROT , PROSITE , RCSB - PDB , PIR – PSD	
	4.2.3	Literature data bases- OMIM , PubMed	
	4.2	Sequence alignment	
	4.2.1	Bioinformatics tools - BLAST and FASTA	
	4.2.2	Pairwise sequence alignment: Global and Local alignment	
	4.2.3	Multiple Sequence alignment (MSA): Eg: Clustal W , Clustal X	
	4.3	Sequence visualization and Structure Visualization tools	
	4.3.1	ORF Finder, Swiss PDB Viewer, Rasmol,Cn3D, Phymol.	
	4.4	Molecular Phylogenetics	
	4.4.1	Construction of phylogenetic trees: Distance Based Methods- Clustering and Optimality based Methods	
	4.5	Applications of Bioinformatics	

MSc. PART-I SEMESTER-II
PRACTICAL-IIICredit-2(50M)
BPSZOOP2

1	Quantitative estimation of RNA by standard graph method
2	Construction of Pedigree chart and pedigree analysis of given charts
3	Identification: a. Pedigree symbols b. Prenatal test
4	Literature survey of diseases from OMIM and Pub Med
5	Retrieving Protein sequences from Uni-Prot
5	Retrieving DNA data from NCBI
6	Pairwise Sequence Analysis- BLAST
7	Multiple Sequence Analysis- Clustal W
8	Studying the 3D structure of protein using- Rasmol, Cn3D
9	Construction of cladogram
10	Report writing: Genome projects

Suggestions for 40 marks internals:To establish and maintain a Drosophila culture in the laboratory, To identify various mutations in Drosophila and record of various crosses and submission of report

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. Semester-II
Skeleton Question paper Practical-III (BPSZOOP1)
Duration: 5.00 hrs Marks: 50

Q.1	Quantitative estimation of RNA by standard graph method	14
	OR	
Q.1	Construction of Pedigree chart of given data/ Analyze the given pedigree chart and comment	
	OR	
Q.1	Retrieve the sequence of the given proteins / genes and construct the cladogram	
Q.2	Retrieve the query sequence for the given protein or DNAand use BLAST for sequence alignment.	08
	OR	
Q. 2	Construct the cladogram using Clustal W with the given sequences	
Q.3	Find the 3D structure of protein using- Rasmol / Cn3D	04
	OR	
Q.3	Retrieve the information of given disease from OMIM / Pub Med	
Q. 4	Identification: a. Pedigree symbols b. Prenatal test	06
Q.5	Submission of Report and viva based on Genome projects	08
Q.6	Viva-voce and Journal	10

References:

Molecular Biology and DNA Recombinant Technology

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. 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.
10. Principles of Gene Manipulation & Genomics; Primrose SB and R. Twyman; Blackwell Science Publications; 2006.
11. Genetic engineering - Principles and Practice; Sandhya Mitra; Macmillan India Ltd., New Delhi.
12. Molecular Biotechnology - Principles and applications of recombinant DNA; Glick, B.R.and Pasternak, J. J.; ASM press, Washington; 2010.
13. Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005.
14. Biotechnology - Expanding Horizons; B.D.Singh; Kalyani Publishers, Ludhiana.
15. A textbook of Biotechnology; R.C.Dubey; S.Chand and Company Ltd., New Delhi.

Biotechnology -II

1. Biotechnology - U Satyanarayana
2. Molecular cloning; Joseph Sambrook, David William Russell; Third. Edition; CSHL Press; 2001.
3. Gene Cloning - An Introduction; Brown .T.A; Fourth Edition; Wiley-Blackwell; 2011.
4. 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.
5. Principles of Gene Manipulation & Genomics; Primrose SB and R. Twyman; Blackwell Science Publications; 2006.
6. Molecular Biotechnology - Principles and applications of recombinant DNA; Glick, B. R. and Pasternak, J. J.; ASM press, Washington; 2010.
7. Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005.
8. Biotechnology - Expanding Horizons; B. D. Singh; Kalyani Publishers, Ludhiana.
9. Environmental Biotechnology :Basic concepts and applications ; InduShekar Thakur; I.K. International Pvt. Ltd, Mumbai, New Delhi
10. Basic Biotechnology, 2nd Edition, Colin Rateledge and Bjorn Krisiansen, Cambridge University Press.

Genetic counseling:

1. Facilitating the genetic counseling process- Practice based skills by Bonnie S. and Lay Roy, Patricia McCarty Veach , Nanacy P Callanan
2. Harper's Practical Genetic Counseling (8^{th} Edition) by Angus Clarke.

Bioinformatics:

1. Dan E Krane and Michael L Raymer, fundamental concepts of bioinformatics, Pearson Education(low priced Edition)
2. Claverie & Notredame, Bioinfomatics- A Beginners Guide, Wiley-Dreamtech India Pvt LTD,2003.
3. Pevnezer, Bioinformatics and functional genomics, John Wiley
4. Lesk, Introduction to Bioinformatics, Oxford University Press, Indian Edition,2003
5. JinXiong, Essential Bioinformatics-Cambridge University Press, Printed and bound in India byReplika Press Pvt.Ltd.
6. Introduction to bioinformatics-Attwood and Parrysmith, Pearson education.
7. Bioinformatics-A Beginner's guide by Jean-Michel Claverie, Cedric Notredame - Wiley-India Pvt. Ltds

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

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

M.Sc. Zoology, Semester- II

Title:**Techniques and Methodologies in Zoology-II**

COURSE CODE: **BPSZOO204 Credit: 4 (100M)**

Course Outcome:

1. *Students will learn the principles and applications of various separation techniques. They will also learn to use these techniques and interpret the results in the laboratory.*
2. *Students will learn the importance of intellectual property rights and method of filling the patents.*
3. *Students will learn to apply the biostatistical methods to interpret the research data. They will be able to use the software SPSS for the data analysis.*
4. *Students will understand various research methods, ways of writing the hypothesis and apply the same in their research projects.*

Unit	Title of the unit		Total Lectures (60)
I	**INSTRUMENTATION-II**		15L
	1.1	Chromatography: Principle and applications of Chromatography	
	1.2	Column chromatography: Packing and operation of column, loading of column, eluting the column, collection of eluent, detection of eluent	
	1.3	Ion-exchange chromatography: Ion exchange resins, selection of ion-exchanger, choice of buffers, preparation and use of ion-exchangers, storage of resins.	
	1.4	Principle and Instrumentation of HPTLC, HPTLC vs TLC	
	1.5	Principle and Instrumentation of HPLC	
	1.6	Principle and Instrumentation of GC	
	1.7	Electrophoresis: Principle and applications of Electrophoresis	
	1.7.1	Agarose Gel Electrophoresis	
	1.7.2	Poly acrylamide gel Electrophoresis	
	1.7.3	2D Electrophoresis	
II	**INTELLECTUAL PROPERTY RIGHTS AND PATENTS**		15L
	2.1	Introduction and the need for Intellectual property Rights	
	2.1.1	PR in India and Abroad : Genesis and development	
	2.1.2	Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883 The Berne Convention, 1886. The Universal Copyright Convention, 1952 The WIPO Convention, 1967. The Patent Co-operation Treaty, 1970, The TRIPS Agreement, 1994	
	2.2	Kinds of Intellectual Property Rights	
	2.2.1	Patents: Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application Non - Patentable Subject Matter Registration Procedure Rights and Duties of Patentee Assignment and license	

		Restoration of lapsed Patents Surrender and Revocation of Patents Infringement, Remedies & Penalties Patent office and Appellate Board	
	2.2.2	Copyrights Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright	
	2.2.3	Plant Variety Protection	
		Plant variety protection: meaning and benefit sharing and farmers' rights – Procedure for registration, effect of registration and term of protection, farmers rights act, 2001	
	2.2.4	Design Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection	
	2.2.5	Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection	
	2.2.6	India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies	
III	**BIOSTATISTICS**		15L
	3.1	Elementary concepts in Statistics	
	3.1.1	Concepts of statistical population and sample from a population Collection, classification and presentation of data	
	3.1.2	Presentation of data: Diagrammatic and graphical representation of data; frequency distributions and cumulative frequency distributions; histogram, frequency polygon, stem and leaf chart and ogives.(Self Study)	
	3.2	Descriptive statistics: Concepts of central tendency or location, Absolute and relative measures of dispersion; Box plot, Lorenz curve; skewness and kurtosis.	
	3.3	Probability	
	3.3.1	Random Experiment; sample point; sample space; events; mutually exclusive and exhaustive events; frequency.	
	3.3.2	Classical definitions of probability	
	3.3.3	Axiomatic definition of probability	
	3.3.4	Addition and multiplication theorems	
	3.3.5	Conditional probability and independence	
	3.3.6	Bayes' theorem. (The main thrust is on numerical problems and applications)	
	3.4	Difference between parametric and non- parametric statistics Confidence interval, errors and significance	
	3.4.1	Analysis of variance, t test, Z test, X2 Test	
	3.5	Regression and Correlation	
	3.6	Anova	
	3.7	Introduction to statistical software SPSS	
	3.7.1	Creating Tables and Graph	

	3.7.2	Regression analysis	
	3.7.3	Calculation of anova	
IV	**RESEARCH METHODOLOGY**		15L
	4.1	Introduction to research methodology: Meaning of research, Objective of research, Motivation in research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific methods, Importance of knowing how research is done, Research process, Criteria for good research	
	4.2	Research Problem and research design: Selecting research problem, Necessity of defining a problem, Techniques involved in defining the problem, Meaning of research design, Need for research design, Important concepts related to research design; Different research designs, Basic principles of experimental design, Important experimental designs.	
	4.3	Interpretation and report writing:Meaning of interpretation, Technique of interpretation, Precautions in interpretation, Significance of report writing, Layout of research report types of reports, Presentation of research work-oral, poster and writing research paper; Precautions for writing research report	
	4.4	Review of related literature:Understanding the role of review, how to begin as research for related literature, Library reference, recording and indexing, classification of references, Internet sites for biological references-downloading the information through internet; requests for reprints through e-mail and post, Classification and filing of reprints.	
	4.5	Writing research proposal: Characteristics of a proposal, Content and organization of a proposal, Weakness in proposal seeking funding	

REFERENCES

1. ModernExperimentalBiochemistry: 3rdEd.RodneyBoyer, PearsonEducation.
2. PrinciplesandTechniquesofPracticalBiochemistry.WilsonandWalker, CambridgeUniv.Press.
3. BiologicalScience;3rdEd.D.J.Taylor,N.P.O.Green,G.W.Stou,CambridgeUniv.Press
4. CellandMolecularBiologyConceptsandExperiments,GeraldKarp.JohnWiley&Co.
5. Analytical Biochemistry, 3 edition, (1998), David Holmes, H.Peck, Prentice Hall, UK.
6. Bancroft & Stevens: Theory and Practice of Histological techniques (2002, Churchill-Livingstone)
7. Casselman: Histochemical techniques (1959, John Wiley)
8. Pearse: Histochemistry: Theoretical and Applied (Vol. I, II & III) (4th ed 1980-1993, Churchill- Living stones)
9. Biological Science; 3rd Ed. D. J. Taylor, N.P.O. Green, G.W. Stou, Cambridge Univ. Press
10. Introductory Practical Biochemistry; S. K. Swahney, Randhir Singh. Narosa Publ.
11. An Introduction to Practical Biochemistry; 3rd Ed. David Plummer. Tata McGrawHill
12. Practical Research Planning and Design; 2nd Ed. Paul D. Leedy. Macmillan Publ.
13. Elementary Practical Organic Chemistry Part I: Small Scale Preparations.2nd Ed. Arthur I. Vogel. CBS Publ. And Distributors.
14. Research Methodology, Methods and Techniques; C. R. Kothari .Wiley Eastern Ltd. Mumbai
15. Intellectual Property Law in India, Nishith Desai

16. Manual of Patent Office, Practice and Procedure , The Office Of Controller General of Patents, Designs &Trademarks, Boudhik Sampada Bhawan, S. M. Road, Antop Hill, Mumbai (India)

PRACTICAL IVCredit-2(50M)
Course Code: BPSZOOP2

Sr.No.	Practicals based on **BPSZOO204**
1.	Separation of plant pigments by column chromatography
2.	Separation of amino acids from casein by ion exchange chromatography
3.	Separation of plasma proteins by Poly acrylamide gel Electrophoresis
4.	Demonstration of separation of genomic DNA / plasmid DNA by Agarose gel Electrophoresis
5.	Demonstration of HPTLC, HPLC, GC
6.	Solving Biostatistics Problems based on Z test, t test, Chi- square test
7.	Using SPSS : Creating Tables and Graph, Regression analysis Calculation of anova

Internal submission for 40 marks: Based on IPR and Patent and Research methodology

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. Semester-II
Skeleton Question paper Practical-IV (BPSZOOP2)
Duration: 5.00 hrs Marks: 50

Q.1	Demonstrate separation of plant pigments by column chromatography	12
	OR	
Q.1	Demonstrate separation of amino acids from casein by ion exchange chromatography	
Q.2	Solve the problems based on Biostatistics- Z test, t test, Chi-square test **(Any two)**	10
Q.3	Demonstrate separation of genomic DNA / plasmid DNA by Agarose gel Electrophoresis	10
	OR	
Q.3	Demonstrate separation of plasma proteins by Poly acrylamide gel Electrophoresis	
Q.4	Identify and comment on : HPTLC / HPLC / GC	08
Q.5	Journal and viva-voce	10

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

Syllabus for M.Sc.

CELL BIOLOGY

Program M.Sc.

Course: Zoology (Cell Biology and Cytogenetics)

Semester III and IV

(With effect from 2022-23)

M.Sc.
Programme outcomes

PO	PO Description **A student completing post-graduation in Science (M.Sc.) will be able to attain the following**
PO1	Due to individual Research projects, research orientation and temperament will be enhanced.
PO2	Advanced Applied papers will upgrade the students' knowledge essential in the field.
PO3	Postgraduates with varied but interrelated and interdisciplinary academic background will be produced to serve as human resources. The knowledge of basic and applied/novel disciplines of the subject will aid in professional growth
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 probably solutions
PO6	Responsible execution of their roles in society as professionals, employers, and employees in various industries as regulators, researchers, educators and managers.
PO7	Life-long Learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of Subject and beyond through various Online platforms.

Program Specific Outcome

M.Sc. Zoology with Cell Biology as specialization will help students in acquiring in-depth knowledge of theoretical and practical aspects of cell biology. The syllabus will provide the insight not only in classical aspects of the subject but also the most recent and the modern aspects. The program will equip the students with the set of skills which are required to obtain the high profile jobs in the industries and research institutions of national and international repute.

The variety of skill sets practiced by the students will enable them in learning practical aspects of cell biology. This specialization will provide overabundance of knowledge to the students in the field of cell biology and will present ample opportunities in job sectors. Students will also be able to create their own niche in fields of super specialization such as genetic counseling, cancer biology and stem cell biology as they will be gaining an adequate knowledge of necessary techniques such as chromosomal banding, karyotyping, cell culture and maintenance of cell line, patent writing etc. where scholars with expertise are in demand.

Visits to the different institutions planned during this program will help students in understanding these organizations better and also provide them with opportunities to have firsthand experience of witnessing the functioning of these institutions. This will encourage students further to complete the program with greater force.

Project assigned for 150 marks will be extensive enough to provide opportunities to the students to use all the techniques which they will be learning in their practical sessions. Students will be able to publish their worthwhile findings.

Continuous internal assignment is a part of the evaluation system in this program; it will maintain the continuity in teaching and learning process.

If the program is completed with zeal, enthusiasm and dedication students will be able to incept their own start up and become job providers than the job seekers.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. Zoology
Specialization: Cell Biology and Cytogenetics
Syllabus

Semester –III			
Paper Number	**Title of the Paper**	**Course Code**	**Credits**
Paper I	**Cell Biology–I**	**BPSZOOCB301**	04
I	Introduction to Cell Biology	**(100M)**	
II	Plasma Membrane		
III	Cell organelles- Endo membrane system		
IV	Cytoskeleton		
Practical I		**BPSZOOCBP3 (50M)**	02
Paper II	**Cell Biology –II**	**BPSZOOCB302**	04
I	Mitochondria	**(100M)**	
II	Nucleus		
III	Cell cycle and It's Check Points		
IV	Protein Sorting and Targeting		
Practical II		**BPSZOOCBP3 (50M)**	02
Paper III	**Cytogenetics –I**	**BPSZOOCB303**	04
I	History and Principles of Cytogenetics	**(100M)**	
II	Molecular Mechanism of Mitosis and Meiosis		
III	Central Dogma		
IV	Mutations and Instability of Human DNA		
Practical III		**BPSZOOCBP3 (50M)**	02
Paper IV	**Cytogenetics –II**	**BPSZOOCB304**	04
I	Linkage and Crossing Over	**(100M)**	
II	Methods of Analyzing Chromosome		
III	Banding Techniques :Visualization and Identification of Chromosomes		
IV	Approaches for Gene Identification		
Practical IV		**BPSZOOCBP3 (50M)**	02
Total			24

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

M.Sc. Zoology: Specialization: Cell Biology and Cytogenetics Semester-III

Paper: I Course Code**: BPSZOOCB301**

Title: **Cell Biology–I Credits: 4 (100M)**

Learning objectives: *Cell is the fundamental structural and functional unit of life. In order to understand the intricate nature of the cell and its complex function, it is necessary to learn the detailed structure of the cell. The units prescribed in this paper fulfill the simple objective of unravel the structural mysteries of the cell.*

Course outcome:

1. Students will learn the history of cell biology and its development as a discipline. Students will also understand structural differences between prokaryotic and prokaryotic cells.
2. Students will understand the structure- function correlation of plasma membrane and learn to illustrate the concept with the help of diagrams.
3. Students will learn the details of cell organelle of eukaryotic cells. Students will understand the structure, function and interrelation of organelle.
4. *Students will understand the significance of microtubule network present in the cell and understand the cell architecture as a whole.*

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
I	**Introduction to Cell Biology**	15L
1.1	Definition and scope,	
1.1.1	History of cell biology, Cell as basic unit of life, cell theory, protoplasm theory and organismal theory, broad classification of cell types.	
1.1.2	Cell Architecture: Bacteria, Archaea (prokaryotic) and eukaryotic cells. Structure, similarities and differences.	
1.1.3	The Composition of Cells and Cell Metabolism	
1.1.4	Structure and functions of cell wall: bacterial cell wall – plant cell wall and fungal cell wall	
II	**Plasma Membrane**	15L
2.1	Unit membrane concept.	
2.1.2	Models: Lipid membrane, Protein-Lipid (Danielli-Dawson) and Fluid Mosaic.	
2.1.3	Membrane proteins. Protein secretion, biogenesis of membrane proteins	
2.1.4	Membrane receptors. Modifications: Microvilli, Desmosomes and Plasmadesmata	
2.1.4	Transport: Passive and Active	
2.1.5	Exocytosis, endocytosis, Pinocytosis, Phagocytosis and secretion.	
III	**Cell organelles- Endo membrane system**	15L
3.1	Endoplasmic Reticulum	
3.1.1	Discovery , occurrence and ultrastructure	
3.1.2	Type: Smooth and Rough	

3.1.3	Functions	
3.2	Golgi complex	
3.2.1	Origin, occurrence and morphology	
3.2.2	Ultrastructure and functions	
3.3	Types of Vesicles	
3.3	Lysosomes, Peroxisomes	
3.3.1	Origin, occurrence and morphology	
3.3.2	Ultrastructure, polymorphism and microsomes	
3.3.3	Transport and their functions	
IV	**Cytoskeleton**	15 L
4.1.1	Introduction	
4.1.2	Microtubules, Microfilaments and Intermediate filament	
4.1.3	Location, ultrastructure	
4.1.4	Molecular motors.	
4.1.5	Filament dynamics and motility	
4.1.6	Biochemical composition and functions	

Cell Biology- I Practical I Credits: 2 (50M)

Course Code: **BPSZOOCBP3**

1.	Introduction to Cell Biology Lab / Computers in Biology
2.	Microscopy- Principle and Parts of microscopes
3.	Isolation of cell organelle
4.	Preparation of stains and fixatives
5.	Fixation and staining of cell organelle
6.	Differential staining of prokaryotic cells.
7.	Study of unicellular eukaryotic cell (Paramecium cell from culture and amoeba from permanent slide).
8.	Study of fungal cell from mucor /mushroom
9.	Mounting of plant cell.
10	Preparation of blood smears-Cell type identification and Differential Count.
11	Electron micrographs - Interpretation of cellular ultrastructure – Plasma membrane, Endoplasmic reticulum, Golgi complex, vesicles and Cytoskeleton
12	Study of Phagocytosis and pinocytosis
13	Study of lipid solubility of membranes
14	Determination of percent Hemolysis and osmotic fragility of erythrocytes

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc.-II Semester-III
Skeleton Question paper (Practical-I): Course Code: **BPSZOOCBP3**

Duration: 5hrs Marks: 50

Q. 1	Demonstrate differential staining of prokaryotic cells using the given material	14
	OR	
Q.1	Stain, identify and make the differential count of the animal cells from the blood sample provided	14
	OR	
Q.1	Demonstrate the effects of two different organic solvents on lipid solubility of cell membrane	14
Q.2	Make a temporary mounting of unicellular eukaryotic cell/ plant cell/ fungal cell, sketch and label.	05
	OR	
Q.2	Prepare the satin and fixative of given concentration, stain the given cells and comment and analyze the results.	05
Q.3	Stain the cells and locate the cell organelles.	06
	OR	
Q.3	Identify the cell organelles from the given electron micrograph and explain their structures	06
Q.4	Demonstrate hemolysis and osmotic fragility of erythrocytes using solvents of different osmolarity.	06
	OR	
Q.4	Present your idea of ideal cytology laboratory and sketch.	06
Q. 5	Identify and describe (a to c): a and b: Parts of the microscope , b: Pinocytosis/ Phagocytosis	09
Q. 6	Viva-voce	05
Q. 7	Journal	05

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

M.Sc. Zoology: Specialization: CELL BIOLOGY

Semester-III

Paper: II Course Code**: BPSZOOCB302**

Title: **Cell Biology–II Credits: 4 (100M)**

Learning objectives: *Every cell organelle play their individual and unique role in and contribute in integrated functioning of the cell. The units are planned in this paper with objectives of learning such roles of these organelles.*

Course outcome:

1. *Students will understand the ultrastructure and function of mitochondria and its role in respiratory chain and phosphorylation. They will also learn to correlate it with other pathways and cycles.*
2. *Students will understand the structure of nucleus and its function. Students will also understand the nucleo-cytoplasmic interactions.*
3. Students will understand the details of cell division, cell cycle and its regulation, they will also learn to illustrate the same in the form of diagrams, charts and models.
4. Students will understand the role of Gogi Apparatus and Endoplasmic Reticulum in protein sorting and targeting. They will also understand the process of protein transportation across the cell and to the exterior of cell.

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
I	**Mitochondria**	15L
1.1.1	Origin, occurrence and morphology	
1.1.2.	Ultrastructure and functions	
1.1.3	Organization of respiratory chain	
1.1.4	Phosphorylation	
II	**Nucleus**	15L
2.1.1	Size, shape, number and position	
2.1.2	Ultrastructure of nuclear membrane and pore complex	
2.1.3	Nucleolus: general organization, chemical composition and functions	
2.1.4	Nuclear sap/ nuclear matrix, nuclear transports	
2.1.5	Nucleo-cytoplasmic interactions	
III	**Cell Division, Cell cycle and Its Check Points**	15 L
3.1.1	Cell division: Mitosis, Meiosis and various phases of cell cycle.	
3.1.1	Regulation of the cell division cycle	
3.1.3	Regulation of DNA replication	
3.1.4	Regulation of Mitosis and Meiosis	
3.1.5	Role of centriole in the cell division	
3.1.6	Role of various cycle-CDK complexes in the transition of various checkpoint of cell cycle. Role of ubiquitin-protein ligase –SCF and	

	APC/C in the control of cell cycle.	
IV	**Protein Sorting and Targeting**	15 L
4.1.1	Introduction and Historical background	
4.1.2	Protein translocation across ER- membrane, SRP. Modification and quality control of protein in ER	
4.1.3	Golgi vesicular traffic, Protein import in mitochondria, peroxisomes, chloroplasts	
4.2	Signal for Import and Export of Macromolecules from Nucleus	
4.2.1	Glycosylation in mammalian cells, origin, nature and types of Glycosylation. Role of Glycosylation in protein stability and folding with reference to ER exit.	

CELL BIOLOGY-II Practical II Credits: 2 (50M)
Course Code: **BPSZOOCBP3**

1.	Isolation of Mitochondria from cells
2.	Study of detection of mitochondria by Janus Green B
3.	Detection of DNA and RNA by Methyl Green Pyronin staining
4.	Detection of DNA by Feulgen reaction
5.	Detection of proteins by mercuric bromo-phenol blue staining
6.	Study of permanent slides of mitosis & meiosis
7.	Study of temporary preparation of different mitotic stages from onion root tip cells
8.	To study the effect of colchicine on mitosis
9.	Study of mitotic index.
10	Study of temporary preparation of different meiotic stages from grasshopper/ Tradescantia / Onion floral bud
11	Spectrophotometry: Principle, working and applications Cell Growth/ Growth curves
12	Study of electron micrographs of mitochondria, nucleus and nuclear membrane
13	Cell cycle analysis using FACS/FCM.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. -II Semester-III
Skeleton Question paper Practical-II: Course Code: **BPSZOOCBP3**

Duration: 5hrs Marks: 50

Q. 1	Detect DNA and RNA using Janus Green B stain/ Methyl Green Pyronin satin	10
	OR	
Q.1.	Detect DNA using Feulgen reaction.	10
	OR	
Q.1	Detection of proteins by mercuric bromo-phenol blue staining	10
Q.2	Study the cell growth and plot the growth curve for the cells provided (yeast/bacteria)	10
	OR	
Q.2	Prepare a temporary slide to demonstrate meiosis and draw the diagram.	10
Q.3	Make a squash preparation of onion root tip and make a temporary slide to demonstrate mitosis.	05
	OR	
Q.3	Demonstrate the effect of colchicine on mitosis using onion root tips and compare it with the slide of untreated sample provided.	05
	OR	
Q.3	Calculate mitotic index for the colchicine treated and untreated onion roots tips	05
Q.4	Study the cell cycle using Florescence Activated Cell Sorting.	06
Q.4	Isolate or separate mitochondria from given cells.	06
Q.5	Identify (a to c): a- Mitochondria/Nucleus/Nuclear Membrane b- one of the stages of mitosis, c- one of the stages of meiosis.	09
Q. 6	Viva-voce	05
Q. 7	Journal	05

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

M.Sc. Zoology: Specialization: CELL BIOLOGY

Semester-III

Paper: III Course Code: BPSZOOCB303

Title: Cytogenetics-I Credits: 4(100M)

Learning objectives: *Cytogenetics mainly deals with the study of gross structural features and anomalies of nucleic material. The paper mainly deals with structure of chromosomes, mutation, governing principles of cell division etc. the objective here is to make the students aware of gross structure and role of these material.*

Course outcome:

1. *Students will acquire the knowledge on chemical and physical structure of chromosome and learn about the special chromosomes. Students will also learn about the dosage compensation due to X chromosome inactivation.*
2. *Students will understand the underlying mechanism and role of various structures present in the nucleus in cell division.*
3. Students will learn more about the central dogma, transcription and translation both in prokaryotes and eukaryotes and learn to differentiate between them. They will also learn about the post transcriptional and translational changes.
4. Students will understand the cause and effects of mutations in human DNA. They will also learn about the types of mutations, molecular mechanisms governing the mutation and the methods to detect them.

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
I	**History and Principles of Cytogenetics**	15 L
1.1	Nucleus - Internal organization, Nuclear pore complex, Nucleosomes. Euchromatin and heterochromatin.(Facultative and constitutive heterochromatin)	
1.1.1	Structure and functions of chromosomes chemical composition, telomeres, centromeres and kinetochores, nucleolar organizers, chromomeres.	
1.1.2	Variations in chromosome structure: The origin and adaptive significance of duplications, deletions, inversions, and translocations, iso-chromosomes, ring chromosomes, centric fusions and fissions.	
1.1.3	Endomitosis and Polyteny- Lampbrush chromosomes and polytene chromosomes	
1.1.4	Sex chromosomes, X chromosome inactivation- Lyon hypothesis-Barr body and mosaicism	
II	**Molecular mechanism of Mitosis and Meiosis**	15 L
2.1	Molecular mechanism of cell division: Amitosis, Endomitosis and Mitosis	

2.2	Ultrastructure and organization of centrosome, centromere, Kinetochore, genetic control of meiosis.	
2.3	Microtubules and their dynamic instability, Microtubule Associated proteins, Anaphasic movements, Cytokinesis	
2.4	Non-disjunction Changes in chromosome number - aneuploidy in animals, their origins, cytogenetic effects	
III	**Central Dogma**	15L
3.1	Structure, Types and Functions of DNA and RNA	
3.2	Genetic Code and its features	
3.3	Transcription and Translation in Prokaryotes	
3.4	Transcription and Translation in Eukaryotes	
3.5	Post Transcriptional and Translational modification	
IV	**Mutations and Instability of Human DNA**	15L
4.1	Types of mutations (Spontaneous, Induced, Base substitutions and frameshifts- Transitions, Transversions, gain in function, loss in function, Neutral mutations)	
4.1.1	Molecular mechanism of mutations (Base analogs, alkylating agents)	
4.1.2	Detection of mutations : Dominant lethal test, Sex-linked recessive lethal test, II-III translocations, Ames test, P-mediated mutagenesis	
4.1.3	Cytogenetic effects of ionizing and nonionizing radiations	

Cytogenetics-I Practical III Credits: 2(50M)
Code: Course Code: **BPSZOOCBP3**

1.	Study of stages of mitosis and meiotic chromosomes of grass hopper by observation of permanent slides and calculation of chiasmata frequency
2.	Study of morphology of *Drosophila melanogaster*
3.	Study of mutants of *Drosophila melanogaster*
4.	Preparation of polytene chromosomes of *Drosophila melanogaster* / chironomous larvae
5.	Preparation of genital plate of *D. melanogaster*
6.	Study of Barr body using buccal smear
7.	Study of eye pigmentation in Drosophila mutants by TLC
8.	Effects of Para-diclorobenzene as mutagen on chromosomes.
9.	Comet assay- for DNA strand breaking
10.	Micronuclei assay - for mutations due to toxins
11.	Identification of mutations- from photographs/slides
12.	Extraction of Genomic DNA from *E. coli* and Drosophila.
13.	Separation of DNA by Agarose Gel Electrophoresis
14.	Study of conventions of nomenclature of genes and gene products in different modelsystems
15.	Problems - Central Dogma

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc.-II Semester-III
Skeleton Question paper Practical-III Course Code: **BPSZOOCBP3**

Duration: 5hrs Marks: 50

Q. 1	Extract genomic DNA and perform the test for its confirmation from E. coli or Drosophila.	12
	OR	
Q.1.	Separate the genomic DNA of bacteria from Plasmid DNA using Agarose Gel Electrophoresis.	12
	OR	
Q.1	Perform TLC for the separation of eye pigments of normal drosophila from mutants.	12
	OR	
Q. 1	Make a temporary mounting polytene chromosome from the material provided.	12
Q.2	Demonstrate the effects of Para-diclorobenzene as mutagen on chromosomes.	10
	OR	
Q.2	Perform the Comet Assay to demonstrate the brakes in DNA	10
	OR	
Q.2	Perform Micronuclei assay to demonstrate mutations due to given toxins	10
Q. 3	Make a temporary mounting of bar body using your won buccal smear and draw the diagram.	06
	OR	
Q. 3	Calculate Chiasma frequency for mitotic or meiotic chromosomes of grasshopper using the permanent slides provided.	06
Q. 4	Compare the two drosophila (Live specimen / Photograph) and identify which is normal and which is a mutant form. Give justification	06
	OR	
Q.4	Identify and describe the types of mutations from the photographs provided.	06
	OR	
Q.4	Identify the gene from the given abbreviation/ Write the abbreviation/ write the meanings of the given symbols used in gene nomenclature/ Write the symbols for the following.	06
Q.5	Solve the given problems (Two problems based on central dogma)	06
Q. 6	Viva	05
Q. 7	Journal	05

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

M.Sc. Zoology: Specialization: CELL BIOLOGY

Semester-III

Paper: IV Course Code: BPSZOOCB304

Title: Cytogenetics–II Credits: 4 (100M)

Learning objectives: *The paper deals with the chromosomal anomalies, banding techniques, and crossing over and gene identification methods. The objective behind prescribing this paper is to impart the knowledge to the students on structural and numerical chromosomal abnormalities and genetic disorders caused and to help identifying the underlying principles of genetic variations which are caused by linkages and crossing over.*

Course outcome:

1. *Students will understand different types of linkages and crossing over molecular mechanism of crossing over and the factors affecting the crossing over and its importance in genetic variations. Students will also learn to construct and interpret the linkage maps.*
2. *Students will learn different techniques involved in chromosomal studies. They will gain the knowledge of the most recent techniques such as SKY.*
3. *Students will learn to locate the probable position of genes with help of banding techniques. They will learn the skill chromosomal banding in the laboratory.*
4. *Students will learn the most recent techniques to identify the genes and their applications.*

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
I	**Linkage and Crossing over**	15 L
1.1.1	Types of linkages, Linkage and construction of genetic maps: Cytogenetic and link-age maps, Two and three point cross in Drosophila, RFLP mapping	
1.1.2	Crossing over.	
1.1.3	Molecular mechanism of crossing over	
1.1.4	Chromosomal evidence of crossing over	
1.1.5	Environmental and genetic factors which affect the frequency of crossing over	
1.1.6	Crossing over with translocations/inversions, recombination and its effect during reproduction	
II	**Methods of Analyzing Chromosome**	15 L
2.1	Karyotype Analysis and Nomenclature	
2.2	Preparation of slides for Karyotype	
2.3	Karyotype Analysis of autosomal and sex chromosomal abnormalities	
2.4	Manual identification of GTG bands, Identification using computerized image analyzer	

2.5	Spectral Karyotyping – SKY	
III	**Banding Techniques :Visualization and Identification of chromosomes**	15 L
3.1	Methods of Chromosome Banding	
3.2	C - Banding, G-banding , Q - banding, R– Banding, M-Banding	
3.3	Banding Patterns and its significance	
IV	**Approaches for Gene Identification**	15L
4.1	Functional cloning	
4.2	Positional cloning	
4.3	Position independent candidate gene approach	
4.4	Position dependent candidate gene approach	
4.5	Epigenetic signatures	
4.6	Transcriptome analysis	

Cytogenetics-II- Practical IV Credits: 2 (50M)
Course Code: **BPSZOOCBP3**

1	Metaphase chromosome preparations from bone marrow of mouse/ rat/ human/Goat/Chicken
2	Chromosome preparation from lymphocyte culture
3	Preparation of metaphase chromosomal spread of 3rd instar larvae of *Drosophila* (from ganglion)
4	G-banding, C-banding, R-banding from metaphase chromosomal spread of Mouse/Goat/Chicken.
5.	Karyotyping of cells, preparation of slides and microphotographs
6.	Effect of mitogen induction on lymphocytes
7.	Identification of abnormality from the given karyotype/ slides
8.	Sister Chromatid Exchange (SCE) assay - for genotoxicity
9.	Chromosome preparation from chorionic villi, stem cells, cell lines (Clinic/institutes)
10	Identification: Approaches for gene identification
11	Identification: Spectral Karyotyping (SKY)
12	Construction of Linkage maps

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc-II Semester-III
Skeleton Question paper Practical-IV: Course Code: **BPSZOOCBP3**

Duration: 5hrs Marks: 50

Q.1.	Demonstrate metaphase chromosome preparation from the given bone marrow	12
	OR	
Q.1	Demonstrate the metaphase chromosome preparation from third instar stage of drosophila.	12
	OR	
Q.1.	Prepare the slide for karyotype analysis from the given cell culture.	12
	OR	
Q.1	Prepare chromosome spread from the lymphocyte culture.	12
Q. 2	Demonstrate G-banding/C-banding, R-banding from metaphase chromosomal spread of Mouse/Goat/Chicken.	08
	OR	
Q.2	Chromosome preparation from chorionic villi, stem cells, cell lines (Clinic/institutes)	08
Q.3	Demonstrate the effect of mitogen induction on lymphocytes	07
	OR	
Q.3	Perform Sister Chromatid Exchange (SCE) assay to demonstrate genotoxicity.	07
Q.4	Compare the SKY karyotype type with normal but conventional karyotype and find the chromosomal abnormalities.	06
	OR	
Q.4	Prepare the ideogram from SKY karyotype by identifying the pairs of homologous chromosomes.	06
	OR	
Q.4	Identify the genes from given map and describe	06
Q. 5	Construct the linkage map from the recombination frequency table provided.	07
	OR	
Q.5	Calculate the distance between the genes from the data set provided for two point cross/three point cross	07
Q. 6	Viva-voce	05
Q. 7	Journal	05

B. K. Birla College (Autonomous), Kalyan
DEPARTMENT OF ZOOLOGY
M.Sc. Zoology
Specialization: CELL BIOLOGY
Syllabus

Semester –IV			
Paper Number	**Title of the Paper**	**Course Code**	**Credits**
Paper I	**Cell Biology-III**	**BPSZOOCB401**	04
I	Cell Signaling - Signal Transduction - I	**(100M)**	
II	Cell Signaling - Signal Transduction - II		
III	Cancer Cell Biology		
IV	Stem Cell Biology		
Practical I		**BPSZOOCBP4 (50M)**	02
Paper II	**Clinical Cytogenetics**	**BPSZOOCB402**	04
I	Genetic Disorders -I	**(100M)**	
II	Genetic Disorders –II		
III	Prenatal Tests		
IV	Genetic Counseling		
Practical II		**BPSZOOCBP4 (50M)**	02
Paper III	**Tools and Techniques in Cell Biology and Cytogenetics**	**BPSZOOCB403**	04
I	Techniques used in Cell Biology and Cytogenetics – I	**(100M)**	
II	Techniques used in Cell Biology and Cytogenetics – II		
III	Mapping of Chromosomes		
IV	Cell Culture Techniques and Visualization of Cells		
Practical III		**BPSZOOCBP4 (50M)**	02
Paper IV	**Research Based Project**	**BPSZOOCB404 (150M)**	06

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

M.Sc. Zoology: Specialization: CELL BIOLOGY

Semester-IV

Paper: I Course Code: BPSZOOCB401

Title: Cell Biology–III Credits: 4(100M)

Learning objective: *Membrane receptors play very important role in Signaling, facilitating and even blocking the transportation across the membrane. Having the knowledge of this process is desirable in advance branches of biology such drug designing, vaccine production, cancer treatment and even stem cell research. All these branches are incorporated in this paper having an objective of preparing students for developing skills in these topics because these topics are sure to provide solutions to several unsolved problems in the fields of medicine.*

Course outcome:

1. *Students will understand role of receptors and signal molecules involved in signal transduction.*
2. *Students will also understand the pathways of intra and inter cellular signal transduction*
3. *Students will learn the safety methods essential in laboratory dealing with cancerous tissues and cells. They will also learn to identify the cancers cells based on the structure of the tissue and the biochemical markers expressed by the tissue.*
4. Students will learn about the types, structure, methods of identification and culturing of stem cells. They will also understand the applications of stem cells.

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
I	**Cell Signaling - Signal Transduction - I**	15 L
1.1.1	Receptors involved in Signal Transduction; Introduction	
1.1.2	G protein-coupled receptor	
1.1.3	Receptor Tyrosine Kinases and MAP Kinase	
1.1.4	Cytokine receptors	
1.1.5	Integrins and Survival Signals	
1.1.6	Signal molecules, signal amplification	
II	**Cell Signaling - Signal Transduction - II**	15L
2.1.1	Cell to Cell signaling	
2.1.2	Hormones and Receptors	
2.1.3	Pathways of Intracellular Signal Transduction	
2.1.4	Quorum sensing	
2.1.5	Intracellular signaling in Development and Disease	
III	**Cancer Cell Biology**	15 L
3.1.1	Quality management system and laboratory safety	

3.1.2	Basic principle bone marrow culture and cell count	
3.1.3	Specimen collection and processing	
3.1.4	Phenotypic Characters, Theories/ hypothesis regarding causes of cancer	
3.1.5	Extrinsic and Intrinsic causes of Cancer: Physical. Chemical and biological agents (viruses) as extrinsic factors and Somatic mutations as intrinsic factors.	
3.1.6	Proto-oncogene, Oncogene, Tumor suppressor genes and Oncogenesis and aging related phenomenon	
3.1.7	Cancer Cell markers	
3.1.8	Cytogenetic abnormalities in leukemia, lymphomas and in solid tumors	
IV	**Stem Cell Biology**	15L
4.1.1	Stem Cells : introduction and Types	
4.1.2	Stem cells Research - An overview	
4.1.3	Stem Cell markers	
4.1.4	Identification of stem cells- Methods	
4.1.5	Culturing of Stem cells and Applications of Stem Cells	

CELL BIOLOGY-III- Practical I Credits: 2 (50M)
Code: **BPSZOOCBP4**

1	Study of cell receptors, structure and function of G-Protein coupled receptors, Cytokine receptors and tyrosine kinases receptors
2	Analysis of Pathways- JAK and STAT
3.	Monitoring cell death by LDH assay
4.	Apoptosis assays- Kinase assay, Ubiquitination assay
5.	Antioxidant assays- DPPH /ABTS/ FRAP/ FOX/ FTC/ ACA(any two)
6.	Ascorbic acid estimation from the given tissue.
7.	Identification of apoptosis, Senescent cells, autophagy and necrosis from slides/photographs
8.	Study of human Dental Pulp/Umbilical cord/ amniotic fluid and stem cells.
9.	Identification of cell types from bone marrow (Goat)
10	Study of nude rat as a popular animal model in cancer treatment
11	Identification of types of leukemia cells, lymphoma, myeloma etc.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc.-II Semester-IV
Skeleton Question paper Practical-I (Code: **BPSZOOCBP4**)

Duration: 5hrs Marks: 50

Q.1	Perform Antioxidant assays for DPPH /ABTS/ FRAP/ FOX/ FTC/ ACA (any two) from given tissue samples.	12
	OR	
Q.1	Estimate the amount of ascorbic acid from the given tissue and comment on its antioxidant status	12
Q.2	Perform Kinase assay/Ubiquitination assay to demonstrate apoptosis	08
	OR	
Q.2	Perform LDH assay to demonstrate cell death.	08
	OR	
Q.2	Make a temporary slide and identify the cell types from the given bone marrow	08
Q.3	Study the given chart, identify the receptors and comment on its structure and function (of G-Protein coupled receptors/Cytokine receptors/ tyrosine kinases receptors)	06
	OR	
Q.3	Complete the given pathway and write its significance (JAK and STAT)	06
Q.4	Identify the given tissue, its cells and comment on their function. (Study of human Dental Pulp/Umbilical cord/ amniotic fluid and stem cells).	05
Q.5	Identify and describe (any three): apoptosis, Senescent cells, autophagy, necrosis and nude mouse	09
Q.6	Viva	05
Q.7	Journal	05

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

M.Sc. Zoology: Specialization: CELL BIOLOGY

Semester-IV

Paper: II Course Code**: BPSZOOCB402**

Title: **Clinical Cytogenetics Credits: 4 (100M)**

Learning objective: *Genetic disorders are expressed congenitally or around puberty or any time during the life time of the person if the person is genetically predisposed. It is necessary to understand the reasons behind these disorders, their diagnostic methods and methods of counseling to the victim. The objectives behind the units here are to make students learn the reasons and understand principals behind the disorders*

Course outcome:

1. *Students will learn about the types of genetic disorders, causes, symptoms and diagnostic tests.*
2. *Students will learn more about the common genetic disorders, population screening and management.*
3. Students will learn about the different types of prenatal tests to diagnose the genetic disorders and learn to interpret the reports.
4. Students will learn to prepare and interpret the pedigree charts. They will also learn to provide genetic counselling to the people.

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
I	**Genetic Disorders –I**	15 L
1.1	Introduction - Classification of genetic disorders	
1.1.1	Single gene Disorders (Cystic Fibrosis, Marfan's syndrome)	
1.1.2	Multifactorial disorders (Diabetes, Atherosclerosis, Schizophrenia)	
1.1.3	Chromosome Breakage and Instability Syndromes	
1.1.4	Epigenetic mechanisms and Genomic Imprinting disorders	
1.1.5	Chromosomal disorders	
1.1.6	Chromosomal abnormalities in cancer	
1.2	Genetic testing	
1.2.1	Methods of genetic testing	
1.2.2	Newborn Screening, Diagnostic testing, Carrier testing, Prenatal testing, Preimplantation testing, Predictive and Pre-symptomatic testing, Forensic testing	
II	**Genetic Disorders –II**	15 L
2.1	Thalassemia, Fanconi anemia, Sickle Cell anemia, Fragile-X syndrome, Alzheimer's disease	
2.2	Duchenne Muscular Dystrophy/Becker's Muscular Dystrophy, Huntington's disease	
2.3	Allelic susceptibility test for multifactorial disorders - Neural Tube	

	Defect, Cleft Lip and Palate, Cardio Vascular Disorder, Male infertility	
2.4	Population screening for genetic disorders	
2.5	Treatment and management of genetic disorders	
III	**Prenatal Tests**	15 L
3.1	Noninvasive Pre-natal Tests	
3.1.1	Triple test, Ultrasonography (USG), cf DNA testing	
3.2	Invasive Pre-natal Tests	
3.2.1	Amniocentesis (AC), Chorionic villi sampling (CVS), Fetal blood sampling(FBS)	
IV	**Genetic Counseling**	15 L
4.1	Introduction and scope of Genetic counseling	
4.2	Genetic Counseling- Processes	
4.3	Genetic testing. - carrier testing, pre-natal testing, pre- implantation testing	
4.4	Pedigree analysis: Symbols and preparation of pedigree chart for autosomal; and sex linked dominant and recessive traits, Problems in pedigreeRole of RFLP in pedigree analysis	

Clinical Cytogenetics- Practical II Credits: 2 (50M)

Code: **BPSZOOCBP4**

1.	Identification and symptoms of single gene disorders
2.	Identification and symptoms of Multifactorial disorders (Diabetes, Atherosclerosis, Schizophrenia)
3.	Identification and symptoms of chromosome breakage and instability syndromes
4.	Cause, inheritance, symptoms and diagnosis - of Thalassemia, Fanconi anemia, Sickle Cell anemia, Fragile-X syndrome, Alzheimer's disease, Cystic fibrosis.
5.	Cause, inheritance, symptoms and diagnosis - of Duchenne Muscular Dystrophy/ Becker's Muscular Dystrophy, Huntington's disease
6.	Principle and procedures of Prenatal tests - non invasive
7.	Cell free DNA testing- cfDNA
8.	Principle and procedures of Prenatal tests – invasive
9.	Use of sonography in detection of genetic disorders.
10.	Concept of genetic disorder databases and demonstration of use of OMIM.
11.	Symbols and Preparation of human pedigree charts
12.	Construction of Pedigree Chart for autosomal and sex - linked dominant and recessive inheritance in humans.
13.	Problems based on Pedigree
14.	Genetic counseling – Case study.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc.-II Semester-IV
Skeleton Question paper Practical-II (Code: **BPSZOOCBP4**)
Duration: 5hrs Marks: 50

Q.1	Identify the type of disorder from the chart provided and describe (any two)	10
	OR	
Q.1	Construct the pedigree chart based on the case study provided (Any two)	10
	OR	
Q.1	Find out the symptoms, occurrence and describe the given genetic disorder using OMIM.	10
Q.2	Identify and describe the symptoms of the given gene disorder and find the sequence of the gene involved from NCBI	07
Q.2	Identify and describe the symptoms of the given genetic disorder , find out the factors involved form NCBI	07
Q.3	Identify the procedure of parental test form the given picture (Noninvasive, Invasive-Amniocentesis/Chorionic villi) write its principle and describe the procedure	05
	OR	
Q.3	Write the principle and procedure of Cell free DNA testing- cfDNA	05
Q.4	Draw the pedigree symbols for the given description (any three) and Write the meaning of given pedigree symbols (any three)	06
	OR	
Q.4	For the given case study write the details of the counselling you would provide.	06
Q.5	Identify and describe (any four): chromosome breakage and instability syndromes, Thalassemia, Fanconi anemia, Sickle Cell anemia, Fragile-X syndrome, Alzheimer's disease, Cystic fibrosis, Duchenne Muscular Dystrophy/Becker's Muscular Dystrophy, Huntington's disease, sonogram of the foetus having genetic disorder.	12
Q.6	Viva	05
Q.7	Journal	05

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

M.Sc. Zoology: Specialization: CELL BIOLOGY

Semester-IV

Paper: III Course Code**: BPSZOOCB403 Credits: 4 (100M)**

Title: **Tools and Techniques in Cell Biology and Cytogenetics**

Learning objective: *This paper mainly includes all the technical and most recent aspects of cell biology and cytogenetics. The objective behind the paper is to introduce the recent technology to the students.*

Course outcome:

1. Students will learn the recent techniques used in the study of cell biology and cytogenetics like DNA amplification, DNA sequencing and Flow Cytometry.
2. Students will further understand other techniques including FISH, Prenatal diagnostic and genomic hybridization.
3. Students will learn different techniques of chromosomal mapping.
4. Students will understand basic techniques in cell culture, maintenance of cell lines and visualization of cells.

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
I	**Techniques used in Cell Biology and Cytogenetics – I**	15 L
1.1	DNA amplification -Polymerase Chain Reactors - Working Principle, Methodology andtypes of PCR	
1.2	DNA Sequencing- Sangers dideoxy chain termination, Maxam and Gilbert Method, NGS (New Generation Sequencing).	
1.3	Flow Cytometry- Working principle - Uses and Application	
1.3.1	DNA content analysis	
1.3.2	Immunophenotyping	
1.3.3	Cell sorting - RBC, WBC, Platelets, Cancer cell	
1.3.4	Apoptosis Analysis	
1.3.5	Intracellular Calcium Flux	
II	**Techniques used in Cell Biology and Cytogenetics - II**	15 L
2.1	Fluorescence Microscope- Working principle (different filters)	
2.2	Florescence - in- situ - hybridization- FISH - Principle and working	
2.3	Types of FISH,- multiplex FISH	
2.4	Types of FISH probes (Locus specific, probes centromeric repeat probes) and application of FISH	
2.4.1	Detection of congenital diseases	
2.4.2	Pre-natal diagnosis of chromosome abnormality	
2.4.3	Detection of Copy Number Variants (CNV) in adults	
2.4.4	Detection of Cancer and Infectious diseases	
2. 5	Comparative Genomic Hybridization (CGH)	
2.5.1	Principle and Methods of CGH	

2.5.2	Advances in CGH- Array CG	
2.6	Working principle and application in cytogenetic microarray/SNP array, Its application in prenatal, postnatal and cancer genetics.	
III	**Mapping of Chromosomes**	15 L
3.1	Low resolution mapping	
3.1.1	Sub- chromosomal mapping	
3.1.2	Chromosomal break points	
3.1.3	Cytogenetic methods	
3.1.4	Somatic cell hybrid mapping	
3.1.5	Radiation hybrid mapping	
3.2	High resolution mapping	
3.2.1	DNA FIBRE FISH	
3.2.2	Restriction mapping	
3.2.3	VNTR microsatellite markers for mapping	
3.2.4	EST, STS and SNP mapping	
3.2.5	Conserved region mapping: IRE, CpG site mapping, Promoter site recognition	
3.2.6	Mapping for single gene disorders	
3.2.7	Mapping for complex genetic disorders	
IV	**Cell Culture Techniques and Visualization of Cells**	15 L
4.1	Aseptic Techniques	
4.2	Use of Laminar flow hood	
4.3	Culture media	
4.3.1	Constituents, types and sterilization of culture media	
4.3.2	Culturing of blood cells, fibroblast cells. Bone marrow cells	
4.3.3	Feeder Cells	
4.3.4	Maintenance of cell lines	
4.4	Cell Visualization	
4.4.1	Phase contrast microscope - Working Principle and uses	
4.4.2	Confocal Microscope - Working Principle and uses	

Tools and Techniques in Cell Biology and Cytogenetics: Practical III Credits: 2 (50M)
Code: BPSZOOCBP4

1.	DNA extraction and Polymerase chain reaction (PCR) Principles, Explanation, Demonstration
2.	Detection of mutation using ARMS-PCR (e.g.; Thalassemia) and microsatellite markers (e.g. fragile-X syndrome)
3.	Molecular markers for tumor detection: Bcr-abl (RT-PCR) BRCA1 (PCR) Her2new (FISH)
4.	cDNA preparation and RT-PCR
5.	*In- silico* design of PCR primers for a gene of interest
6.	Extraction of DNA from plasmid and restriction enzyme mapping of plasmidDNA
7.	Construction of Chromosome maps
8.	Study of restriction maps of cloning vectors (pBR 322, YAC, M13 etc.), Problems based on restriction digestion.
9.	DNA sequencing (demonstration)
10	Preparation of Culture media
11	Culturing of blood cells, fibroblast cells. Bone marrow cells
12	Trypsinization of spleen / Liver tissue and viability cell count.
13	Preparation of mouse embryonic fibroblasts,Cytotoxicity assay - MTT assay, Cell viability assays, Cell proliferation assay, Migration assay, Invasion assay, Soft agar assay, Apoptosis assays, Kinase assay, Protein and mRNA turnover assays, Cell staining techniques
14	Five days visit to Cytogenetic laboratories/ Molecular Biology laboratories (TIFR/BARC/TATA Memorial/ACTRAC/IIT Mumbai/Jaslok Hospital etc.).

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Department of Zoology
M.Sc.-II Semester-IV
Skeleton Question paper Practical-III (Code: **BPSZOOCBP4**)

Duration: 5hrs Marks: 50

Q.1	Extract Plasmid DNA from the given cells and find its molecular weight using standard DNA with the help of AGE.	10
Q.1	Demonstrate restriction digestion of the given plasmid, separate the fragments using AGE and construct the restriction map	10
Q.2	Prepare the culture media from the given components and demonstrate its effect on cell growth.	08
Q.2	Culture the blood cells/fibroblast cell/bone marrow cells	08
Q.2	Trypsinize the given tissue and take the viability cell count	08
Q.3	Demonstrate mouse embryonic fibroblasts preparation/ Cytotoxicity assay - MTT assay/ Cell viability assays/ Cell proliferation assay/Migration assay, Invasion assay/ Soft agar assay/ Protein and mRNA turnover assays/Cell staining techniques	05
	OR	05
Q.3	Design PCR primers for a given gene *In- silico*.	05
	OR	
Q.3	Write the principle and procedure for preparation of C-DNA using RT-PCR method and convert the given strand of m-RNA into C-DNA	05
Q.4	Problems based on restriction digestion (Two)	06
Q.5	Identify and describe (a and b) : a- Molecular markers for tumor detection Bcr-abl (RT-PCR)/BRCA1 (PCR)/Her2new (FISH), b- Restriction maps of cloning vectors	06
Q.6	Visit Report	05
Q.7	Viva	05
Q.8	Journal	05

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

M.Sc. Zoology: Specialization: CELL BIOLOGY

Semester-IV

Paper: IV Course Code: BPSZOOCB404

Title: Research Based Project Credits: 6 (150M)

Learning objective: A research based project is introduced in the syllabus in semester 4 for 150 marks (Credit 4+1) with an objective of giving a flavor of research to the students. It would help them apply the analytical skills and research methodologies they have learnt in their earlier class. The project would initiate them in research and help them understand the biological processes which they learn in the theory units.

Project outcome: It is expected that the students would learn to apply the methodical and analytical techniques not only in research but in every aspect of their professional and personal life. A worthwhile research publication is also expected from the students under the guidance of their mentors. It is also expected that some of the students may develop national and international contacts which would help them in research career ahead.

Guideline to conduct the project.

1. The research project shall be designed by the student in consultation with the mentor assigned to the student.
2. Research project to be accomplished is an individual activity and not a group venture.
3. Any competent person with relevant qualifications and research experience can be chosen by the student or requested to be assigned from head of the department of Zoology, B.K. Birla College, Kalyan.
4. A mentor can be a faculty from Department of Zoology, B.K. Birla College, Kalyan/ one of the Science departments of B.K. Birla College, Kalyan/ an outsider from other renowned degree colleges affiliated to University of Mumbai/ Research personals from Industries/ Research personals from research institutions of high repute.
5. The Mentor should be from the jurisdiction of Thane district, Mumbai and Mumbai Suburban. It is suggested that the mentors from outside of the mentioned region be avoided as it is likely to cause inconvenience in communication and completion of research work.
6. Maximum six students inclusive of both fields of specialization not more than three in any one specialization are allowed less than one guide.
7. If selected by the student, name of the mentor and his/her professional credentials should be submitted to the head of the department and get approved before starting of research work.
8. Acceptance letter from the mentor should be submitted in the prescribed format provided by the department.

9. If the mentor is not form B. K. Birla College, Kalyan then a permission letter must be submitted by the students duly signed by the parents/ local guardian of the student in the format prescribed by the department.
10. If the travel is involved in the research project for any purpose such as collection of data, reference papers, attending the conferences/ symposia/ paper presentations etc., a prior written request from the student duly singed by the mentor and the parents/local guardian should be compulsorily submitted to the department. Failing in submission of such a letter would be liable for disciplinary action.
11. Preparation of the research project such as collection of the reference papers, secondary data, setting of the objectives etc. can be started when the student enters M.Sc. Part -1 class. The actual or the physical work of the research should be started only after third semester ends.
12. No project can commence before being approved by the research committee of the department/college.
13. The topics for the research should be compulsorily selected from the field of specialization the student has opted for. Any topic from allied branches should be properly correlated to the field of specialization with justification.
14. No monitory help of any nature shall be provided by the department or the College for completion of the project.
15. Special leave will not be granted for completion of the project.
16. A disciplinary action will be taken if the students are found guilty of absentia from theory or practical classes under the pretext of completion of the research project.
17. Students are fully restrained form coming to the Zoology laboratory / College for research project completion on any Sundays and public holidays.
18. Students are not allowed to stay back in the laboratory for completion of the project after working hours of the college.
19. Use of departmental chemicals, instruments, stationary, printing facilities and any other consumable is allowed only after submission of requisition form to the head of the department duly signed by the student and the mentor.
20. It is compulsory that the project should completed at least by the end of February and a pre-submission LCD presentation and short synopsis should submitted to the panel of experts in first week of March or date decided by the department.
21. Aims and objectives of the project, Abstract, Introduction, Literature Review, Materials and methodology, Results and Observations, Discussion, conclusion and bibliography (Webliography if applicable) are the compulsory components of the project report.
22. Tables and graphs should be made using Microsoft excel and data should be interpreted using biostatistical tools only.
23. Photograph courtesy should be acknowledged if any photograph from external sources is used. Other Instructions for writing the project report would be provided at appropriate time.

24. It is compulsory to submit a hard bound copy of the Project report to the department along with the soft copy for the college website.
25. If any data from the project is published, it should be informed and a copy of the published work should be submitted to the department.
26. Project shall be assessed by the external examiner as single authority or along with an internal examiner.
27. Credits (4+1) for the project will be added only in the mark sheet of semester-4 and consolidated mark sheet.

References:

Cell Biology

1. Cell and molecular biology, 1988, De Robertis EDP and De Robertis EME, Molt Saunders Inc
2. Cell biology, 1986, C. B. Powar, Himalaya Publi. House.
3. Cell and molecular biology, 1968, Dupraw I, Academic Press New York
4. Cell biology, 1986, Avers C.J. Addison Wesley Puub. Co. New York & London
5. Cell and molecular biology, 1996, G.Carp John Waley,USA
6. Cell biology, 1993, David E. Sadava Johnes and Bartlett Publi. London.
7. Cell Structure and Function, 1991, 3rd edn, A.G. Lowey & Siekevitz, J.R. Menninger &J.A.N. Gallew, Saunder college Publi. Philadelphia
8. The Cell, A Molecular Approach – 6th Edition – Geoffrey M.Cooper/Robert .Hausman Sinauer Associates, Inc.
9. Molecular Biology of the Cell - 5th Edition - Bruce Alberts et al - Garland Science
10. Molecular Cell Biology - 7th Edition - Harvey Lodish, Arnold Berk & Chris A. KaiseW.H. Freeman
11. Lewin's Cells – 2nd Edition – Cassimeris/Lingappa/Plopper – Johns & Bartlett Publishers
12. Cell Biology, A Short Course – 3rd Edition – Stephen R.Bolsover et al – John Wiley & Sons
13. Molecular Cell Biology" 5th Edition by Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris Kaiser, Monty Krieger, Matthew Scott, Lawrence Zipursky and James Darnell.W.H Freeman and Company.
14. The Cell A Molecular Approach-Cooper-Hausman 15 Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.
15. Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6th Edn, Pathfinder Publication. p.608.
16. Hardin J. and Bertoni G. (2017) Becker's World of the Cell. 9th Edn (Global Edition), Pearson Education Ltd., p. 923
17. Karp G., Iwasa J. and Masall W. (2015) Karp's Cell and Molecular Biology – Concepts and Experiments. 8th Edn. John Wiley and Sons. p.832.
18. Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) Campbell Biology in Focus. Pearson Education. p.1080.
19. Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P.(2018)
20. Essential Cell Biology 5th Edn., (paperback) W.W. Norton & Company p.864. Cooper G.M. and Hausman R.E. (2016)
21. The Cell – A Molecular Approach, 7th Edn., Sinauer Associates Inc., p.832. , 22 Mason K.A., Losos J.B. and Singer S.R. (2011)
22. Raven and Johnson's Biology. 9th Edn. Mc Graw Hill publications. p.1406. 23 Alberts B., Johnson B., Lewis J., Morgan D., Raff M., Roberts K. and Walter P. (2015)
23. Molecular biology of cell, 6th edn., Garland Science, Taylor and Francis, p. 1465, 24 Challoner J. (2015)
24. The Cell: A visual tour of the building block of life, The University of Chicago Press and Ivy Press Ltd., p.19325 Lodish, et al.

25. Molecular Cell Biology. 5th ed. New York, NY: W.H. Freeman and Company, 2003. ISBN: 978071674366
26. Human Molecular Genetics 4 Tom Strachan, Andrew P. Read Garland Science/Taylor& Francis Group, 27 Becker, Kleinsmith, and Hardin. (2003)
27. The World of the Cell (Fifth Edition) Benjamin Cummings: San Francisco.28 Alberts B, Bray D, Lewis J, Rabt M, Robert K and J.D.Watson. (1989)
28. Molecular Biology of Cell, II Edn. Garland Publishing Corp. Inc. London., L. Harvey, B. Arnold, Z.S. Lawrence, M. Paul, D. Baltimore, J.E. Darnell. 1999.
29. Molecular Cell Biology, W. H. Freeman & Co, New York, USA.
30. The Cell: Molecular Approach, G.M. Cooper. ASM Press, Washington, D.C. USA.2000
31. Cell Biology Protocols.J.R. Harris, J. M. Graham, D. Rickwood, J Wiley and Sons Inc.2006

Cytogenetics

1. An Introduction to Genetic Analysis, 7th edition Anthony JF Griffiths, Jeffrey H Miller,
2. David T Suzuki, Richard C Lewontin, and William M Gelbart. New York: W. H. Freeman; 2000. ISBN-10: 0-7167-3520-2
3. Genetics: A Conceptual Approach by Benjamin A Pierce (W.H. Freeman & Co. Ltd
4. 2014 ISBN-13: 9781464109461
5. Introduction to Genetics: A Molecular Approach T A Brown Edition:1st Garland Science Taylor & Francis Group ISBN: 9780815365099
6. Concepts of Genetics by William S. Klug, Michael R. Cummings, Charlotte A. Spencer
7. 2005 Benjamin-Cummings Publishing Company ISBN 0131918338 (ISBN13: 9780131918337)
8. Genetic Analysis: An Integrated Approach by Mark Frederick Sanders, John L. Bowman
9. 2014 2nd edition ISBN: 0321948904/ ISBN-13: 9780321948908
10. Drosophila: A Laboratory Handbook by Michael Ashburner Cold Spring Harbor Laboratory Press,U.S.; 2nd ed. edition ISBN-13: 978-1936113699
11. Theory and Problems of Genetics (Schaum's Outline Series) by William Stansfield Mc-Graw-Hill Book Company
12. Human Heredity: Principles and Issues. Cummings, M.R. (2009). Pacific Grove, CA:Brooks/Cole.
13. Human Genetics: A.G. Motulsky and F. Vogel (1986)
14. Human Genetics: Gardner, A. and Davies, T. (2009). Scion Publishing, 2nd ed.
15. Human Genetics: Concepts and ApplicationsLewis, R. (2008) McGraw-Hill Publishing, New York, 8th ed.
16. Human Genetics — The Basics. Lewis, R. (2011). Routledge, London
17. Genetics -A Conceptual Approach by Benjamin A. Pierce
18. Genome organization and function in the cell nucleus; edited by Karsten Rippe WileyVCH Verlag GmbH & Co. KGaA, Germany.2012.
19. Bacterial Genomics: Genome Organization and Gene Expression Tools by Aswin SaiNarain Seshasayee, Publisher: Cambridge University Press (2015) ISBN-10:1107079837.
20. Genomes. 2nd edition. Brown TA. Oxford: Wiley-Liss; 2002.
21. Organization of the Prokaryotic Genome by Robert L. Charlebois ASM Press, 1999.
22. Molecular Biology of the Cell. 4th edition by Alberts B, Johnson A, Lewis J, et al. NewYork: Garland Science; 2002

23. The Cell: A Molecular Approach. 2nd edition. by Cooper GM. Sunderland (MA):Sinauer Associates; 2000.
24. DNA Damage Repair, Repair Mechanisms and Aging by Allison E. Thomas NovaScience Publisher's, 2010.
25. Chromosomal Translocations and Genome Rearrangements in Cancer by Janet D. Rowley, Michelle M. Le Beau, Terence H. Rabbitts Springer International Publishing, 2015.
26. Molecular Cell Biology. 4th edition Lodish H, Berk A, Zipursky SL, et al.New York: W. H. Freeman; 2000.
27. Molecular Biology of the Cell: 6th Edition: by Bruce Alberts and Alexander D. Johnson publisher garland Science.
28. Human Chromosomes Authors: Orlando J. Miller &Eeva Therman 4th edition.
29. Chromosome Techniques (Third Edition) Theory and Practice Author(s): Arun KumarSharma and Archana Sharma.
30. The Cell: A Molecular Approach by Goeffrey Cooper and Robert Hausmann
31. Cell & Molecular Biology. E.D.D De Robertis & E.M.F De Robertis, Waverly publication.
32. Chromosomal Translocations and Genome Rearrangements in Cancer by Janet D. Rowley, Michelle M. Le Beau, Terence H. Rabbitts Springer International Publishing, 2015.
33. The Science of Genetics, Atherley A.G, Girton J.R and J. F. McDonald, Saunders College Publishing, Harcourt Brace College Publishers, N.Y. 1999
34. Mutation Research: Problems, Results and Perspectives, Auerbach C, Chapman and Hll Ltd. London. 1976
35. Genetics: Analysis and Principles. Brooker R. J, Benjamin/Cummings, Longman Inc.1999
36. Genetics. A molecular approach. Brown T A. and Nostrand Co. N.Y 1989
37. Genetics - The continuity of Life, Fairbanks D.J and W.R Anderson. Brooks/Cole Publishing Company, N.Y and Toranto 1999
38. Principles of Genetics. Gardner EJ, Simmons M.J and D.P.Snustad. Int. Rev. Cytol. 175:29-90. 1997
39. An introduction to genetic analysis. Griffiths A.J.F, Miller J.H, Suzuki D.T, Lewontin R.C and W.M.Gelbart. W.H.Freeman and Company, N.Y.1996s
40. Genetics: Principles and analysis. Hartle D.L and E.W.Jones. 1998s Jones and Bartlett Publishers
41. Chemical mutagens, Principles and method of their detection, vols.1- 3, Hollander A (Ed) Plenum Press, N.Y (1971-76)
42. Gene VI. Lewin B. Oxford University Press, Oxford. 1977
43. An introduction to animal cytogenetics, Macgregor H.C, Chapman and Hall, 1993
44. Somatic cell genetics and its application to Medicine.Puck T. T and F.T. Kao Ann. Rev.Genet. 16:225-272., 1982
45. Genetics. Russel P. J.The Benjamin Cummings Publishing Co Inc. 1998s
46. Principles of Genetics, Snustad D.P and M.J.Simons., John Wiley and Sons Inc. N.Y.1997
47. Genetics. Strickberger M.W., MacMillan Collier Co. Pvt Ltd. 1977

48. Molecular biology of gene. , Watson J.D, Hopkins, N.H, Roberts J.A, Steitz and A. M. Weiner. The Benjamin Cummings Publishing Co Inc.1987
49. Chromatin: structure and function. Wolfe A., Academic Press N.Y 1995
50. Molecular cloning, A Laboratory Manual Vol. I- III. (Fourth edition), M.R. Green and J.Sambrook, 2012.

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

Syllabus for M.Sc. Part-I

Program M.Sc.

Course: Zoology

Semester I and II

(With effect from 2020-21)

M.Sc.

Programme outcomes

PO	PO Description A student completing postgraduation in Science (M.Sc.) will be able to attain the following
PO1	Due to individual Research projects, research orientation and temperament will be enhanced.
PO2	Advanced Applied papers will upgrade the students' knowledge essential in the field.
PO3	Postgraduates with varied but interrelated and interdisciplinary academic background will be produced to serve as human resources. The knowledge of basic and applied/novel disciplines of the subject will aid in professional growth
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 probably solutions
PO6	Responsible execution of their roles in society as professionals, employers, and employees in various industries as regulators, researchers, educators and managers.
PO7	Life-long Learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of Subject and beyond through various Online platforms.

Program Specific Outcome:

M.Sc. Zoology with Biotechnology-Endocrinology as specialization is the unique combination offered by the Department of Zoology, B. K. Birla College. The specialization presents dual advantage of learning the applications of modern biology along with classical branch of zoology.
Students will be introduced to theoretical and practical aspects of biotechnology as well as endocrinology.
The skill acquired by the students during the two years of this program will make them proficient in their practical skills which will create better understanding among them about the related theory units.
The specialization offered also aims to empower students in creating job opportunities or to start an entrepreneur endeavor of their own. The first two semesters having common syllabus with another specialization under Zoology will prepare students for the specialization of their choice.
Learning Biotechnology will provide an insight to the students in national problems and the methods to mitigate them, such as agricultural pest management, production of fortified crop, solid waste management by the ways of biomass utilization, bioremediation for pollution control etc. Industrial applications of Biotechnology and its use in health sector such as pharmaceutical productions, vaccine productions, enzyme technology taught in the syllabus will provide multiple job opportunities to the students.
Endocrinology will deal with invertebrate and vertebrate endocrine systems and hormone biology. Detailed knowledge in Endocrinology will help students in understanding the role of endocrine disruptors in causing hormonal disorders, infertility etc. Students will be able to take the counseling as a profession in the fields of fertility-infertility clinics. Students will understand the principles behind this subject which will help them in acquiring jobs in the field of clinical endocrinology, embryology and IVF.
Continuous internal assignment is a part of the evaluation system in this program; it will maintain the continuity in teaching and learning process.
If the program is completed with zeal, enthusiasm and dedication students will be able to incept their own start up and become job providers than the job seekers.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –I Zoology Semester I

Proposed Course Code	Unit	Topics	Proposed Changes in Topics	Credits	Lectures/ Week
BPSZOO101 Essentials of Zoology-I	I	Phylogeny Systematics of non-chordates and assorted topicsI	Comparative Anatomy- I	04	1
	II	Phylogeny, systematics of non-chordates, Hemichordata& Assorted Topics	Developmental Biology –I		1
	III	Phylogeny, systematic of chordates and Assorted topics -I	Systematics, Taxonomy and Phylogeny		1
	IV	Comparative vertebrate osteology- I	Laboratory Culture of Small Organisms		1
BPSZOO102 Biochemistry and Physiology-I	I	Biomolecules-a structural and functional approach- I	Biochemistry	04	1
	II	Biochemical Thermodynamics	Bioenergetics		1
	III	Metabolic Pathways and integration of Metabolism- I	Metabolism –I		1
	IV	Regulation of metabolism	Mammalian Physiology –I		1
BPSZOO103 Modern Concepts in Zoology-I	I	Genetics–Chromosome theory of inheritance and Mendelism- I	Molecular Biology – I	04	1
	II	Genetics Extension of Mendelian Genetics and Non-Mendelian inheritance-I	Animal Cell Biotechnology		1
	III	Evolution- I	Genetics		1
	IV	Developmental Biology- I	Recombinant DNA Technology		1
BPSZOO104 Techniques and Methodologies in Zoology-I	I	Principles and applications of Microtomy, microscopy, centrifugation	Instrumentation-I	04	1
	II	Principle and applications of radioisotopes & extraction techniques	Histopathological and Biochemical Techniques		1
	III	Principles and applications of spectroscopy	Introduction to Nano-Biotechnology		1
	IV	Good laboratory practices & research methodology-I	Ecotoxicology		1

B. K. Birla College of Arts, Science and Commerce, (Autonomous), Kalyan
M.Sc. –I Zoology Semester- II

Proposed Course Code	Unit	Topics	Proposed Changes	Credits	Lectures /Week
BPSZOO201 Essentials of Zoology-II	I	Phylogeny, systematics of non-chordates and assorted topics-II	Comparative Anatomy- II	04	1
	II	Phylogeny of Protochordates, Agnatha& Assorted Topics	Developmental Biology –II		1
	III	Phylogeny, systematics of chordates and assorted topics- II	Fundamentals of Histology and Endocrinology		1
	IV	Comparative vertebrate osteology- II	Fundamentals of Cell Biology		1
BPSZOO202 Biochemistry and Physiology-II	I	Biomolecules- a structural and functional approach- II	Enzymology	04	1
	II	Enzymes and Enzyme kinetics	Chemical Messengers and Cell Signaling		1
	III	Metabolic Pathways and integration of Metabolism- II	Metabolism –II		1
	IV	Inborn errors of Metabolism	Mammalian Physiology –II		1
BPSZOO203 Modern Concepts in Zoology-II	I	Genetics–Chromosome theory of inheritance and Mendelism - II	Molecular Biology – II	04	1
	II	Genetics- Extension of Mendelian Genetics and Non-Mendelian inheritance- II	Genome Projects		1
	III	Evolution- II	Genetic Counseling		1
	IV	Developmental Biology-II	Bioinformatics		1
BPSZOO204 Techniques and Methodologies in Zoology-II	I	Principles and applications of chromatography- I	Instrumentation-II	04	1
	II	Principles and applications of chromatography-II (Gel chromatography and affinity chromatography)	Intellectual Property Rights and Patents		1
	III	Principles and applications of chromatography & Electrophoresis (GC, HPTLC, Electrophoresis	Biostatistics		1
	IV	Good laboratory practices & Research methodology- II	Research Methodology		1

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –I Zoology
Syllabus

Semester -I			
Paper Number	**Title of the Paper**	**Course Code**	**Credit**
Paper I	**Essentials of Zoology-I**	**BPSZOO101**	04
I	Comparative Anatomy- I	**(100M)**	
II	Developmental Biology –I		
III	Systematics, Taxonomy and Phylogeny		
IV	Laboratory Culture of Small Organisms		
Practical I		**BPSZOOP1 (50M)**	02
Paper II	**Biochemistry and Physiology-I**	**BPSZOO102**	04
I	Biochemistry	**(100M)**	
II	Bioenergetics		
III	Metabolism –I		
IV	Mammalian Physiology –I		
Practical II		**BPSZOOP1 (50M)**	02
Paper III	**Modern Concepts in Zoology-I**	**BPSZOO103**	04
I	Molecular Biology – I	**(100M)**	
II	Animal Cell Biotechnology		
III	Genetics		
IV	Recombinant DNA Technology		
Practical III		**BPSZOOP1 (50M)**	02
Paper IV	**Techniques and Methodologies in Zoology-I**	**BPSZOO104**	04
I	Instrumentation-I	**(100M)**	
II	Histopathological and Biochemical Techniques		
III	Introduction to Nano-Biotechnology		
IV	Ecotoxicology		
Practical IV		**BPSZOOP1 (50M)**	02

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M.Sc. –I Zoology
Syllabus

Semester –II			
Paper Number	**Title of the Paper**	**Course Code**	**Credit**
Paper I	**Essentials of Zoology-II**	**BPSZOO201**	04
I	Comparative Anatomy- II	**(100M)**	
II	Developmental Biology –II		
III	Fundamentals of Histology and Endocrinology		
IV	Fundamentals of Cell Biology		
Practical I		**BPSZOOP2 (50M)**	02
Paper II	**Biochemistry and Physiology-II**	**BPSZOO202**	04
I	Enzymology	**(100M)**	
II	Chemical Messengers and Cell Signaling		
III	Metabolism –II		
IV	Mammalian Physiology –II		
Practical II		**BPSZOOP2 (50M)**	02
Paper III	**Modern Concepts in Zoology-II**	**BPSZOO203**	04
I	Molecular Biology – II	**(100M)**	
II	Genome Projects		
III	Genetic Counseling		
IV	Bioinformatics		
Practical III		**BPSZOOP2 (50M)**	02
Paper IV	**Techniques and Methodologies in Zoology-II**	**BPSZOO204**	04
I	Instrumentation-II	**(100M)**	
II	Intellectual Property Rights and Patents		
III	Biostatistics		
IV	Research Methodology		
Practical IV		**BPSZOOP2 (50M)**	02

SEMESTER-I

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

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

M.Sc. Zoology, Semester- I

Title:**Essentials of Zoology-I**

COURSE CODE: **BPSZOO101 Credit: 4(100M)**

Course Outcome:

1. Students will be acquiring the knowledge on comparative anatomy and will be able to understand the development and evolution of various systems across the vertebrate classes.
2. In developmental biology students will understand the intricacies of developmental process. They will be able interpret the fate map and the morphogenetic movements etc.
3. Students will understand the principle of classification and systematic. They will be able to identify the animals based on their characters and also to construct the cladogram.
4. Students will learn to maintain and culture the small animals in the laboratory.

Unit	Title of the unit		Total Lectures (60)
I	**COMPARATIVE ANATOMY of Vertebrates- I**		15L
	1.1	Integumentary system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.1.1	Structure of amphibian skin	
	1.1.2	Structure of mammalian skin	
	1.1.3	Derivatives of integuments: Scales, feathers, hair, beak, claws, nails, hoofs, horns, antlers and glands associated with skin.	
	1.2	Digestive system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.2.1	Digestive tube and its evolution	
	1.2.2	Primary divisions of the tube	
	1.2.3	Tooth structure and position, teeth in lower vertebrates, mammalian dentition	
	1.2.4	Study of digestive system in aves (Pigeon)	
	1.2.5	Study of digestive system in mammals (Rat/Rabbit/Cattle/Man)	
	1.3	Circulatory system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.3.1	Evolution of heart	
	1.3.2	Types of heart	
	1.3.3	Aortic arches	
	1.3.4	Venous, portal (Hepatic portal and renal portal systems, e.g. Frog) and Lymphatic systems in vertebrates.	
	1.3.5	Open and closed circulation. Single and double circulation	
II	**DEVELOPMENTAL BIOLOGY –I**		15L
	2.1	Basic concepts in developmental biology:	
	2.1.1	Cell fate, cell lineage and commitment	
	2.1.2	Mosaic and regulatory development	
	2.1.3	Pattern formation and compartments	

	2.1.4	Morphogenesis and cell adhesion: Differential cell affinity, cadherins and catenins, sorting out of embryonic tissue and cell recognition, cell differentiation and totipotency, stem cell.	
	2.2	Factors affecting cellular differentiation:	
	2.2.1	Nucleo-cytoplasmic interaction	
	2.2.2	Mechanism of gene action during cell differentiation	
	2.2.3	Maintenance of differentiation	
	2.3	Cell Specialization: RBC, secretory cells, retinal rod cells	
	2.4	Organizer and its role in embryonic development	
	2.5	Primary embryonic induction	
	2.6	Developmental gradients: Developmental gradients in hydra, Maternal effect genes and axial gradients in drosophila development.	
III	**SYSTEMATICS, TAXONOMY AND PHYLOGENY**		15L
	3.1	Systematics: Definition and types (Numerical systematics, Biochemical Systematics and experimental systematics).	
	3.2	Taxonomy: Definition and taxonomic characters (morphological, physiological, molecular, behavioral, ecological and geographical characters).	
	3.3	Basis of Classification (Five fundamental basis), six kingdom classification, rules of binomial nomenclature.	
	3.4	Phylogeny: Definition, significance in evolutionary studies, Cladistics, molecular phylogeny	
IV	**LABORATORY CULTURE OF SMALL ORGANISMS**		15L
	4.1	Use of live animals in laboratory- Ethical issues. Need of small culturing small organisms in laboratory.	
	4.2	Bacterial culture- *E. coli* culture, Types of Culture Media required, doubling time, use of *E. coli* in experiments.	
	4.3	Paramecium Culture:Collection and isolation of paramecium from the sample water, Establishing the pure culture of paramecium.	
	4.3	Hydra culture: Hydra Biology: Ecology and behavior Types of Culture media and other laboratory conditions, doubling time, use of *hydra* in experiments,	
	4.4	Vermiculture: Earthworm biology: Ecology, behavior and types of earthworms used in culture, Methods of culture, Use of earthworm in experiments, commercial use	
	4.5	Drosophila Culture: Drosophila Biology: Ecology, behavior, species Methods of culture, use in experiments.	
	4.6	Daphnia Culture: Daphnia Biology: Ecology, behavior, species Methods of culture, use in experiments, commercial use	

References:

1. Chordate Zoology by Jordan and Verma
2. Chordate Zoology by Kotpal
3. Chordate Zoology by Dhami and Dhami.
4. Systematics and Origin of species by Ernst Mayer
5. Introduction to Bioinformatics by Arther M. Lesk
6. Phylogenetic Systematics by Willi Henning

7. Essential developmental biology by J.M. W. Slack
8. Developmental Biology : Introduction by Scott F. Gilbert
9. Invertebrate Zoology by Jordan and Verma
10. Biology of Protozoans by D.R. Khanna.
11. Hydra Research methods by Howard M. Lenhoff
12. Drosophila: A laboratory Handbook: Michael Ashbumer, Kent Golic and R. Scott Hawley.
13. Vermiculture Technology: Earthworms, Organic Wastes and Environmental management by Clive A. Edwards, Norrman Q Arancon and Rhonda Sherman.
14. Laboratory methods in Microbiology by W.F. Harrigan and Margaret E. McCance
15. Manual for the Culture of Selected Freshwater Invertebrates by Lawrence, S.G.

M.Sc.-1, Semester -1 BPSZOOP1 , Paper I Practical-I Credit-2 (50M)	
Sr. No.	Title of the experiment
1.	Study of types of fish scales (Mounting): Placoid, Ctenoid and cycloid scales
2.	Study of types of feathers and their arrangement as per their position (Diagrams/ Students should collect the fathers) and other integumentary derivatives: beak, claws, nails, hoofs, horns, antlers, glands associated with skin and T.S. of skin of frog and mammals (Rat or human)
3.	Study of T.S. of tooth, ruminant stomach of cattle, gizzard in birds.
4.	Study of types of heart and Study of L.S. of avian heart (Chicken heart)
5.	Study of aortic arches and portal systems
5.	Study of morphogenetic movements in chick embryo
6.	Mounting of 72 hrs. Of chick embryo for study of development of eye vesicle.
7.	Retrieval of data for the given protein and construction of cladogram
8.	Study of given cladogram and finding the phylogenetic relation between the organisms
9.	Study of binomial nomenclature
10.	Study of growth curve in *E.coliI*.
11.	Study of cyclosis, irritability and chemotaxis in paramecium.
12.	Study of Morphological characters of drosophila.
13.	Study of different species of earthworms used in vermiculture and study of cocoon.

Suggestions for 40 marks internals:

1. Observe ten birds around your residential area and make a report on their food and feeding habits and adaptations to the surrounding based on the types of their feathers, beaks and claws and submit the report.
2. Make permanent slides of chick embryo for 24, 48, 72 and 96 hrs. and make a report on their special developmental features.
3. Construct the cladogram for given animals (any four) based on the specific protein sequences provided.
4. Establish and maintain the culture of Paramecium/Earthworm/E. coli/Drosophila/Daphnia. Write the methodology and make the presentation.
5. Presentations on any topic from comparative anatomy-1, six kingdom classification, binomial nomenclature etc.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
MSc. Semester-I
Skeleton Question paper Practical-I (BPSZOOP1)

Duration: 5 hrs Marks: 50

Q.1	Make a permanent mounting of the chick embryo and comment on its developmental status	12
	OR	
Q.1	Retrieve the data of the given protein and trace the phylogeny of the given animals using appropriate tool for drawing the cladogram	12
	OR	
Q.1	Identify (Giving reasons) and arrange the given specimens of heart as per their evolutionary sequence. Take the L.S. of the specimen given and draw its neat and labeled diagram.	12
Q.2	Identify the type of feathers provided and arrange them in the order of their position and write their functions	06
	OR	
Q.2	Mount the scales from the given specimen/material identify their type and draw the diagrams	06
	OR	
Q.2	Demonstrate morphogenetic movement in the given chick embryo	06
Q.3	Demonstrate cyclosis/ Irritability/Chemotaxis in paramecium	06
	OR	
Q.3	Mount the given organism (daphnia) and locate its heart	06
	OR	
Q.3	Identify the morphological variants of drosophila and describe their phenotypic characters	06
	OR	
Q.3	Study the given cladogram and answer the questions asked.	06
Q.4	Identify and describe the given specimens/material/Picture etc**. (any 8)**: beak, claws, nails, hoofs, horns, antlers, glands associated with skin and T.S. of skin of frog and mammals (Rat or human), T.S. of tooth, ruminant stomach of cattle, gizzard in birds, aortic arches and portal systems, cocoon	16
Q.5	Viva-voce and Journal	10

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

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

M.Sc. Zoology, Semester- I

Title:**Biochemistry and Physiology-I**

COURSE CODE: **BPSZOO102 Credit: 4 (100M)**

Course Outcome:

1. Students will understand the principles of biochemistry, methods of buffer preparation, importance of physiological buffers and their role in maintaining homeostasis.
2. Students will understand the importance of electron transport system and oxidative phosphorylation and its importance in the production of high energy compounds
3. Students will understand carbohydrate metabolism in detail and its regulation
4. Students will learn about the structure and physiology of digestive system and excretory systems.

Unit	Title of the unit		Total Lectures (60)
I	**BIOCHEMISTRY**		15L
	1.1	Water: the basic molecule of Life	
	1.1.2	Ionization of water, weak acids and weak bases	
	1.2	Henderson-Hasselbalch equation	
	1.3	Dissociation constant of weak acids and weak bases	
	1.4	Titration curve and pKa of weak acids	
	1.5	Biological buffers- maintenance of blood pH	
	1.5.1	Blood buffers-1. Bicarbonate buffer, 2. Phosphate buffer, 3. Protein buffer	
	1.6	Water balance	
	1.6.1	Water - turn over and balance	
	1.7	Electrolyte balance	
	1.7.1	Osmolarity and osmolality of body fluids, regulation of electrolyte balance	
	1.8	Acid-base balance	
	1.8.1	Disorders of acid-base balance	
II	**BIOENERGETICS**		15L
	2.1	High energy compounds: ATP, ADP, ATP-ADP cycle, ATP-AMP ratio	
	2.2	Biological oxidation: Electron transport chain and mitochondria	
	2.3	Oxidative phosphorylation - Mechanism, uncoupling of oxidative phosphorylation and its significance.	
	2.4	Bioenergetics, coupled reaction, group transfer, biological energy transducers	
	2.5	Free radicals, antioxidants and antioxidant system	
III	**METABOLISM–I**		15L
	3.1	Metabolism: Concept, Definitions, Catabolism, Anabolism.	
	3.2	Integration of Metabolism	
	3.2.1	Energy demand and supply; Integration of major metabolic pathways of energy metabolism	
	3.2.2	Overview of intermediary metabolism; organ specialization and metabolic integration, metabolism in starvation	
	3.3	Carbohydrate Metabolism	

	3.3.1	Glycolysis: Reaction sequence, flow of carbon, conversion of pyruvate to lactate AndAcetyl coenzyme-A, significance of pyruvate- lactate interconversion	
	3.3.2	Aerobic and anaerobic glycolysis and energetics of glycolysis; Regulation of glycolysis	
	3.3.3	Gluconeogenesis: Reaction sequence from pyruvate, gluconeogenesis from amino acids, glycerol, propionate, lactate. Regulation of gluconeogenesis.	
	3.3.4	Glycogen metabolism: Glycogenesis, Glycogenolysis. Regulation of two pathways	
	3.3.5	Significance of following pathway; Hexose monophosphate shunt as a multifunctio nal pathway; Uronic Acid Pathway; Glyoxalate cycle.	
	3.4	Regulation of metabolism	
	3.4.1	Regulation of metabolic flux by genetic mechanisms Control of enzyme synthesis, regulatory proteins-Helix turn Helix, Zinc Fingers, Leucine Zippers	
	3.4.2	Regulation of metabolism by extracellular signals: nutrient supply, nutrient transport,Endocrine control, neural control.	
IV	**MAMMALIAN PHYSIOLOGY–I**		**15L**
	4.1	Digestive system	
	4.1.1	Gastrointestinal tract and accessory digestive organs	
	4.1.2	Phases of digestion; deglutition	
	4.1.3	Digestion in mouth, stomach, small intestine and large intestine	
	4.1.4	Absorption in small intestine and large intestine; regulation of digestive functions	
	4.2	Excretory system	
	4.2.1	Kidneys and Nephron	
	4.2.2	Urine formation- Glomerular filtration, tubular reabsorption and tubular secretion	
	4.2.3	Hormonal regulation of Urine formation	
	4.2.4	Urine concentration- countercurrent multiplication and countercurrent exchange	
	4.2.5	Micturition, regulation of blood pressure, blood volume and acid base balance	

REFERENCES

1. Lehninger's Principles of Biochemistry: David Lee Nelson, A.L. Lehninger, Michael M Cox; W.H. Freeman, New York; 2008
2. Biochemistry: Fifth Edition; J. M. Berg, J. L. Tymoczko and LubertStryer ;W.H. Freeman, New York; 2002
3. Biochemistry: Fourth Edition; U. Satyanarayana& U. Chakrapani; Elsevier; 2013
4. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
5. Biochemistry: Fifth Edition; Reginald H. Garrett & Charles M. Grisham; Brooks/ Cole (Cengage Learning); 2013
6. Principles of Anatomy and Physiology, Gerard J. Tortora, Bergen Community College , Bryan Derrickson Valencia Community College, John Wiley & Sons, Inc, Twelfth Edition
7. TextBook of Medical Physiology, Arthur C. Guyton and John E. Hall , Elsevier Saunders, Eleventh Edition
8. C. C. Chatterjee's Human Physiology 12ed Vol 1& 2 (Pb 2018), Chatterjee C.C.,CBS; 12 edition (2018)
9. Comparative Animal Physiology: Knut Schmidt Nielson; Cambridge Press
10. Comparative Animal Physiology: Prosser and Brown
11. Comparative Animal Physiology: William S Hoar
12. Text book of Comparative Physiology: R Nagabhushanam, MsKodarkar, Sarojini R, India Book House Pvt. Ltd.
13. Animal Physiology: N. Arumugam, A. Mariakuttikan; Saras Publication

MSc. PART-I SEMESTER-I
PRACTICAL-IICredit-2 (50M)
BPSZOOP1

1.	Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter
2.	Titration curve of strong acid v/s strong base
3.	Determination of pKa of weak acid
4.	Qualitative tests for carbohydrates and identification of the nature of carbohydrates in the given sample: a. Molisch's test b. Anthrone test c. Iodine test d. Barfoed's test e. Seliwanoff's test f. Fehling's test g. Benedict's test h. Picric acid test i. Mucic acid test j. Bial's test.
5.	Determination of glucose by Benedict's method (volumetric method)
6.	Determination of reducing sugars by 3,5-dinitrosalicylic acid (colorimetric) method
7.	Determination of glycogen in the given tissue (liver/ skeletal muscle/ kidney/ brain)
8.	Acid and enzyme hydrolysis of glycogen and colorimetric estimation of the products by 3,5-DNSA method
9.	Isolation of starch from potato
10	Determination of creatinine in serum and urine

Suggestions for 40 marks internals:

1. Project based on various natural antioxidants and effect
2. Presentations based on all 4 units

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. Part-I Semester-I
Skeleton Question paper Practical-II (BPSZOOP1)

Duration: 5hrs Marks: 50

Q. 1	Determination of glycogen in the given tissue (liver/ skeletal muscle/ kidney/	12

	brain)	
	OR	
Q.1	Acid and enzyme hydrolysis of glycogen and colorimetric estimation of the products by 3,5-DNSA method	12
Q.2	Qualitative tests for carbohydrates and identification of the nature of carbohydrates in the given sample:	10
	OR	
Q.2	Isolation of starch from potato	10
Q.3	Determination of reducing sugars by 3,5-dinitrosalicylic acid (colorimetric) method	10
	OR	
Q.3	Determination of glucose by Benedict's method (volumetric method)	10
	OR	
Q.3	Determination of pKa of weak acid	10
Q.4	Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter	08
	OR	
Q.4	Titration curve of strong acid v/s strong base	08
	OR	
Q.4	Determination of creatinine in serum and urine	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, 2021-22 (CBCS)

M.Sc. Zoology, Semester- I

Title:**Modern Concepts in Zoology-I**

COURSE CODE: **BPSZOO103 Credit: 4 (100M)**

Course Outcome:

1. *Students will understand the central dogma, protein synthesis and gene regulation in prokaryotes. They will also acquire the knowledge of gene mutation.*
2. *The students will understand the methods of animal cell culture and its requirement. They will learn to maintain the aseptic conditions in the laboratory.*
3. *Students will learn the genetics of popular laboratory models. They will also learn the techniques of karyotyping and banding techniques. Students will understand the genome organization of virus and bacteria.*
4. *Students will learn details about the gene cloning methods.*

Unit	**Title of the unit**		**Total Lectures (60)**
I	**MOLECULAR BIOLOGY –I**		15L
	1.1	Molecular Biology-I	
	1.1.2	Transcription in Prokaryotes	
	1.1.3	Enzymatic synthesis of RNA	
	1.1.4	Classes of RNA molecules	
	1.2	Translation in Prokaryotes	
	1.2.1	Outline of Translation, Genetic code, Codons, The decoding system- tRNA and Aminoacyl Synthetases The cloverleaf structure of tRNA The codon- anti-codon interactions	
	1.2.2	Chemical composition and physical structure of Prokaryotic Ribosomes	
	1.2.3	Protein synthesis- initiation, chain elongation and chain termination. Post translational modification of protein, polysomes, couples transcription and translation in prokaryotes.	
	1.3	Gene regulation in Prokaryotes	
	1.3.1	General aspects of gene regulation, general mechanisms of metabolic regulation in bacteria, types of regulation of transcription	
	1.3.2	Operon Models- Lac operon, tryptophan operon	
	1.4	DNA mutation : Types, Mutagens	
II	**Animal Cell Biotechnology**		15L
	2.1	Aseptic Techniques: General sterilization of glass ware and working place Aseptic transfer of Media	
	2.2	Animal Cell culture	
	2.2.1	Introduction	
	2.2.2	Isolation of cells for cell culture- Trypsinization	
	2.2.3	Types of Culture: Primary, secondary , anchorage dependent and independent cell lines and established cell lines	
	2.2.4	Cell culturing and dilution techniques: Spreading, viable count	
	2.2.5	Examples of established cell lines and mammalian cell lines	
	2.3	Culture Media: Natural, chemical, complex	
	2.3.1	Commonly used culture media	
	2.4	Hybridoma technology	
	2.5	Application of cell lines	
III	**GENETICS**		15L
	3.1	Model systems in Genetic Analysis: Life cycle and advantages of	

		Bacteriophage, *E. coli*, yeast, Drosophila, *C. elegans* and Zebra fish	
	3.2	Cytoplasmic inheritance – Basis and mechanism, role of organellar genes.	
	3.3	Chromatin structure: Histones, DNA, nucleosome morphology and higher level organization	
	3.4	Techniques in the study of chromosomes and their applications:	
	3.4.1	Short term (lymphocyte) and long term (fibroblast) cultures	
	3.4.2	Chromosome preparations	
	3.4.3	Karyotyping	
	3.4.4	Chromosome Banding	
	3.5	Genome organization in viruses, prokaryotes and eukaryotes:	
	3.5.5	Transposons.	
IV	**Recombinant DNA Technology**		15L
	4.1	Enzymes involved in DNA recombination Techniques Restriction enzymes with examples Ligases - E. coli DNA ligase and T4 DNA ligase Polynucleotide kinase, Phosphatases, DNA polymerases, Reverse Transcriptase, Terminal Transferase.	
	4.1.2	Vectors: General properties, advantages and disadvantages of cloning vectors. plasmid vectors (pBR322), phage vectors (λ Phage), cosmid vectors, Yeast Artificial chromosomes, Retrovirus,, SV 40 vectors	
	4.1.3	**Special purpose vectors:** Expression vectors, Secretion vectors, Bi-functional vectors (Shuttle vectors)	
	4.1.4	Host cells for cloning: Prokaryotic hosts- Escherichia coli, Bacillus subtilis Eukaryotic hosts - Saccharomyces cerevisiae	
	4.2.1	Cloning techniques: Cloning after restriction digestion - blunt and cohesive end ligation Creation of restriction sites using linkers and adapters, Cloning after homopolymer tailing,	
	4.2.2	Methods of gene transfer: Transformation, Transduction, By using chemicals (Calcium phosphate), Electroporation, Liposome -mediated gene transfer, microinjection.	
	4.2.3	Selection of recombinants: Insertional inactivation, Replica Plating	

MSc. PART-I SEMESTER-I
PRACTICAL-IIICredit-2 (50M)
BPSZOOP1

1.	Isolation of Genomic DNA / E.coli DNA and its quantitative estimation
2.	Setting Agarose gel for electrophoresis.
3.	Isolation of Plasmid DNA / Genomic DNA of E.coli from the given strain of bacteria (KIT Method) and show the purity of the isolate by Agarose Gel

	electrophoresis (Southern blotting Demonstration)
4.	Culturing of Lymphocyte and Fibroblast
5.	Aseptic transfer of media and wrapping techniques.
6.	Preparation of LB agar plate, slant and butt
7.	Determination of viable cell count in the culture of bacteria by dilution and spreading method
8.	Isolation of cells by Trypsinization
9.	Problems based on: a. Transcription b. Translation c. Restriction Digestion
10.	Growth curves –*E. coli*
11.	Identification based on genetics: life cycles of bacteriophage/ *E. coli/ C. elegans* / drosophila/ zebra fish. Chromosome banding- And G banding
12.	Identifying the genetic syndrome from the given Karyotype
13.	Estimation of number of bacteria in the given culture- nephalometry
14.	Replica plating technique

Suggestions for 40 marks internals:
Presentations based on all 4 unit

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. Semester-I
Skeleton Question paper Practical-III (BPSZOOP1)
Duration: 5.00 hrs Marks: 50

Q.1	Isolate and quantify the genomic DNA / E.coli DNA from the given sample	14

	OR	
Q.1	Determine the purity of the given plasmid DNA / Genomic DNA of E.coli by AGE and demonstrate the technique of southern blotting	
	OR	
Q.1	Determine the number of viable cell in the given culture of bacteria by dilution and spreading method	
	OR	
Q.1	Estimate the number of bacteria in the given culture bynephalometry	
Q.2	Demonstrate the aseptic transfer of media and wrapping technique.	10
	OR	
Q. 2	Separate the fibroblast cells from the given tissue by trypsinization	
Q.3	Identification: (Any 04) Life cycles of bacteriophage/ *E. coli/ C. elegans* / drosophila/ zebra fish / Chromosome banding and G banding / genetic syndrome from the given Karyotype	08
Q. 4	Solve the given Problems A and B (Transcription / Translation / Restriction Digestion)	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, 2021-22 (CBCS)

M.Sc. Zoology, Semester- I

Title:**Techniques and Methodologies in Zoology-I**

COURSE CODE: **BPSZOO104 Credit: 4 (100M)**

Course Outcome:

1. *Students will understand the principles of microscopy and spectroscopy. They will also lean to use these instruments in their practical.*
2. *Students will learn the techniques and acquire the practical skills of histochemoical preparation and localization of cell organelle and biomolecules.*
3. *Students will understand the concept in nanotechnology and learn to prepare the bionanomaterial and their applications.*
4. *Students will become aware of the effects of anthropological interference with environment and their mitigation.*

Unit	Title of the unit		Total Lectures (60)
I	**INSTRUMENTATION-I**		15L
	1.1	Microscopy: Principle and applications of Microscopy	
	1.1.1	Light microscopy	
	1.1.2	Phase contrast microscopy	
	1.1.3	Fluorescence microscopy	
	1.1.4	Polarization microscopy	
	1.1.5	Confocal scanning microscopy	
	1.1.6	Transmission electron microscopy	
	1.1.7	Scanning electron microscopy	
	1.2	Spectroscopy: Principle and applications of Spectroscopy	
	1.2.1	Ultraviolet and visible absorption spectroscopy	
	1.2.2	Fluorescence spectroscopy	
	1.2.3	Nuclear magnetic resonance spectroscopy	
	1.2.4	IR and FTIR	
	1.2.5	Mass spectroscopy	
	1.2.6	Atomic absorption spectroscopy (AAS) and Atomic emission spectroscopy (AES)	
II	**HISTOPATHOLOGICAL AND BIOCHEMICAL TECHNIQUES**		15L
	2.1	Microtomy: Tissue fixation, dehydration, clearing, infiltration, embedding for paraffin method, sectioning, mounting, staining- differential and specific.	
	2.2	Principles and methods of histochemical localization and identification of the following: Carbohydrate moieties, Glycogen and glycoproteins with oxidizable vicinal diols by periodic acid Schiff method	
	2.3	Protein end groups General protein localization by bromophenol blue method. NH2 groups by ninhydrin-Schiff method SS- groups by performic acid –Schiff	
	2.4	Lipids moieties General lipids by Sudan black B method	

		Neutral lipids by Sudan III and Sudan IV methods. Differentiation of neutral lipids from acidic lipids by Nile blue sulphate method	
	2.5	Nucleic acids: Methyl green pyronin-Y for DNA and RNA Feulgen reaction for DNA	
III	**INTRODUCTION TO NANO-BIOTECHNOLOGY**		15L
	3.1	Nanobiotechnology: Introduction, history, and Nano scale dimensions	
	3.1.1	Nanostructures: Types and composition Carbon Based- Carbon nano-tubes, graphene, fullerene Metal based, Protein based- and green nanoparticles	
	3.1.2	Preparation and characterization of bionanomaterials Grindig/ high energy ball milling	
	3.1.3	Microfluidics in nanosciences Nanopainting of DNA, RNA ,Protein , Biochips	
	3.1.4	Medical Applications of nano biotechnology Drug delivery, bioimaging, anti- microbial properties	
	3.1.5	Bio-nano composites: Nanoparticles and microorganisms, Microbial synthesis of nano- material, Biological Methods for Synthesis of nano-emulsions using bacteria, Fungi and Actinomycetes	
	3.2	Characterization techniques: X-ray diffraction technique,Scanning Electron Microscopy, Transmission Electron Microscopy including high-resolution imaging,Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS, Nano-indentation, Small-angle X-ray and neutron scattering, DLS Ellipsometer, Confocal microscopy	
IV	**ECOTOXICOLOGY**		15L
	4.1	Definition and scope	
	4.2	Common Ecotoxicants -Natural and Artificial: (Source, chemical nature and their effects)	
	4.2.1	Molds and Mycotoxins	
	4.2.2	Pesticides. (Organophosphates and organochlorides)	
	4.2.3	Heavy metals (Lead, Mercury, cadmium, Arsenic)	
	4.2.4	Chemicals used in personal hygiene, fragrance chemicals and domestic detergents	
	4.2.5	Plasticizers (Phthalates)	
	4.2.6	Asbestos	
	4.2.7	Radioactive elements.	
	4.3	Major ecotoxicity related phenomena the chemicals involved:	
	4.3.1	Global Warming	
	4.3.2	Green House effect	
	4.3.3	Bioaccumulation and biomagnifiction	
	4.3.4	Acid Rain	
	4.4	Major international accidents having ecotoxicological effects	
	4.4.1	Chernobyl Incidance of Russia	
	4.4.2	Minamata incidence of Japan	
	4.4.3	Bhopal gas tragedy of India	
	4.4.4	Red tide incidence of Florida	
	4.5	Ecotoxicity testing and its prevention	
	4.5.1	Acute and chronic toxicity studies, LD50, LC50 and EC50 studies	

	4.5.2	OECD guidelines	
	4.5.3	Endocrine disruptor screening program.	
	4.5.4	Endangered species assessment	
	4.5.5	Ecotoxicity preventive majors	

REFERENCES

1. ModernExperimentalBiochemistry: 3rdEd.RodneyBoyer,PearsonEducation.
2. PrinciplesandTechniquesofPracticalBiochemistry.WilsonandWalker,CambridgeUniv.Press.
3. BiologicalScience;3rdEd.D.J.Taylor,N.P.O.Green,G.W.Stou,CambridgeUniv.Press
4. CellandMolecularBiologyConceptsandExperiments,GeraldKarp.JohnWiley&Co.
5. Analytical Biochemistry, 3 edition, (1998), David Holmes, H.Peck, Prentice Hall, UK.
6. Bancroft & Stevens: Theory and Practice of Histological techniques (2002, Churchill-Livingstone)
7. Casselman: Histochemical techniques (1959, John Wiley)
8. Pearse: Histo-chemistry: Theoretical and Applied (Vol. I, II & III) (4th ed 1980-1993, Churchill- Living stones)
9. Biological Science; 3rd Ed. D. J. Taylor, N.P.O. Green, G.W. Stou, Cambridge Univ. Press
10. Introductory Practical Biochemistry; S. K. Swahney, Randhir Singh. Narosa Publ.
11. An Introduction to Practical Biochemistry; 3rd Ed. David Plummer. Tata McGrawHill
12. Casarett and Doulls Toxicology – The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill; 2001
13. A Textbook of Modern Toxicology, Ernest Hodgson, Patricia E. Levi, McGraw-Hill International Edition, Second edition ,2000
14. Toxicological testing handbook – Principles, applications and data interpretation; David Jacobson-Kram and Kit Keller; CRC Press; 2006
15. Principles and Methods of toxicology; A. Wallace Hayes; CRC Press; 2007
16. Toxicology – Principles and Methods; M.A. Subramanian; MJP Publishers, Chennai; 2004
17. Fundamentals of Toxicology; Kamleshwar Pandey and J.P. Shukla; New Central book agency Ltd., Kolkata; 2011
18. Elements of Toxicology; Kamleshwar Pandey and J.P. Shukla; Wisdom Press, New Delhi; 2010
19. Principles and Applications of Toxicology; Lahir Y.K.; Seekay Publications; 2013

PRACTICAL IVCredit-2 (50M)
Course Code: BPSZOOP1

Sr.No.	Practicals based on **BPSZOO104**
1.	Study of Microtomy: a. Tissue preservation and fixation b. Dehydration, infiltration, paraffin embedding c. Block preparation and section cutting d. Staining of sections/ribbon
2.	Histochemical staining of the given specimens: a. For carbohydrates using Periodic acid/Schiff's method for neutral glycoproteins b. For acidic glycoprotein using Alcian blue pH 2.5 method c. For lipids using Sudan black B method / Sudan III method / Sudan IV method d. For protein localization by bromophenol blue method e. For Nucleic acids by Methyl green pyronin- Y for DNA and RNA f. For DNA by Feulgen reaction
3.	Verification of Beer Lamberts law and calculation of molar extinction coefficient of a coloured chemical compound of known molecular weight
4.	Use of UV spectrophotometry to determine the concentration of protein
5.	Extraction of Heavy metals from fish tissue and Analysis of heavy metal using AAS and UV spectrophotometer
6.	Demonstration of IR and FTIR
7.	Principle and working of compound microscopy with the help of permanent slides
8.	Synthesis of nano particles by sonochemical method (TiO2/ ZnO / CdS)
9.	Determination of surface area of nanoparticles by Methylene blue technique
10.	Synthesis of nanoparticles by nsawball milling from biomaterial
11.	Biogenesis of nano-particles by bacteria/ fungi–for development of Microbial Emulsion.
12.	Identification and characterization of nanoparticles by XRD, SEM, TEM, TG-DTA (only output analysis)
13.	Effects of heavy metal on heart beats of Daphnia.
14.	Effects of heavy metal /pesticides on daphnia /Zebra fish – LC 50 studies
15.	Effects of heavy metal/ Pesticides on structure function relation of gills, fish liver, fish kidney, fish muscles etc. (Using permanent slides – comparative studies of Normal and treated samples)
16.	Study of water quality from aneutrophicated pond or river (BOD, COD, Acidity, Alkalinity, organic content, Nitrate-Nitrogen and Nitrite-Nitrogen contents).

Internal 40 Marks:

1. Writing a research proposal for the given topic
2. Writing a Research paper by using given data

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. Semester-I
Skeleton Question paper Practical-IV (BPSZOOP1)
Duration: 5.00 hrs Marks: 50

Q.1	Extraction of Heavy metals from fish tissue and Analysis of heavy metal using AAS and UV spectrophotometer	12
	OR	
Q.1	Verification of Beer lamberts law and calculation of molar extinction coefficient of a coloured chemical compound of known molecular weight	
	OR	
Q.1	Demonstrate the effect of given heavy metal /pesticides on daphnia /Zebra fish – LC 50 studies	
Q.2	Demonstrate synthesis of nano particles by sonochemical method (TiO2/ ZnO/ CdS)	10
	OR	
Q.2	Determination of surface area of nanoparticles by Methylene blue technique	
	OR	
Q.2	Demonstrate synthesis of nanoparticles by nsawball milling from biomaterial	
	OR	
Q.2	Demonstrate biogenesis of nano-particles by bacteria/ fungi–for development of Microbial Emulsion.	
Q.3	Process the given tissue for **a/b/c** and submit report to the examiner a. Embedding and block preparation b. Trimming and preparation of ribbon c. Staining the given slide	08
	OR	
Q.3	Histochemical staining of the given paraffin sections for **(Any two)** a) acidic glycoprotein using Alcian blue pH 2.5 method b) protein localization by bromophenol blue method c) DNA by Feulgen reaction d) Nucleic acids by Methyl green pyronin- Y for DNA and RNA	
	OR	
Q.3	Demonstrate thermal Denaturation of DNA and Protein	
	OR	
Q.3	Demonstrate the effect of heavy metal on heart beats of Daphnia.	
Q.4	Estimate BOD / COD / Acidity / Alkalinity / Organic content / Nitrate-Nitrogen / Nitrite-Nitrogen contents of given eutrophicated pond or river water	10
Q.5	Journal and viva-voce	10

SEMESTER-II

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –I Zoology
Syllabus

Semester –II			
Paper Number	**Title of the Paper**	**Course Code**	**Credit**
Paper I	**Essentials of Zoology-II**	**BPSZOO201**	04
I	Comparative Anatomyof Vertebrates- II	**(100M)**	
II	Developmental Biology –II		
III	Fundamentals of Histology and Endocrinology		
IV	Fundamentals of Cell Biology		
Practical I		**BPSZOOP2 (50M)**	02
Paper II	**Biochemistry and Physiology-II**	**BPSZOO202**	04
I	Enzymology	**(100M)**	
II	Chemical Messengers and Cell Signaling		
III	Metabolism –II		
IV	Mammalian Physiology –II		
Practical II		**BPSZOOP2 (50M)**	02
Paper III	**Modern Concepts in Zoology-II**	**BPSZOO203**	04
I	Molecular Biology – II	**(100M)**	
II	Genome Projects		
III	Genetic Counseling		
IV	Bioinformatics		
Practical III		**BPSZOOP2 (50M)**	02
Paper IV	**Techniques and Methodologies in Zoology-II**	**BPSZOO204**	04
I	Instrumentation-II	**(100M)**	
II	Intellectual Property Rights and Patents		
III	Biostatistics		
IV	Research Methodology		
Practical IV		**BPSZOOP2 (50M)**	02

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

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

M.Sc. Zoology, Semester- II

Title: **Essentials of Zoology-II**

COURSE CODE: **BPSZOO201 Credit: 4 (100M)**

Course Outcome:

1. Students will be acquiring the knowledge on comparative anatomy and will be able to understand the development and evolution of various systems across the vertebrate classes.
2. In developmental biology students will understand the intricacies of developmental processes, programme cell death, mechanism of aging, metamorphosis and its hormonal control.
3. Students will learn the structure and function of major apocrine, exocrine and endocrine glands.
4. Students will understand the fundamentals of cell biology and structure-function of cell organelle.

Unit	**Title of the unit**		**Total Lectures (60)**
I	**COMPARATIVE ANATOMY of Vertebrates- II**		15L
	1.1	Respiratory system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.1.1	Gills in cartilaginous and bony fish	
	1.1.2	Lungs of frog, birds and mammals	
	1.1.3	Mechanism of respiration in man	
	1.1.4	Accessory respiratory organs	
	1.1.5	Swim bladder	
	1.2	Nervous system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.2.1	Central nervous system in vertebrates	
	1.2.2	Development of brain in vertebrates	
	1.2.3	Peripheral nervous system	
	1.3	Urogenital system of vertebrates: fishes, amphibians, reptiles, birds and mammals	
	1.3.1	Types and development of kidneys	
	1.3.2	Structure of nephron	
	1.3.3	Urogenital ducts	
	1.3.4	Urinary bladder	
II	**DEVELOPMENTAL BIOLOGY –II**		15L
	2.1	Metamorphosis, regeneration and aging:	
	2.1.1	Metamorphosis: Retrogressive metamorphosis in ascidians and amphibians, incomplete and complete metamorphosis in insects and their hormonal control, metamorphosis in amphibians and its control.	
	2.1.2	Apoptosis : The programmed cell death	
	2.1.3	Aging: Senescence, life span and causes of aging	
	2.2	Developmental cycle and morphogenesis	
	2.2.1	Developmental cycle and morphogenesis	

		Dictyosteliumdiscoideum, life cycle, polarity, pattern formation and morphogenesis, role of mitochondria in growth/ differentiation transition, gene expression during cell growth.	
	2.2.2	Developmental cycle and morphogenesis of *Drosophila melanogaster*	
	2.2.3	Embryogenesis, gastrulation, larvae and metamorphosis	
	2.2.4	Maternal effect on genes and establishment of body plan, role of bicoid, hunch back, nano and caudal genes.	
	2.2.5	Zygotic genes and establishment of anterior/ posterior body pattern Parasegments- Gap genes, pair rule genes Segmentation- segment polarity genes, homeotic and selector genes.	
III	**FUNDAMENTALS OF HISTOLOGY AND ENDOCRINOLOGY**		15L
	3.1	Types of glands: Apocrine, Exocrine and endocrine (Definition and functions)	
	3.2	Histology of digestive organs and associated digestive glands: Stomach, Small intestine, large intestine, Salivary gland, liver, pancreas	
	3.3	Endocrine glands of human body: Position , histology and functions	
	3.4	Feedback mechanism: Hypothalamus- Pituitary – Thyroid axis	
	3.5	Histology of human skin, kidney, lungs, spleen, thymus	
	3.6	Histology of male and female reproductive organs and accessary reproductive organs (Testis, ovary, seminal vesicles, prostate gland, epididymis, placenta, uterus, mammary glands)	
IV	**FUNDAMENTALS OF CELL BIOLOGY**		15L
	4.1	Types of cells and their structures	
	4.2	Cell wall formation and its functions	
	4.3	Cell membrane: Sandwich model, fluid mosaic model, functions of cell membrane	
	4.4	Types of cell organelles of eukaryotic cells and their functions.	
	4.5	Endomembrane system	
	4.6	Eukaryotic nucleus and nuclear organizers	
	4.7	Giant Chromosomes	

References:

1. Chordate Zoology by Jordan and Verma
2. Chordate Zoology by Kotpal
3. Chordate Zoology by Dhami and Dhami.
4. Essential developmental biology by J.M. W. Slack
5. Developmental Biology : Introduction by Scott F. Gilbert
6. Invertebrate Zoology by Jordan and Verma
7. Drosophila: A laboratory Handbook: Michael Ashbumer, Kent Golic and R. Scott Hawley.
8. Cell biology by C.B. Pawar.
9. Essential Cell biology by Bruce Alberts, Karen Hopkin, Alexander D Johnson
10. Electron Microscopy: Principles and fundamentals by S Amelinckx, D Van Dyck, J Van Landuyt.
11. Vertebrate Endocrinology by David O Norris.

M.Sc.-1, Semester –II BPSZOOP2, Paper 1 Practical-I **Credit-2(50M)**	
Sr. No.	Title of the experiment
1.	Study of respiratory organs: T.S. of gills of cartilaginous and bony fishes (Slides/diagrams/Photographs). T.S. Lungs of Birds, T.S. of lungs of mammals (Rat/human), Study of air sacs of pigeon (Videos and photographs)
2.	Study of Brain of shark, frog, lizard, pigeon and rat and T.S. of Spinal Cord of Frog and Mammals (Rat/Human) Using preserved slides or photographs.
3.	Study of types of kidneys (Photographs). T.S. of avian Kidney, T.S. of mammalian kidney.
4.	Study of life cycle of *Dictyosteliumdiscoideum*(Using diagrams/Photographs)
5.	Study of retrogressive metamorphosis in ascidians and salamander
6.	Study of metamorphosis in frog and insects
7.	Study of viable and dead cells from fibroblast culture.
8.	An observational assessment method for aging laboratory rats from the given data
9.	Study of stages in embryogenesis in drosophila (with help of pictures or culture if available)
10.	Study of T.S. of Salivary gland, liver, pancreas, endocrine glands, Testis, ovary, placenta, prostate gland, seminal vesicles, epididymis, uterus , placenta, mammary glands, kidney, skin, spleen, thymus, small and large intestine, stomach, lungs etc.
11.	Mounting of bacterial cells from the given culture / Curd
12.	Mounting of leucocytes to study eukaryotic cells.
13.	Mounting of plant cells from dead and live regions of the plant to study the differences in the cell wall.
14.	Study of membrane permeability using suitable cells.
15.	Study of electron micrographs to observe cell organelles.
16.	Study of polytene chromosome (Identify and describe)

Suggestions for 40 marks internals:

1. Presentations on the topics of Comparative anatomy -II
2. Make the permanent slides of Liver tissue from various animals (Fish, chicken and Goat) and submit the report.
3. Make the permanent slides of Gills of cartilaginous fishes and bony fishes and submit the report.
4. Make the permanent slides lungs of birds and mammals and submit the report.
5. Make the permanent slides of Kidneys from fish, birds and mammals and submit the report.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
MSc. Semester-II
Skeleton Question paper Practical-I (BPSZOOP2)

Duration: 5 hrs Marks: 50

Q.1	Mount the cells from the two cultures provided, make viability cell count and find which culture is older. Show the dead cells under high power of compound microscope.	10
	OR	
Q.1	Demonstrate membrane permeability for the given tissue sample	10
	OR	
Q.1	Make an observational assessment for aging laboratory rats from the given data and write its analysis and plot the histograms.	10
Q.2	Mount the bacterial cells from the given culture	08
	OR	
Q.2	Mount the eukaryotic cells from the given sample of blood and comment on the structure of nuclear morphology observed.	08
Q.3	Make the temporary mounting of given tissue and focus the cell membrane	04
	OR	
Q.3	Identify the cells and describe the status of the cell organelles in the given micrograph	04
	OR	
Q.3	Identify and describe the given giant chromosome	04
Q. 4	Identify and describe (**any seven**): T.S. of gills of cartilaginous and bony fishes (Slides/diagrams/Photographs). T.S. Lungs of Birds, T.S. of lungs of mammals (Rat/human), Study of air sacs of pigeon (Videos and photographs), Brain of shark, frog, lizard, pigeon and rat and T.S. of Spinal Cord of Frog and Mammals (Rat/Human) Using preserved slides or photographs, types of kidneys (Photographs), T.S. of avian Kidney, T.S. of mammalian kidney, T.S. of Salivary gland, liver, pancreas, mammalian endocrine glands	14
Q.5	Identify and describe **(any two):**Stages in the life cycle of *Dictyosteliumdiscoideum*(Using diagrams/Photographs), retrogressive metamorphosis in ascidians and salamander, metamorphosis in frog and insects, stages in embryogenesis in drosophila (with help of pictures or culture if available).	04
Q.5	Viva and Journal	10

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

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

M.Sc. Zoology, Semester- II

Title:**Biochemistry and Physiology-II**

COURSE CODE: **BPSZOO202 Credit: 4 (100M)**

Course Outcome:

1. *Students will learn the classification, mechanism of action and kinetics of enzymes.*
2. *Students will understand the types of chemical messengers and their role in signaling.*
3. *Students will understand lipid and protein metabolism and their regulation and they will also learn about inborn errors of metabolism.*
4. *Students will learn about the structure and physiology of nervous system and reproductive systems.*

Unit	Title of the unit		Total Lectures (60)
I	**ENZYMOLOGY**		15L
	1.1	Definition, nomenclature and classification (based on Enzyme Commission) of enzymes, non-protein enzyme-ribozyme	
	1.2	Cofactors and coenzymes	
	1.3	The concept and properties of active site	
	1.3.1	Mechanism of enzyme action	
	1.4	Concept of activation energy	
	1.5	Enzyme kinetics, concept of steady state, enzyme assay	
	1.5.1	Derivation of Michaelis-Menten equation andLineweaver-Burk plot	
	1.5.2	Concept and significance of km, Vmax and kcat	
	1.6	Factors affecting enzyme activity – pH, temperature, enzyme concentration, substrate concentration, inhibitors	
	1.7	Enzyme inhibitors – Reversible: Competitive, non-competitive, mixed inhibitors and Irreversible inhibitors and their kinetics	
	1.8	Regulation of enzyme activity	
	1.8.1	Allosteric regulation	
	1.8.2	Activation of latent enzymes	
	1.8.2	Compartmentation of metabolic pathways	
	1.8.3	Control of enzyme synthesis	
	1.8.4	Enzyme degradation	
	1.9	Isozymes e.g. LDH	
II	**CHEMICAL MESSSENGERS AND CELL SIGNALLING**		15L
	2.1	Chemical Messengers	
	2.1.1	Introduction, concept and classification	
	2.2	Neurotransmitters ad Neurosecretory substance	
	2.2.1	Acetyl catecholamine, Gama-amino butyric acid (GABA), Aspartic acid, Purine ATP	
	2.3	Mode of working of transmitters and its regulation	
	2.4	Neurosecretory substances and a brief account of Neurosecretory system.	
	2.5	Cell Signaling	
	2.5.1	Hormones and their receptors, cell surface receptors	
	2.5.2	Second messenger hypothesis	
	2.5.3	G-protein coupled receptors, signal transduction pathway, regulation of signaling pathway	

	2.5.4	Receptor tyrosine kinases.	
	2.6	Cellular communication	
	2.6.1	General principles of cell communication	
	2.6.2	Cell adhesion molecules, Integrin	
III	**METABOLISM–II**		15L
	3.1	Lipid metabolism	
	3.1.1	Lipid digestion, absorption and transport	
	3.1.2	Biosynthesis of fatty acids and triacylglycerols	
	3.1.3	Fatty acid oxidation and regulation of fatty acid metabolism	
	3.1.4	Ketone bodies and their oxidation	
	3.1.5	Biosynthesis of phospholipids and cholesterol	
	3.2	Protein metabolism	
	3.2.1	Amino acid pool, amino acid biosynthesis	
	3.2.2	Transamination; oxidative and non-oxidativedeamination; metabolism of branched chain amino acids; fate of carbonskeleton of amino acids.	
	3.2.3	Urea cycle	
	3.3	Inborn errors of metabolism	
	3.3.1	Carbohydrate metabolism: Glycogen storage disease, G-6-PD deficiency	
	3.3.2	Lipid metabolism: Metabolic disorders of cerebrosides	
	3.3.3	Protein metabolism: PKU, Albinism, Cysteinurea	
	3.3.4	Purine metabolism: Primary Gout	
IV	**MAMMALIAN PHYSIOLOGY–II**		15L
	4.1	Nervous system	
	4.1.1	Gross neuroanatomy of brain and spinal cord	
	4.1.2	Neurons and electrical signals and transmission in synapses	
	4.1.3	Central and peripheral nervous system	
	4.1.4	Reflex and reflex arcs	
	4.1.5	Blood brain barrier and CSF	
	4.1.6	Sense organs- vision, hearing and tactile response	
	4.2	Respiratory system	
	4.2.1	Respiratory organs	
	4.2.2	Mechanics of pulmonary ventilation	
	4.2.3	Lung volume and capacity	
	4.2.4	Transport and exchange of gases	
	4.2.5	Control of respiration- respiratory center and its regulation	
	4.3	Cardiovascular system	
	4.3.1	Heart- anatomy, valves, circulation of blood and cardiac conduction.	
	4.3.2	ECG- principle and significance	
	4.3.3	Cardiac cycle, Cardiac output	
	4.3.4	Blood vessels ,blood pressure and control and hormonal regulation of blood pressure	
	4.3.4	Lymphatic system	

REFERENCES

1. Lehninger's Principles of Biochemistry: David Lee Nelson, A.L. Lehninger, Michael M Cox; W.H. Freeman, New York; 2008
2. Biochemistry: Fifth Edition; J. M. Berg, J. L. Tymoczko and LubertStryer ;W.H. Freeman, New York; 2002
3. Biochemistry: Fourth Edition; U. Satyanarayana& U. Chakrapani; Elsevier; 2013
4. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
5. Biochemistry: Fifth Edition; Reginald H. Garrett & Charles M. Grisham; Brooks/ Cole (Cengage Learning); 2013
6. Principles of Anatomy and Physiology, Gerard J. Tortora, Bergen Community College , Bryan Derrickson Valencia Community College, John Wiley & Sons, Inc, Twelfth Edition
7. TextBook of Medical Physiology, Arthur C. Guyton and John E. Hall , Elsevier Saunders, Eleventh Edition
8. C. C. Chatterjee's Human Physiology 12ed Vol 1& 2 (Pb 2018), Chatterjee C.C.,CBS; 12 edition (2018)
9. Comparative Animal Physiology: Knut Schmidt Nielson; Cambridge Press
10. Comparative Animal Physiology: Prosser and Brown
11. Comparative Animal Physiology: William S Hoar
12. Text book of Comparative Physiology: R Nagabhushanam, MsKodarkar, Sarojini R, India Book House Pvt. Ltd.
13. Animal Physiology: N. Arumugam, A. Mariakuttikan; Saras Publication

MSc. PART-I SEMESTER-II
PRACTICAL-II V Credit-2(50M)
BPSZOOP2

1	Determination of acid value of fats/ oils
2	Determination of saponification value of fats/ oils
3	Determination of total cholesterol and HDL cholesterol from serum
4	Qualitative tests for amino acids and Proteins: a. Ninhydrin test b. Xanthoproteic test c. Millon's test d. Biuret test
5	Colorimetric estimation of protein by Peterson-Lowry method
6	Quantitative estimation of amino acids using ninhydrin reagent
7	Isolation of casein from milk and its confirmatory test
8	Detection of conformation of BSA by viscosity measurement and effect of varying concentration of urea on viscosity of BSA
9	Determination of specific activity of enzyme succinate dehydrogenase (SDH)

Suggestions for 40 marks internals:

1. Isolation and assay of some naturally occurring enzymes
2. Presentations based on all 4 units

Department of Zoology
M.Sc. Part-I Semester-II
Skeleton Question paper Practical-II (BPSZOOP2)

Duration: 5hrs Marks: 50

Q. 1	Colorimetric estimation of protein by Peterson-Lowry method	12
	OR	
Q.1	Quantitative estimation of amino acids using ninhydrin reagent	12
	OR	
Q.1	Determination of specific activity of enzyme succinate dehydrogenase (SDH)	12
Q.2	Detection of conformation of BSA by viscosity measurement and effect of varying concentration of urea on viscosity of BSA	10
	OR	
Q.2	Determination of saponification value of fats/ oils	10
Q.3	Qualitative tests for amino acids and Proteins	08
Q.4	Determination of acid value of fats/ oils	10
	OR	
Q.4	Isolation of casein from milk and its confirmatory test	10
	OR	
Q.4	Determination of total cholesterol and HDL cholesterol from serum	10
Q. 5	Viva-voce and Journal	10

Syllabus w.e.f. Academic Year, 2021-22 (CBCS)
M.Sc. Zoology, Semester- II
Title: **Modern Concepts in Zoology-II**

COURSE CODE: **BPSZOO203 Credit: 4 (100M)**

Course Outcome:

1. *Students will understand the protein synthesis and gene regulation in eukaryotes. They will also acquire the knowledge of DNA damage and its repair.*
2. *Students will understand the history and learn about the findings of human genome sequencing and its application.*
3. *Students will learn the methods and importance of genetic counseling and also learn the use of modern methods in pedigree analysis.*
4. *Students will come to know about the various data bases, methods of retrieving the data, its analysis and interpretation. Students will learn to construct a phylogenetic tree.*

Unit	**Title of the unit**		**Total Lectures (60)**
I	**Molecular Biology –II**		15L
	1.1	Molecular Biology-II	
	1.1	Transcription in Eukaryotes	
	1.1.1	The transcription unit concept	
	1.1.2	Classes of RNA molecules, RNA polymerases and promoters	
	1.1.3	Hypersensitive sites, upstream activation sites, enhancers	
	1.1.4	Post transcriptional modifications- structure of 5' - 3' termini of eukaryotic mRNA molecules, Caps and Tails Splicing	
	1.2	Translation in Eukaryotes	
	1.2.1	Differences between Protein synthesis in Eukaryotes and prokaryotes	
	1.3	Gene regulation in Eukaryotes	
	1.3.1	Important differences in the genetic organization of prokaryotes and eukaryotes	
	1.3.2	Regulatory strategies of genes in Eukaryotes- at transcriptional and translational level	
	1.4	DNA damage and repair.	
II	**Genome Projects**		15L
	2.1	Human Genome Project:	
	2.1.1	Scopes and Goals of the project. The features of human genome	
	2.2	Techniques used in human genome project	
	2.2.1	Genetic linkage maps, sequencing of DNA- chromosome walking	
	2.2.2	Restriction mapping	
	2.2.3	Physical Maps and sequence tagged sites	
	2.2.4	RFLPs and its uses	
	2.3	Mapping human diseases	
	2.4	Variations in human Genome- HapMap Project	
	2.5	The 1000 genome project: To focus genetic variation and diseases	

	2.6	ENCODE Project: To find out the functional elements	
III	**Genetic Counseling**		15L
	3.1	Introduction and scope of genetic counseling	
	3.2	Genetic counseling – Processes	
	3.3	Genetic testing – Carrier testing , prenatal testing , preimplantation testing	
	3.4	Pedigree analysis – Symbols and preparation of Pedigree chart for autosomal and sex linked dominant and recessive traits.	
	3.5	Role of RFLP in pedigree analysis	
	3.6	Problems in pedigree	
IV	**Bioinformatics**		15L
	4.1	Introduction to bioinformatics:	
	4.1.1	Nature, scope and Branches of Bioinformatics	
	4.2	Biological Databases in Bioinformatics	
	4.2.1	Sequence databases and Structure databases	
	4.2.2	General overview of NCBI , Genbank , DDBJ , EMBL , UNI-PROT , PROSITE , RCSB - PDB , PIR – PSD	
	4.2.3	Literature data bases- OMIM , PubMed	
	4.2	Sequence alignment	
	4.2.1	Bioinformatics tools - BLAST and FASTA	
	4.2.2	Pairwise sequence alignment: Global and Local alignment	
	4.2.3	Multiple Sequence alignment (MSA): Eg: Clustal W , Clustal X	
	4.3	Sequence visualization and Structure Visualization tools	
	4.3.1	ORF Finder, Swiss PDB Viewer, Rasmol,Cn3D, Phymol.	
	4.4	Molecular Phylogenetics	
	4.4.1	Construction of phylogenetic trees: Distance Based Methods- Clustering and Optimality based Methods	
	4.5	Applications of Bioinformatics	

MSc. PART-I SEMESTER-II
PRACTICAL-IIICredit-2(50M)
BPSZOOP2

1	Quantitative estimation of RNA by standard graph method
2	Construction of Pedigree chart and pedigree analysis of given charts
3	Identification: a. Pedigree symbols b. Prenatal test
4	Literature survey of diseases from OMIM and Pub Med
5	Retrieving Protein sequences from Uni-Prot
5	Retrieving DNA data from NCBI
6	Pairwise Sequence Analysis- BLAST
7	Multiple Sequence Analysis- Clustal W
8	Studying the 3D structure of protein using- Rasmol, Cn3D
9	Construction of cladogram
10	Report writing: Genome projects

Suggestions for 40 marks internals:To establish and maintain a Drosophila culture in the laboratory, To identify various mutations in Drosophila and record of various crosses and submission of report

Department of Zoology

M.Sc. Semester-II

Skeleton Question paper Practical-III (BPSZOOP1)

Duration: 5.00 hrs Marks: 50

Q.1	Quantitative estimation of RNA by standard graph method	14
	OR	
Q.1	Construction of Pedigree chart of given data/ Analyze the given pedigree chart and comment	
	OR	
Q.1	Retrieve the sequence of the given proteins / genes and construct the cladogram	
Q.2	Retrieve the query sequence for the given protein or DNAand use BLAST for sequence alignment.	08
	OR	
Q. 2	Construct the cladogram using Clustal W with the given sequences	
Q.3	Find the 3D structure of protein using- Rasmol / Cn3D	04
	OR	
Q.3	Retrieve the information of given disease from OMIM / Pub Med	
Q. 4	Identification: a. Pedigree symbols b. Prenatal test	06
Q.5	Submission of Report and viva based on Genome projects	08
Q.6	Viva-voce and Journal	10

References:

Molecular Biology and DNA Recombinant Technology

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. 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.
10. Principles of Gene Manipulation & Genomics; Primrose SB and R. Twyman; Blackwell Science Publications; 2006.
11. Genetic engineering - Principles and Practice; Sandhya Mitra; Macmillan India Ltd., New Delhi.
12. Molecular Biotechnology - Principles and applications of recombinant DNA; Glick, B.R.and Pasternak, J. J.; ASM press, Washington; 2010.
13. Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005.
14. Biotechnology - Expanding Horizons; B.D.Singh; Kalyani Publishers, Ludhiana.
15. A textbook of Biotechnology; R.C.Dubey; S.Chand and Company Ltd., New Delhi.

Biotechnology -II

1. Biotechnology - U Satyanarayana
2. Molecular cloning; Joseph Sambrook, David William Russell; Third. Edition; CSHL Press; 2001.
3. Gene Cloning - An Introduction; Brown .T.A; Fourth Edition; Wiley-Blackwell; 2011.
4. 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.
5. Principles of Gene Manipulation & Genomics; Primrose SB and R. Twyman; Blackwell Science Publications; 2006.
6. Molecular Biotechnology - Principles and applications of recombinant DNA; Glick, B. R. and Pasternak, J. J.; ASM press, Washington; 2010.
7. Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005.
8. Biotechnology - Expanding Horizons; B. D. Singh; Kalyani Publishers, Ludhiana.
9. Environmental Biotechnology :Basic concepts and applications ; InduShekar Thakur; I.K. International Pvt. Ltd, Mumbai, New Delhi
10. Basic Biotechnology, 2nd Edition, Colin Rateledge and Bjorn Krisiansen, Cambridge University Press.

Genetic counseling:

1. Facilitating the genetic counseling process- Practice based skills by Bonnie S. and Lay Roy, Patricia McCarty Veach , Nanacy P Callanan
2. Harper's Practical Genetic Counseling (8^{th} Edition) by Angus Clarke.

Bioinformatics:

1. Dan E Krane and Michael L Raymer, fundamental concepts of bioinformatics, Pearson Education(low priced Edition)
2. Claverie & Notredame, Bioinfomatics- A Beginners Guide, Wiley-Dreamtech India Pvt LTD,2003.
3. Pevnezer, Bioinformatics and functional genomics, John Wiley
4. Lesk, Introduction to Bioinformatics, Oxford University Press, Indian Edition,2003
5. JinXiong, Essential Bioinformatics-Cambridge University Press, Printed and bound in India byReplika Press Pvt.Ltd.
6. Introduction to bioinformatics-Attwood and Parrysmith, Pearson education.
7. Bioinformatics-A Beginner's guide by Jean-Michel Claverie, Cedric Notredame - Wiley-India Pvt. Ltds

Syllabus w.e.f. Academic Year, 2021-22 (CBCS)
M.Sc. Zoology, Semester- II
Title:**Techniques and Methodologies in Zoology-II**

COURSE CODE: **BPSZOO204 Credit: 4 (100M)**

Course Outcome:

1. *Students will learn the principles and applications of various separation techniques. They will also learn to use these techniques and interpret the results in the laboratory.*
2. *Students will learn the importance of intellectual property rights and method of filling the patents.*
3. *Students will learn to apply the biostatistical methods to interpret the research data. They will be able to use the software SPSS for the data analysis.*
4. *Students will understand various research methods, ways of writing the hypothesis and apply the same in their research projects.*

Unit	**Title of the unit**		**Total Lectures (60)**
I	**INSTRUMENTATION-II**		15L
	1.1	Chromatography: Principle and applications of Chromatography	
	1.2	Column chromatography: Packing and operation of column, loading of column, eluting the column, collection of eluent, detection of eluent	
	1.3	Ion-exchange chromatography: Ion exchange resins, selection of ion-exchanger, choice of buffers, preparation and use of ion-exchangers, storage of resins.	
	1.4	Principle and Instrumentation of HPTLC, HPTLC vs TLC	
	1.5	Principle and Instrumentation of HPLC	
	1.6	Principle and Instrumentation of GC	
	1.7	Electrophoresis: Principle and applications of Electrophoresis	
	1.7.1	Agarose Gel Electrophoresis	
	1.7.2	Poly acrylamide gel Electrophoresis	
	1.7.3	2D Electrophoresis	
II	**INTELLECTUAL PROPERTY RIGHTS AND PATENTS**		15L
	2.1	Introduction and the need for Intellectual property Rights	
	2.1.1	PR in India and Abroad : Genesis and development	
	2.1.2	Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883 The Berne Convention, 1886. The Universal Copyright Convention, 1952 The WIPO Convention, 1967. The Patent Co-operation Treaty, 1970, The TRIPS Agreement, 1994	
	2.2	Kinds of Intellectual Property Rights	
	2.2.1	Patents: Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application Non - Patentable Subject Matter Registration Procedure Rights and Duties of Patentee Assignment and license Restoration of lapsed Patents	

		Surrender and Revocation of Patents Infringement, Remedies & Penalties Patent office and Appellate Board	
	2.2.2	Copyrights Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright	
	2.2.3	Plant Variety Protection	
		Plant variety protection: meaning and benefit sharing and farmers' rights – Procedure for registration, effect of registration and term of protection, farmers rights act, 2001	
	2.2.4	Design Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection	
	2.2.5	Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection	
	2.2.6	India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies	
III	**BIOSTATISTICS**		15L
	3.1	Elementary concepts in Statistics	
	3.1.1	Concepts of statistical population and sample from a population Collection, classification and presentation of data	
	3.1.2	Presentation of data: Diagrammatic and graphical representation of data; frequency distributions and cumulative frequency distributions; histogram, frequency polygon, stem and leaf chart and ogives.(Self Study)	
	3.2	Descriptive statistics: Concepts of central tendency or location, Absolute and relative measures of dispersion; Box plot, Lorenz curve; skewness and kurtosis.	
	3.3	Probability	
	3.3.1	Random Experiment; sample point; sample space; events; mutually exclusive and exhaustive events; frequency.	
	3.3.2	Classical definitions of probability	
	3.3.3	Axiomatic definition of probability	
	3.3.4	Addition and multiplication theorems	
	3.3.5	Conditional probability and independence	
	3.3.6	Bayes' theorem. (The main thrust is on numerical problems and applications)	
	3.4	Difference between parametric and non- parametric statistics Confidence interval, errors and significance	
	3.4.1	Analysis of variance, t test, Z test, X2 Test	
	3.5	Regression and Correlation	
	3.6	Anova	
	3.7	Introduction to statistical software SPSS	
	3.7.1	Creating Tables and Graph	
	3.7.2	Regression analysis	

	3.7.3	Calculation of anova	
IV	**RESEARCH METHODOLOGY**		15L
	4.1	Introduction to research methodology: Meaning of research, Objective of research, Motivation in research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific methods, Importance of knowing how research is done, Research process, Criteria for good research	
	4.2	Research Problem and research design: Selecting research problem, Necessity of defining a problem, Techniques involved in defining the problem, Meaning of research design, Need for research design, Important concepts related to research design; Different research designs, Basic principles of experimental design, Important experimental designs.	
	4.3	Interpretation and report writing:Meaning of interpretation, Technique of interpretation, Precautions in interpretation, Significance of report writing, Layout of research report types of reports, Presentation of research work-oral, poster and writing research paper; Precautions for writing research report	
	4.4	Review of related literature:Understanding the role of review, how to begin as research for related literature, Library reference, recording and indexing, classification of references, Internet sites for biological references-downloading the information through internet; requests for reprints through e-mail and post, Classification and filing of reprints.	
	4.5	Writing research proposal: Characteristics of a proposal, Content and organization of a proposal, Weakness in proposal seeking funding	

REFERENCES

1. ModernExperimentalBiochemistry: 3rdEd.RodneyBoyer, PearsonEducation.
2. PrinciplesandTechniquesofPracticalBiochemistry.WilsonandWalker, CambridgeUniv.Press.
3. BiologicalScience;3rdEd.D.J.Taylor,N.P.O.Green,G.W.Stou,CambridgeUniv.Press
4. CellandMolecularBiologyConceptsandExperiments,GeraldKarp.JohnWiley&Co.
5. Analytical Biochemistry, 3 edition, (1998), David Holmes, H.Peck, Prentice Hall, UK.
6. Bancroft & Stevens: Theory and Practice of Histological techniques (2002, Churchill-Livingstone)
7. Casselman: Histochemical techniques (1959, John Wiley)
8. Pearse: Histochemistry: Theoretical and Applied (Vol. I, II & III) (4th ed 1980-1993, Churchill- Living stones)
9. Biological Science; 3rd Ed. D. J. Taylor, N.P.O. Green, G.W. Stou, Cambridge Univ. Press
10. Introductory Practical Biochemistry; S. K. Swahney, Randhir Singh. Narosa Publ.
11. An Introduction to Practical Biochemistry; 3rd Ed. David Plummer. Tata McGrawHill
12. Practical Research Planning and Design; 2nd Ed. Paul D. Leedy. Macmillan Publ.
13. Elementary Practical Organic Chemistry Part I: Small Scale Preparations.2nd Ed. Arthur I. Vogel. CBS Publ. And Distributors.
14. Research Methodology, Methods and Techniques; C. R. Kothari .Wiley Eastern Ltd. Mumbai
15. Intellectual Property Law in India, Nishith Desai

16. Manual of Patent Office, Practice and Procedure , The Office Of Controller General of Patents, Designs &Trademarks, Boudhik Sampada Bhawan, S. M. Road, Antop Hill, Mumbai (India)

PRACTICAL IVCredit-2(50M)
Course Code: BPSZOOP2

Sr.No.	Practicals based on **BPSZOO204**
1.	Separation of plant pigments by column chromatography
2.	Separation of amino acids from casein by ion exchange chromatography
3.	Separation of plasma proteins by Poly acrylamide gel Electrophoresis
4.	Demonstration of separation of genomic DNA / plasmid DNA by Agarose gel Electrophoresis
5.	Demonstration of HPTLC, HPLC, GC
6.	Solving Biostatistics Problems based on Z test, t test, Chi- square test
7.	Using SPSS : Creating Tables and Graph, Regression analysis Calculation of anova

Internal submission for 40 marks: Based on IPR and Patent and Research methodology

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Department of Zoology
M.Sc. Semester-II
Skeleton Question paper Practical-IV (BPSZOOP2)
Duration: 5.00 hrs Marks: 50

Q.1	Demonstrate separation of plant pigments by column chromatography	12
	OR	
Q.1	Demonstrate separation of amino acids from casein by ion exchange chromatography	
Q.2	Solve the problems based on Biostatistics- Z test, t test, Chi-square test **(Any two)**	10
Q.3	Demonstrate separation of genomic DNA / plasmid DNA by Agarose gel Electrophoresis	10
	OR	
Q.3	Demonstrate separation of plasma proteins by Poly acrylamide gel Electrophoresis	
Q.4	Identify and comment on : HPTLC / HPLC / GC	08
Q.5	Journal and viva-voce	10

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

Syllabus for M.Sc. Part-II

Program M.Sc.

Course: Zoology- Biotechnology-Endocrinology

Semester III and IV

(With effect from 2021-22)

M.Sc.
Programme outcomes

PO	PO Description **A student completing post-graduation in Science (M.Sc.) will be able to attain the following**
PO1	Due to individual Research projects, research orientation and temperament will be enhanced.
PO2	Advanced Applied papers will upgrade the students' knowledge essential in the field.
PO3	Postgraduates with varied but interrelated and interdisciplinary academic background will be produced to serve as human resources. The knowledge of basic and applied/novel disciplines of the subject will aid in professional growth
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 probably solutions
PO6	Responsible execution of their roles in society as professionals, employers, and employees in various industries as regulators, researchers, educators and managers.
PO7	Life-long Learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of Subject and beyond through various Online platforms.

Program Specific Outcome:

M.Sc. Zoology with Biotechnology-Endocrinology as specialization is the unique combination offered by the Department of Zoology, B. K. Birla College. The specialization presents dual advantage of learning the applications of modern biology along with classical branch of zoology. Students will be introduced to theoretical and practical aspects of biotechnology as well as endocrinology.

The skill acquired by the students during the two years of this program will make them proficient in their practical skills which will create better understanding among them about the related theory units.

The specialization offered also aims to empower students in creating job opportunities or to start an entrepreneur endeavor of their own. The first two semesters having common syllabus with another specialization under Zoology will prepare students for the specialization of their choice.

Learning Biotechnology will provide an insight to the students in national problems and the methods to mitigate them, such as agricultural pest management, production of fortified crop, solid waste management by the ways of biomass utilization, bioremediation for pollution control etc. Industrial applications of Biotechnology and its use in health sector such as pharmaceutical productions, vaccine productions, enzyme technology taught in the syllabus will provide multiple job opportunities to the students.

Endocrinology will deal with invertebrate and vertebrate endocrine systems and hormone biology. Detailed knowledge in Endocrinology will help students in understanding the role of endocrine disruptors in causing hormonal disorders, infertility etc. Students will be able to take the counseling as a profession in the fields of fertility-infertility clinics. Students will understand the principles behind this subject which will help them in acquiring jobs in the field of clinical endocrinology, embryology and IVF.

Continuous internal assignment is a part of the evaluation system in this program; it will maintain the continuity in teaching and learning process.

If the program is completed with zeal, enthusiasm and dedication students will be able to incept their own start up and become job providers than the job seekers.

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –II Zoology Semester- III

Proposed Course Code	Unit	Topics	Proposed Changes in Topics	Credits	L/Week
BPSZOOBIOT301	I	The implications of recombinant DNA technology of commercial products & microbial synthesis	The implications of recombinant DNA technology of commercial products &microbial synthesis	04	1
	II	Large scale culture & production from recombinant microorganisms & genetically engineered animal cells	Large scale culture & production from recombinant microorganisms & genetically engineered animal cells		1
	III	Medical Biotechnology	Medical Biotechnology **3.1 to 3.3.2 Changed**		1
	IV	Environmental Biotechnology I	Environmental Biotechnology I		1
BPSZOOBIOT302	I	Genome management and analysis	Genome management and analysis **1.1.6 added**	04	1
	II	Manipulation of gene expression inprokaryotes	Manipulation of gene expression in prokaryotes		1
	III	Bioinformatics	Analysis of Proteome **New**		1
	IV	Animal biotechnology and Human therapies	Animal biotechnology and Human therapies **4.1.1 Added**		1
BPSZOOENDO303	I	General Endocrinology – I	Introduction to invertebrate endocrinology **New**	04	1
	II	Gonadal differentiation	Endocrine glands in invertebrates. **New**		1
	III	Female reproductive tract-I	Application of invertebrate hormones **New**		1
	IV	Conception	Techniques used in study of invertebrate hormones. **New**		1
BPSZOOENDO304	I	Hormones: Function and Classification	General Endocrinology-I **New**	04	1
	II	Biochemical Aspects	Neuro Endocrinology **New**		1
	III	Mechanism of action of peptide hormones –II	Biosynthesis and storage of hormones **New**		1
	IV	Applied Endocrinology -I	Gonadal Differentiation **New**		1
Total				16	16

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
M.Sc. –II Zoology Sem IV

Proposed Course Code	Unit	Topics	Proposed Changes	Credits	L/Week
BPSZOOBIOT401	I	Microbial synthesis of commercial products	Microbial synthesis of commercial products	04	1
	II	Large scale culture & production forindustrial biotechnology	Large scale culture & production forindustrial biotechnology		1
	III	Agricultural Biotechnology	Agricultural Biotechnology		1
	IV	Environmental Biotechnology II	Environmental Biotechnology – II		1
BPSZOOBIOT402	I	Genome management	Genome management **1.1 to 1.1.3 Changed**	04	1
	II	Manipulation of gene expression ineukaryotes	Manipulation of gene expression in Eukaryotes		1
	III	The human genome project	Molecular markers as a tool for Mapping **New**		1
	IV	Regulations and patents in biotechnology	Regulations and patents in biotechnology		1
BPSZOOENDO403	I	General Endocrinology –II	Comparative Studies of Female Reproduction **New**	04	1
	II	Male Reproductive System	Functional Aspects of Female Reproduction **New**		1
	III	Female reproductive tract-II	Functional Aspects of Male Reproductive System. **New**		1
	IV	Contraception	Contraception **New**		1
BPSZOOENDO404	I	Phylogeny and Ontogeny of endocrine Glands	Phylogeny and Ontogeny of endocrine glands **New**	04	1
	II	Biochemical Aspects	Biochemical Aspects of Hormones in metabolism. **New**		1
	III	Mechanism of action of peptide hormones –II	Mechanism of action of peptide and Steroid hormones.		1
	IV	Applied Endocrinology -II	Applied Endocrinology **New**		1
Total				16	16

B. K. Birla Collegeof Arts, Science and Commerce (Autonomous), Kalyan
Zoology: Biotechnology and Endocrinology
Credit Based and Grading System.
To Be Implemented from the Academic Year 2021-2022.

Semester -III

THEORY				
Course	Unit	Topic	Credits	L / Week
BPSZOOBIOT301	**Basics of Industrial & Environmental Biotechnology – I**			
(100M)	I	The implications of recombinant DNA technology of commercial products and microbial synthesis	04	01
	II	Large scale culture & production from recombinant microorganisms & genetically engineered animal cells		01
	III	Medical Biotechnology		01
	IV	Environmental Biotechnology I		01
BPSZOOBIOTP3 (50M)			**02**	
BPSZOOBIOT302	**Genetic Engineering Techniques & Its Applications**			
(100M)	I	Genome management and analysis	04	01
	II	Manipulation of gene expression in prokaryotes		01
	III	Analysis of Proteome		01
	IV	Animal biotechnology and Human therapies		01
BPSZOOBIOTP3 (50M)			**02**	
BPSZOOENDO303	**Invertebrate Endocrinology & Applications**			
(100M)	I	Introduction to invertebrate endocrinology.	04	01
	II	Endocrine glands in invertebrates.		01
	III	Application of invertebrate hormones		01
	IV	Techniques used in study of invertebrate hormones.		01
BPSZOOENDOP3 (50M)			**02**	
BPSZOOENDO304	**General & Vertebrate Endocrinology**			
(100M)	I	General Endocrinology-I	04	01
	II	Neuro Endocrinology		01
	III	Biosynthesis and storage of hormones		01
	IV	Gonadal Differentiation		01
BPSZOOENDOP3 (50M)			**02**	
Total			**24**	**16**

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Zoology - Biotechnology and Endocrinology
Credit Based and Grading System.
To Be Implemented from the Academic Year 2021-2022.

Semester –IV

THEORY				
Course	Unit	Topic	Credits	L / Week
BPSZOOBIOT401	**Basics of Industrial & Environmental Biotechnology II**			
(100M)	I	Microbial synthesis of commercial products	04	01
	II	Large scale culture & production for industrial biotechnology		01
	III	Agricultural Biotechnology		01
	IV	Environmental Biotechnology - II		01
BPSZOOBIOTP4 (50M)			**02**	
BPSZOOBIOT402	**Genome management, manipulation, regulations and patents in biotechnology**			
(100M)	I	Genome management	04	01
	II	Manipulation of gene expression in Eukaryotes		01
	III	Molecular markers as a tool for Mapping		01
	IV	Regulations and patents in biotechnology		01
BPSZOOBIOTP4 (50M)			**02**	
BPSZOOENDO403	**Vertebrate Endocrinology and Reproductive biology**			
(100M)	I	Comparative Studies of Female Reproduction	04	01
	II	Functional Aspects of Female Reproduction		01
	III	Functional Aspects of Male Reproductive System.		01
	IV	Contraception		01
BPSZOOENDOP4 (50M)			**02**	
BPSZOOENDO404	**Comparative and Molecular Endocrinology**			
(100M)	I	Phylogeny and Ontogeny of endocrine glands	04	01
	II	Biochemical Aspects of Hormones in metabolism.		01
	III	Mechanism of action of peptide and Steroid hormones.		01
	IV	Applied Endocrinology		01
BPSZOOENDOP4 (50M)			**02**	
Total			**24**	**16**

SEMESTER-III

SEMESTER III

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

M.Sc. Zoology: BIOTECHNOLOGY ENDOCRINOLOGY

Paper: I Credits-4 (100M)

BPSZOOBIOT301: Basics of Industrial & Environmental Biotechnology– I

Learning Objectives: *Nearly every walk of modern human life is influenced by biotechnology. Large scale production of fortified food, fuel and medicine is possible today because of the biotechnological knowhow. Theory units and the practical proposed in the paper are included with the objectives of teaching industrial and environmental applications of Biotechnology to students.*

Course outcome:

1. *Students will learn the potentials of r-DNA technology in commercial production of novel food products, pharmaceuticals and important biomolecules.*
2. *Students will learn the methods of fermentation using genetically engineered microbes. They will also learn the types of fermenters and alcohol production in detail.*
3. *Students will learn the methods of fermentation using genetically engineered microbes. They will also learn the types of fermenters and alcohol production in detail.*
4. *Students will learn the methods for Ex-vivo and In-vivo gene therapy for genetic diseases. They will also learn the methods of production of bacterial and viral vaccines.*

Unit I	**The implications of recombinant DNA technology of commercial products and microbial synthesis**	**15L**
1.1	The implications of recombinant DNA technology	
1.1.1	General account on applications of biotechnology	
1.1.2	Commercialization of biotechnology & biotech companies	
1.1.3	Prospects of novel food technology. Merits and demerits of genetically modified food.	
1.1.4	Areas of significant public concern: Antibiotic resistance marker gene, transfer of allergies, pollen transfer from GM plants and social, moral & ethical issues associated with GMOs.	
1.2	Commercial use of Amino acids in food, pharmaceutical and chemical industry– manufacturing process, strains of microbes used in the production of L-glutamate, L- aspartate, L-phenylalanine, L-tryptophan.	
Unit II	**Large scale culture & production from recombinant microorganisms & genetically engineered animal cells**	**15L**
2.1	Large scale culture & production from recombinant microorganisms:	
2.1.1	Batch fermentation	
2.1.2	Fed batch fermentation	
2.1.3	Continuous fermentation	
2.1.4	Maximizing the efficiency of fermentation process	
2.1.5	Harvesting, disrupting & downstream processing	
2.2	Large scale culture & production from genetically engineered animal cell cultures:	
2.2.1	Design of bioreactors for large scale animal cell culture-Batch, Fed batch	
2.2.2	Mammalian cell lines & their characteristics	
2.2.3	Media for the cultivation of mammalian cells	
2.2.4	Commercial products produced with mammalian cell culture	
Unit III	**Medical Biotechnology**	**15L**
3.1	Gene Therapy: Ex- vivo and in-vivo gene therapy	
3.1.1	Vectors in gene therapy	

3.1.2	Ex-vivo gene therapy - for Adenosine Deaminase Deficiency (SCID)	
3.1.3	In-vivo gene therapy for Cystic fibrosis	
3.1.4	Gene Therapy strategies for cancer- Tumor necrosis gene therapy, suicide gene therapy	
3.1.5	Nucleic acid therapy- Antisense therapy for Cancer and AIDS	
3.1.6	Aptamers and Ribozymes as therapeutic agents	
3.2	DNA in disease Diagnosis	
3.2.1	Cystic fibrosis, sickle cell anemia, Duchenne's muscular dystrophy, Fragile X syndrome, Huntington's disease and Alzheimer's disease	
3.3	Human Protein replacement therapy and Therapeutic agents	
3.3.1	Production of recombinant insulin, recombinant hGH	
3.3.2	Tissue plasminogen activator, interferons	
3.4	Production of Vaccines	
3.4.1	Sub-unit vaccines	
3.4.2	Sub-unit Vaccine production against viruses-Herpes simplex, Bovine foot & mouth disease virus	
3.4.3	Peptide vaccines-synthetic drugs (engineered proteins)	
3.4.4	Genetic immunization-DNA vaccines, Antisense DNA, Therapeutic ribozymes	
3.4.5	Live recombinant vaccines	
3.4.6	Attenuated vaccines against Cholera, Salmonella sp.	
3.4.7	Vector vaccines-Vaccine directed against viruses - Rabies virus G-protein,Hepatitis B surface antigen	
Unit IV	**Environmental Biotechnology I**	**15L**
4.1	Biomass utilization	
4.1.1	Microorganisms in lignocellulose degradation	
4.1.2	Isolation of prokaryotic & eukaryotic cellulase gene	
4.1.3	Manipulation of cellulase gene	
4.1.4	Production of single cell proteins by using biomass as raw material	
4.1.5	Commercial production of fructose and alcohol from biomass	
4.1.6	Improvements of fructose and alcohol production	
4.1.7	Fuel ethanol from biomass	
4.2	Bioremediation of xenobiotic compounds	
4.2.1	Characteristics of xenobiotics in the environment	
4.2.2	Characteristics of aerobic microorganisms for degradation of organic pollutants	
4.2.3	Genetic engineering of biodegradative pathways- Manipulation by transfer of plasmid, manipulation by gene alteration	
4.2.4	Degradation of xenobiotic compounds-petroleum products, n-alkanes, alkenes, cycloaliphatic compounds, aromatic hydrocarbons, polyaromatic hydrocarbons, chlorinated organic compounds (aliphatic & aromatic)	

SEMESTER III

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

M.Sc. Zoology: BIOTECHNOLOGY ENDOCRINOLOGY

Paper: II Credits-4(100M)

BPSZOOBIOT302: Genetic Engineering Techniques & Its Applications

Learning objectives: *Study of genomics and gene manipulation of prokaryotic cells are important aspects of genetic engineering. The objectives behind this paper are to make the students learn the detailed applications of genetic engineering and also learn some aspects of tissue engineering and human therapies.*

Course outcome:

1. *Students will learn the important concepts of* Genome management and analysis such as synthesis, sequencing and amplification of DNA. They will also understand the concept of DNA probe and its application.
2. *Students will learn various aspects of* gene expression and manipulation in prokaryotes like identification and isolation of functional promoters. Students will also learn the most recent technique of production of fusion proteins and their applications.
3. *Students will understand different methods of protein sequencing and the techniques such as 2-D electrophoresis, protein microarray, western blotting RIA, ELISA etc. required for the analysis of proteome.*
4. *Students will learn the methods of transgenesis for production of transgenic animals for commercial purpose. Students will also understand the methods of tissue engineering and transplantation.*

Unit I	**Genome management and analysis**	**15L**
1.1	The Basic tools of genetic engineering	
1.1.1	Chemical Synthesis of DNA- Oligonucleotide synthesis by Phosphoramidite method, Synthesis of genes	
1.1.2	DNA Sequencing - Maxam-Gilbert method, Sanger's dideoxynucleotide method, Primer walking using- bacteriophage M13	
1.1.3	Polymerase chain reaction and its applications	
1.1.4	Analysis of genome	
1.1.5	DNA fingerprinting/physical mapping/pulsed field gel electrophoresis	
1.1.6	DNA probes - Methods employed to make DNA probes, Mechanism of action of DNA probes, Radioactive and Non-radioactive detection system	
Unit II	**Manipulation of gene expression in prokaryotes**	**15L**
2.1	Promoters of gene expression in prokaryotes	
2.1.1	Prokaryotic gene expression	
2.1.2	Isolation of functional promoters	
2.1.3	Promoter selection with E.coli plasmid pBR316	
2.1.4	Promoter selection with plasmid pKO1	
2.1.5	Gene expression from strong and relatable promoters	
2.2	Expression of cloned genes in prokaryotes	
2.1.1	Increasing protein production and secretion	
2.1.2	Inclusion bodies and fusion proteins	
2.1.3	Unidirectional tandem gene arrays	
2.1.4	Translation expression vectors	
2.1.5	Increasing protein stability	
Unit III	**Analysis of the Proteome**	15L
3.1	Sequencing of proteins	
3.1.1	Edman Degradation. Sangers Method and mass Spectroscopy	

3.2	2D differential gel electrophoresis- Protein expression profiling	
3.3	Protein Microarray	
3.4	Detection of Proteins- Western Blotting	
3.5	Protein- protein interaction mapping- two hybrid assay and complementation assay	
3.7	Immunodetection techniques- RIA, DemoELISA, IFA	
3.8	Analysis of mRNA transcripts	
Unit IV	**Animal biotechnology and Human therapies**	**15L**
4.1	Transgenesis	
4.1.1	Methods of transgenesis: Lipofection, electroporation, DNA micro injection, Embryonic stem cell mediated gene transfer, virus mediated transduction.	
4.1.2	Transgenic animals and their applications: Mice as model system for human diseases and as test case model,	
4.1.3	Cows, pigs, sheep, goats as biopharmaceuticals.	
4.1.4	Transgenic insects and birds	
4.1.5	Recombinant DNA technology to prevent animal diseases	
4.1.6	Conservation biology-Embryo transfer	
4.1.7	Regulation of transgenic animals and patenting genetically engineered animals	
4.2	Human therapies	
4.2.1	Tissue engineering: Skin, liver, pancreas	
4.2.2	Xenotransplantation	
4.2.3	Antibody engineering	
4.2.4	Cell adhesion based therapies: Integrins, Inflammation, Cancer and metastasis	
4.2.5	Targeted gene replacement for correcting a mutated gene	
4.2.6	Site directed mutagenesis	

Semester III

Practical- 1& 2 Credits – 4 (50M+50M)

Practical Course Code BPSZOOBIOTP3 Based onBPSZOOBIOT301 and BPSZOOBIOT302

1	Separation of plasma proteins by PAGE and demonstration of Western Blot
2	Determination of molecular weight of protein using standard, semi-log graph interpretation
3	Determination of viable cell count in the given culture of bacteria by dilution & spreading technique.
4	Demonstration of Immunoblotting (Demo / Video)
5	Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing agarose gel electrophoresis.
6	Problems based on DNA sequencing, Maxam-Gilbert method, Sanger's dideoxynucleotide method and DNA fingerprinting
7	Demonstration of PCR and RT-PCR biotech
8	Bioremediation of heavy metal by bacteria / nano-particle
9	Isolation of cellulase, protease or lipase producing bacteria and fungi from soil

B. K. BIRLA COLLEGE OF ARTS, SCIENCE AND COMMERCE (AUTONOMOUS), KALYAN
DEPARTMENT OF ZOOLOGY
Skeleton Paper MSC-II SEMESTER- III (BPSZOOBIOTP3)

Time: 5 Hrs **TOTAL MARKS-50**

Q.1	Determination of viable cell count in the given culture of bacteria by dilution & spreading technique. (DAY 1)	**25M**
	OR	
Q.1	Isolation of cellulase / protease / lipase producing bacteria / fungi from soil. (DAY 1)	
Q.2	Problems based on DNA sequencing, Maxam-Gilbert method, Sanger's dideoxy nucleotide method and DNA fingerprinting (any 3)	**15M**
Q.3	Viva	**05M**
Q.4	Journal	**05M**

B. K. BIRLA COLLEGE OF ARTS, SCIENCE AND COMMERCE (AUTONOMOUS), KALYAN
DEPARTMENT OF ZOOLOGY
Skeleton Paper MSC-II SEMESTER- III (BPSZOOBIOTP3)

Time: 5 Hrs **TOTAL MARKS-50**

Q.1	Separation of plasma proteins by PAGE and demonstration of Western Blot. (DAY 2)	**15M**
	OR	
Q.1	Determination of molecular weight of protein using standard, semi-log graph interpretation. (DAY 2)	**15M**
Q.2	Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing agarose gel electrophoresis. (DAY 2)	
Q.3	Bioremediation of heavy metal by bacteria / nano particle. (DAY 2)	**10M**
Q.4	Viva	**05M**
Q.5	Journal	**05M**

Reference Books Biotechnology

1. Johan E. Smith, Biotechnology, 3rd Edition, Cambridge Univ. Press
2. Colin Rateledge and Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge Univ. Press
3. Susan R. Barnum, Biotechnology – An Introduction, Vikas Publishing House
4. Bernard R. Glick and Jack J. Pasternack, Molecular Biotechnology – Principles and applications of recombinant DNA, ASM Press, Washington DC.
5. Alexander N. Glazer and Hiroshi Nikaido, Microbial Biotechnology – Fundamentals of applied microbiology, W. H. Freeman and Co, New York
6. InduShekar Thakur, Environmental Biotechnology – Basic concepts and applications, I. K. International Pvt. Ltd, Mumbai, New Delhi
7. John A. Thomas (Ed.), Biotechnology and safety assessments, 2nd Edition, Taylor and Francis
8. S. S. Purohit, Biotechnology – Fundamentals and applications, 3rd Edition, Agrobios, India
9. Patent Facility Centre (PTC) Technology information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology, New Delhi
10. R. S. Crespi; Patents – a basic guide to patenting biotechnology, Cambridge Univ. Press
11. R. E. Speir, J. B. Griffiths, W. Berthold (Ed), Animal Cell Technology – Products of today, prospects of tomorrow, Butterworth –Heinman Publishers
12. Martin Fransman, GerdJunne, AnnemiekeRoobeek (Ed), The Biotechnology revolution, Blackwell Scientific Publishers
13. Terence Cartwright, Animal Cells as Bioreactors, Cambridge Univ. Press
14. A. Rosevear, John F. Kennedy, Joaquim M. S. Cabral, Immobilized enzymes and cells, Adam Hilger Publishers, Bristol and Philadelphia
15. Micheal P. Tombs and Stepan E. Harding, An Introduction to polysaccharide biotechnology
16. T. A. Brown, Gene Cloning – An Introduction, 3rd Edition, Nelson Thornes
17. Bob Old and S. B. Primrose, Principles of Gene Manipulation, 5th Edition, Wiley Blackwell Publishers 18. U. Satyanarayan, Biotechnology, 2007 Reprint, Uppala Author Publisher Interlink

SEMESTER III

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

M.Sc. Zoology: BIOTECHNOLOGY ENDOCRINOLOGY

Paper: III Credits-4(100M)

BPSZOOENDO303: Invertebrate Endocrinology and its Applications

Learning objectives: *Invertebrate endocrinology is less popular and generally neglected part of subject endocrinology. The units in this paper are developed with an objective of making students aware of the various endocrine phenomena like molting, metamorphosis, camouflaging and mating controlled by hormones.*

Course outcome:

1. *Students shall learn to appreciate the dynamics of hormones and endocrine control among invertebrates and apply the knowledge in biological control of pest, apiculture, agriculture and other fields which provide opportunities for entrepreneurship.*
2. *Students will learn the structures and functions of endocrine glands in invertebrates. They will also learn to locate these glands.*
3. *Students will understand the applications of invertebrate hormones as endocrine disruptors, biopesticides and role of pheromones in pest control*
4. *Students will learn the isolation and purification techniques of hormones such as FTIR, GCMS, TLC, HPTLC etc. They will also learn to retrieve the molecular structures of hormones using data bases.*

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
Unit I	**Introduction To Invertebrate Endocrinology**	15L
1.1	Scope of invertebrate endocrinology	
1.2	Neuroendocrine/ Endocrine system in invertebrates, types of invertebrate hormones/ functions	
1.2.1	Specialized cells and tissues in coelenterate and Helminthes (steroids, iodinated organic compounds, neuropeptides, and indoleamines, ecdysosteriod).	
1.2.2	Neurosecretory system in Annelida- Feedback substances	
1.2.3	Neuroendocrine system in Arthropoda- Juvenile hormone, ecdysone, ETH (ecdysone triggering hormone), Methyl farnesoate(MF)	
1.2.4	Neuroendocrine system in Mollusca- GNRH, Schistosomatin, Gonadotrophic hormone, optic gland hormone	
1.2.5	Neuroendocrine system in Echinodermata – Neuropeptide and polypeptide hormones	
1.3	Dispersal, Mode of action, chemical nature, classification and synthesis of invertebrate hormones	
Unit II	**Endocrine Glands In Invertebrates**	15L
2.1	Corpora cardiaca, Corpora allata, Pericardial gland, X organ/Y organ, Epitracheal gland, Mandibular organ in crustaceans, Neuro haemal organs, Prothorasic glands.	
2.2	Physiology of Hormonal Control in invertebrates	
Unit III	**Application of Invertebrate Hormones**	15L
3.1	Endocrine disrupters in invertebrates	
3.1.1	Invertebrate hormones in pest control	
3.1.2	Hormonal control of chitin production in crustaceans	
3.2	Exocrine glands, structure, exocrine secretion (ectohormone)	
3.3	Types of pheromones and defensive secretion in insects	
Unit IV	**Techniques used in study of invertebrate hormones.**	15 L
4.1	Techniques used in isolation and detection of hormones	

	TLC, Paper Chromatography, FTIR, GCMS	
4.2	Techniques used in purification of hormones TLC, Paper Chromatography, HPLC, HPTLC	
4.3	NCBI search for molecular structure of hormones	

Semester III

Practical Course Code BPSZOOENDOP3: Based onBPSZOOENDO303 and BPSZOOENDO304

BPSZOOENDO303: Invertebrate Endocrinology and its Applications

Practical 3 Credits-2(50M)

1	Dissection of retro-cerebral complex (neuro-endocrine system) in insects (e.g., cockroach/any other insect – Corpora cardiaca, Corpora allata, Prothorasic gland and prothorasic ganglion
2	Dissection and localization of testis and ovary in cockroach
3	Dissection of reproductive system in Housefly
4	Dissection of X organ and Y organ from eye stalk of crab
5	Dissection and localization of brain - Earthworm brain/CNS)
6	Dissection and localization of neurosecretary cells. Mollusca- (achatina, pila, clams)
7	Effect of eyestalk ablation on blood sugar level in crustacean- crab
8	Endocrine control of osmoregulation in crustaceans- changes in body weight after eye stalk ablation
9	Mounting of chromatophores from suitable animal
10	Response of chromatophores to varying temperatures (Video)
11	Morphological studies of different types of sperms in invertebrates with the help of permanent slides/ ICT tools/ models/ charts/ photographs etc.
12	Morphological study of different types of eggs, egg capsules of different invertebrates with the help of permanent slides/ ICT tools/ models/ charts/ photographs etc.
13	Effect of hormone mimic on the metamorphosis and other biological-characteristics of Drosophila.
14	Separation of ecdysone and JH form cockroach- by Paper chromatography/ TLC
15	Retrieving 3D structures of hormones from NCBI

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

DEPARTMENT OF ZOOLOGY

Skeleton Paper MSC-II SEMESTER- III (BPSZOOENDOP3) Practical-III

Time: 5 Hrs **TOTAL MARKS-50**

Q. 1	Dissect the given insect to expose its Testis/Ovary, stain and make its temporary mounting / Dissect the given insect so as to expose its reproductive system. (cockroach)	12
Q.2	Expose the prothorasic gland and prothorasicgangalion / Expose corpora cardiaca and corpora allata/ X and Y organs from the given animal.	08
	OR	
Q.2	Dissect the given animal to expose its brain/ make the temporary mounting of neurosecretory cells from the given animal/ Make a temporary mounting of chromophores from the given animal	08
Q.3	Demonstrate the effect of eye stalk ablation on glucose level and body weight in given animal/ demonstrate the effect of temperature on chromatophores in given animal/ Separate ecdysone and JH form cockroach- by Paper chromatography/ TLC)	08
Q.4	Write the functions of _____ and retrieve it's _____structure (3D) using appropriate data base	06
Q. 5	Identify and describe (A, B, C) - A- sperm of an invertebrate animal, B- Egg or egg case of an invertebrate animal. C- Describe the effect of hormone mimic on drosophila from the given pictures.	06
Q. 6	Viva-voce and Journal	10

SEMESTER III

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

M.Sc. Zoology: BIOTECHNOLOGY ENDOCRINOLOGY

Paper: IV Credits- 4(100M)

BPSZOOENDO304: General and Vertebrate Endocrinology.

Learning objectives: *Endocrinology a classic branch of Zoology specially the vertebrate endocrinology is a popular field of specialization. The course content of this paper are developed with the objectives of teaching the role of hormones and the details of histology of endocrine glands and other organs which are conventionally non endocrine but produce hormones.*

Course Outcome:

1. *Students will understand the structure and function of all the glands and organs. Understand the significance of hormones in various vital processes.*
2. *Students will learn the role of neuro endocrine system and pathways in control and coordination. They will also learn about the role of neurotransmitters.*
3. *Students will understand the* biosynthesis and storage of hormones secreted by major endocrine glands.
4. *Students will learn the process of gonadal differentiation and the role of hypothalamus-hypophysial-gonadal axis in the process.*

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
Unit I	**General Endocrinology**	15L
1.1	An overview of hormones: Definition and general properties of hormones, Hormones as Chemical messengers, Classification of hormones.	
1.2	Brief account of human endocrine system: Types of glands and their examples (apocrine, exocrine and endocrine), Positions of the glands, Blood supply, Anatomy and Embryology of Pituitary, Pineal, Thyroid, Adrenal, Pancreas, Ovary, Testis.	
1.3	Hormonal effects and regulation: Basic concepts and methods. Hormonal Feedback mechanisms (Two examples: Thyroid and Pancreas)	
Unit II	**Neuro Endocrinology**	**15 L**
2.1	Hormonal Mechanisms of Integration: Neuro-secretion and Neuroendocrine system, Neuroendocrine integration	
2.2	Endocrine Pathways: Afferent pathways, Integration centers, Efferent pathways	
2.3	Endocrine Reflex: First order, Second order, Third order	
2.4	Synthesis, mechanism of action and functions of dopamine, serotonin, GABA	
Unit III	**Biosynthesis and storage of hormones**	**15L**
3.1	Biosynthesis, storage and secretion of hormones of endocrine glands: Pituitary, Pineal, Thyroid, Parathyroid, Adrenal.	
3.2	Biosynthesis, storage and secretion of hormones of tissues of non-endocrine organs: Heart, Thymus, Stomach, Intestine, Liver, Kidney, Spleen, Pancreas, Bone marrow, Skeletal muscles. Placenta	
3.3	Factors influencing hormonal secretion	
3.4	Hormonal receptors and mechanism of hormonal action.	
Unit IV	**Gonadal Differentiation**	**15L**
4.1	Hypothalamo- hypophyseal- gonadal axis	
4.2	Biosynthesis of gonadal hormones	
4.3	Differentiation of testis and Ovary: Morphological, biochemical and hormonal aspects.	
4.4	Sexual differentiation: Genetic, sex- gonadal , sex- somatic	

4.5	Development of sexual abnormalities:	
4.5.1	Male and female sex organs: Genetic and endocrine aspects.	
4.5.2	Free Martin	
4.5.3	Transgender	
4.5.4	Sexual deviations.	

BPSZOOENDO304: General and Vertebrate Endocrinology
Practical-IV Credits-2(50M)

1	Dissection of the mammal so as to locate various endocrine glands (Using the diagram)
2	Dissection of mammal so to locate the major non endocrine organs and write their endocrine functions (Using the diagram).
3	Dissection of the head of the bird to expose its pituitary gland (Chicken head procured from the butcher's shop).
4.	Dissection of the head of fish to expose its pituitary gland.
5.	Dissection of fish to expose its ovary/Testis/Liver/Kidney
6.	Study of histology of Pituitary, thyroid, parathyroid, pineal, Adrenal.
7.	Study of histology of Pancreas, ovary, Testis, placenta (Human), spleen, liver, kidney
8.	Study of histology of Seminal Vesicles, Prostate, epididymis, vasa differentia, fallopian tube, uterus.
9.	Identification and description of the fine structure of cells of adenohypophysis TEM photographs.
10	Study of effect of gonadectomy on the histology and fine structure of accessory reproductive organs from the photographs provided.
11.	Study of effect of exogenous supplementation of testosterone on the GTH cells of pituitary gland/ Accessary male organs from the photographs provided.
12.	Histological localization of neurosecretory cells from the brain of bird. (Chicken head procured from the butcher's shop).
13.	Preparation of permanent slides from the tissue provided for histopathological preparations. Tissue infiltration and preparation of blocks. Preparation and cutting of blocks. Cutting of blocks and staining.
14.	Differential staining of the ribbon of the tissue provided (Using two different methods and combinations). Toluidine Blue and Janus Green B.
15.	Ectomies of Pituitary gland, Thyroid Gland, Adrenal Gland, gonadectomy (Videos and diagrams)
16	Identification and description of sexual abnormalities from photographs

B. K. BIRLA COLLEGE OF ARTS, SCIENCE AND COMMERCE (AUTONOMOUS), KALYAN
DEPARTMENT OF ZOOLOGY
Skeleton Paper MSC-II SEMESTER- III (BPSZOOENDOP3) Practical-IV
Time: 5 Hrs **TOTAL MARKS-50**

Q. 1	Dissect the given animal (Fish) /material (chicken head) so as expose its pituitary gland.	10
	OR	
Q.1.	Expose the given animal (Fish) so as to expose its gonad, liver, kidney and heart.	10
	OR	
Q.1	Expose the brain and demonstrate the staining of neurosecretory cells from the material given (Fish / Chicken head).	10
Q.2	Follow the procedure of infiltration and prepare the paraffin block for histological studies from the given tissue and cut the same for making the ribbon.	10
	OR	
Q.2	Cut the ribbon from the given block, stain the tissue and make a permanent slide.	10
	OR	
Q.2	Stain the tissue and prepare the permanent slides using two different staining techniques. Identify the tissue and draw it's neat and labeled diagram.	10
Q.3	Label the various endocrine glands, write their position, gross morphology and functions from the photographs provided.	06
	OR	
Q.3	Label the various hormone producing non endocrine glands, write their position, gross morphology and functions from the photographs provided.	06
	OR	
Q.3	From the two permanent slides provided of mammalian tissues identify the organs and the stain used and write the justification	06
Q. 4	Identify types of cells from the transmission electron micrograph of mammalian pituitary gland	05
	OR	
Q.4	Identify the GTH cells from the electron micrographs (a and b) provided and discuss the effect of exogenous supplementation of testosterone.	05
	OR	
Q.4	From the photograph provided identify the organ and describe the effect of gonadectomy on their histological/ fine structure.	05
	OR	
Q.4	Prepare the table for ectomy and draw the diagram	
Q.5	Identify and describe (a to c): A- Pituitary/ thyroid/ parathyroid/ pineal/ Adrenal. B- Pancreas/ovary/ Testis/placenta (Human)/ spleen/ liver/ kidney. C- Seminal Vesicles/ Prostate/ epididymis /vasa deferentia/ fallopian tube/uterus.	09
Q. 6	Viva-voce and Journal	10

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. Invertebrate Zoology by J.K. Dhami and P.S.Dhami published by R. Chand and Company 1979
4. Invertebrate endocrinology and hormonal heterophilly by Walter J. Burdette, Springer-Verlag.
5. Modern text book of Zoology - Vertebrates; Fifth edition; Professor R.L. Kotpal; Rastogi publication.
6. Chordate Zoology by E. L. Jordan & P. S. Verma Rev. edition, S. Chand Publications
7. Vertebrate Zoology by J.K. Dhami and P.S.Dhami published by R. Chand and Company 1979
8. Text Book of Endocrinology – Mala Dharmalingam by JAYPEE publications.
9. Harrison's Endocrinology- J Larry Jameson – 3rd edition.
10. Hormones and the endocrine system: Text book of endocrinology by Winfred Rossmanith; Springer Publications.
11. Histology for pathologists by Stacey E. Mills; 4th Edition; Williams and Wilkins.
12. Human Physiology by Chatterjee and Chatterjee.
13. Principals of Anatomy and Physiology by Tortora
14. B.D.Chaurasia Human Anatomy – Volume 1 and 2

SEMESTER-IV

B. K. Birla College of Arts, Science and Commerce (Autonomous), Kalyan
Zoology - Biotechnology and Endocrinology
Credit Based and Grading System.
To Be Implemented from the Academic Year 2021-2022.
Semester –IV

THEORY				
Course	Unit	Topic	Credits	L / Week
BPSZOOBIOT401	**Basics of Industrial & Environmental Biotechnology II**			
(100M)	I	Microbial synthesis of commercial products	04	01
	II	Large scale culture & production for industrial biotechnology		01
	III	Agricultural Biotechnology		01
	IV	Environmental Biotechnology - II		01
BPSZOOBIOTP4 (50M)			**02**	
BPSZOOBIOT402	**Genome management, manipulation, regulations and patents in biotechnology**			
(100M)	I	Genome management	04	01
	II	Manipulation of gene expression in eukaryotes		01
	III	Molecular markers as a tool for Mapping		01
	IV	Regulations and patents in biotechnology		01
BPSZOOBIOTP4 (50M)			**02**	
BPSZOOENDO403	**Vertebrate Endocrinology and Reproductive biology**			
(100M)	I	Comparative Studies of Female Reproduction	04	01
	II	Functional Aspects of Female Reproduction		01
	III	Functional Aspects of Male Reproductive System.		01
	IV	Contraception		01
BPSZOOENDOP4 (50M)			**02**	
BPSZOOENDO404	**Comparative and Molecular Endocrinology**			
(100M)	I	Phylogeny and Ontogeny of endocrine glands	04	01
	II	Biochemical Aspects of Hormones in metabolism.		01
	III	Mechanism of action of peptide and Steroid hormones.		01
	IV	Applied Endocrinology		01
BPSZOOENDOP4 (50M)			**02**	
Total			**24**	**16**

SEMESTER IV

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

M.Sc. Zoology: BIOTECHNOLOGY ENDOCRINOLOGY

Paper: I Credits-4(100M)

BPSZOOBIOT401: Basics of Industrial & Environmental Biotechnology – II

Learning objectives: *In continuation with the units incorporated in paper 1 semester 1 some more aspects of industrial and environmental biotechnology are covered in paper 1 semester 4. The objectives behind this paper are to make students understand the role of microbial biotechnology in commercial production of environmental material such as bioplastic, and role of microbes in the significant processes such as bioleaching.*

Course Outcome:

1. *Students will learn the methods of synthesis of commercial products like organic acids and antibiotics using microbes. They will also learn the general properties of bacterial and marine polysaccharides.*
2. *Students will learn the process of immobilization, preparation of bioreactors. They will also to apply the technique for large scale production using continuous bioreactors.*
3. *Students will understand the concept of nitrogen fixation and production of plants with Nif-gene. Students will also learn the production of pest resistant, disease resistant and herbicide resistant plants.*
4. *Students will learn the ways of mitigating the various types of pollutions by using processes like bioabsorption, bioleaching, phyto-remediation etc.*

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
Unit I	**Microbial synthesis of commercial products**	**15L**
1.1	Microbial synthesis of commercial products	
1.1.1	Organic acids & their commercial applications-Citric acid, gluconic acid, lactic acid.	
1.1.2	Antibiotics - Cloning antibiotic biosynthetic gene by complementation &other methods. Synthesis of novel antibiotics & improving antibiotic production. Aminoglycosides & their uses	
1.1.3	Polysaccharides: Bacterial polysaccharides: General properties & their commercial applications-Dextran, Xanthan and Alginate. Genetic engineering for the large scale production of Xanthan gum & its modification. Marine polysaccharides: General properties &their commercial application- Agar &agarose, Chitosan	
1.1.4	Polyesters: Polyhydroxy alkanoates (PHA)-Biosynthesis of PHA, Biopol-commercial biodegradable plastic	
Unit II	**Large scale culture & production for industrial biotechnology**	**15L**
2.1	Biotransformations	
2.1.1	Selection of biocatalyst-screening & use of novel existing biocatalyst	
2.1.2	Genetic modification of existing biocatalyst (Indigo biosynthesis)	
2.1.3	Biocatalyst immobilization: Methods of immobilization- Cross linking, supported immobilization, adsorption & ionic binding, covalent coupling, lattice entrapment	
2.1.4	Immobilized soluble enzymes & suspended cells	
2.1.5	Immobilization of multi-enzyme systems & cells	
2.1.6	Immobilized enzyme reactors- Batch reactors, continuous reactors	
2.1.7	Analytical enzymes: Enzymes in diagnostic assays: Test strip systems & Biosensors- Electrochemical & optical type	
Unit III	**Agricultural Biotechnology**	**15L**
3.1	Agricultural Biotechnology:	
3.1.1	Nitrogen fixation	

3.1.2	Nitogenase-Component of nitrogenase; Genetic engineering of nitrogenasecluster	
3.1.3	Hydrogenase-Hydrogen metabolism	
3.1.4	Genetic engineering of hydrogenase gene	
3.1.5	Nodulation-Competition among nodulation organisms, genetic engineering of nodulation gene	
3.1.6	Microbial insecticides-Toxins of *Bacillus thuringiensis*, mode of action & use of thuringiensis toxins, thuringiensis toxin gene isolation, genetic engineering of *Bacillus thuringiensis*strains& cloning of thuringiotoxin gene	
3.1.7	Developing insect resistant, virus resistant & herbicide resistant plant	
3.1.8	Algal products: Fuels from algae, marine natural products & their medical potential- anticancer, antiviral compounds, antibacterial agents.	
Unit IV	**Environmental Biotechnology II**	**15L**
4.1	Bioabsorption of metals (Recovery from effluents)	
4.1.1	Bioabsorption by fungi, algae, moss & bacteria	
4.1.2	Mechanism of bacterial metal resistance & genetic engineering for specific proteins	
4.1.3	Bioreactors for bioabsorption-packed bed, fluidized bed, rotating disc, single blanket, sequential reactors	
4.1.4	Phytoremediation &its use in biotechnology	
4.2	Bioleaching of metals	
4.2.1	Biochemical mechanism of bioleaching	
4.2.2	Extraction from mixtures	
4.2.3	Types of bioleaching	
4.2.4	Methods for bioleaching-Tank & heap bioleaching	
4.1.5	Microorganisms used for bioleaching	

SEMESTER IV

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

M.Sc. Zoology: BIOTECHNOLOGY ENDOCRINOLOGY

Paper: II Credits-4(100M)

BPSZOOBIOT402: Genome Management, Manipulation, Regulations and Patents in Biotechnology.

Learning objectives: *All the units and practical included in this paper are most recent have objectives of providing the exposure to the students to the fields of biotechnology which can be leant in correlation with molecular biology and molecular genetics.*

Course outcome:

1. Students will learn genome management with the help of new techniques like DNA –micro array, expressed sequenced tags, single nucleotide polymorphism (SNPs) and Serial analysis of gene expression (SAGEs).
2. Students will learn the techniques to introduce DNA into yeast for the production of homologous and heterologous protein, students will also learn about the insect cell, and mammalian cell expression system.
3. Students will learn about the molecular markers used in mapping.
4. Students will learn the rules and regulations of producing and releasing GMO in the environment. Students will learn how to patent the biotechnology inventions.

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
Unit I	**Genome management**	**15L**
1.1	Genome expression analysis	
1.1.1	DNA micro array	
1.1.2	cDNA and expressed sequence tags (ESTs)	
1.1.3	Serial analysis of gene expression(SAGE)	
1.1.4	Single nucleotide polymorphism (SNPs)	
1.2	Nucleic acid probes and hybridization – Southern Blotting	
Unit II	**Manipulation of gene expression in eukaryotes**	**15L**
2.1	Eukaryotic gene expression	
2.2	Introduction of DNA into fungi-yeast and filamentous fungi (fungal transformation)	
2.3	Heterologous proteins production in yeasts	
2.4	Heterologous proteins production in filamentous fungi	
2.5	Cultured insect cells expression systems- Baculovirus transfer vector	
2.6	Mammalian cell expression systems-Human Papova BK virus shuttle vector	
Unit III	**Molecular markers as tool for mapping**	**15L**
3.1	Restriction fragment length polymorphism (RFLP) and its uses	
3.2	Single nucleotide polymorphism (SNP)	
3.3	Randomly Amplified Polymorphic DNA (RAPD)	
3.4	Simple Sequence Length Polymorphism (SSCP)	
3.5	Amplified Fragment Length Polymorphism(AFLP)	
3.6	Variable Number of Tandem Repeat (VNTR)	
3.7	Sequence tagged site	
3.8	Simple sequence site	
3.9	Cleaved Amplified Polymorphic Sequences (CAPS)	
3.10	Satellite DNA- Minisatellite, Micro satellite	
Unit IV	**Regulations and patents in biotechnology**	**15L**
4.1	Regulating recombinant DNA technology	
4.2	Regulatory requirements - safety of genetically engineered foods,	

	Chymosin, tryptophan, bovine somatotropin	
4.3	Regulation environmental release of genetically engineered organism (GEO). Ice minus *Pseudomonas syringae*	
4.4	Regulatory agencies and laws for product regulation	
4.5	Risk assessment: How much risk?	
4.6	Open field tests of GEO	
4.7	Development of policy for Human gene therapy	
4.8	Patenting biotechnology inventions	
4.8.1	What constitutes the patent?, The patent process, The conditions to be satisfied for an invention to be patentable: Novelty, Inventiveness, Usefulness	
4.8.2	Patenting in different countries, types of inventions that are not patentable in India, What is Paris convention? Principal features of Paris convention	
4.8.3	Patenting multicellular organisms, Patenting and fundamental research	

Semester IV

Practical-1&2 Credits-4 (50M+50M)

Practical Course Code BPSZOOBIOTP4: Based onBPSZOOBIOT401 and BPSZOOBIOT402

1	Immobilize Yeast cells in calcium alginate & prepare a bioreactor column to demonstrate Invertase activity in the bioreactor column.
2	Restriction-digest the given DNA sample & demonstrate the separation of fragments by performing agarose gel electrophoresis. Interpret the results by comparing with the standard digests provided.
3	To plot a growth curve for the microorganisms provided.
4	Demonstrate the effect of medium on growth curves of given microorganism, using two different media (minimal & enriched).
5	Isolation and quantification of total proteins of the cells at log phase
6	Review writing on published patent and submit a report

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DEPARTMENT OF ZOOLOGY
Skeleton Paper MSC-II SEMESTER- IV (BPSZOOBIOTP4)

Time: 5 Hrs **TOTAL MARKS-50**

Q.1	Demonstrate the effect of medium on growth curves of given microorganism, usingenriched media / minimal media (DAY 1)	**20M**
Q.2	Immobilize Yeast cells in calcium alginate, prepare beads & keep them overnight inactivation medium (DAY 1)	**10M**
Q.3	Report submission on review of patent and viva on it	**10M**
Q.4	Viva	**05M**
Q.5	Journal	**05M**

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DEPARTMENT OF ZOOLOGY
Skeleton Paper MSC-II SEMESTER- IV(BPSZOOBIOTP4)

Time: 5 Hrs **TOTAL MARKS-50**

Q.1	Prepare a bioreactor column to demonstrate Invertase activity in the bioreactor column.(DAY 2)	**25M**
Q.2	Restriction-digest the given DNA sample & demonstrate the separation of fragments by performing agarose gel electrophoresis. Interpret the results by comparing with the standard digests provided. (DAY 2)	**15M**
	OR	
Q.2	Isolation and quantification of total proteins of the cells at log phase	**15M**
Q.3	Viva	**05M**
Q.4	Journal	**05M**

Reference Books Biotechnology

1. Johan E. Smith, Biotechnology, 3rd Edition, Cambridge Univ. Press
2. Colin Rateledge and Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge Univ. Press
3. Susan R. Barnum, Biotechnology – An Introduction, Vikas Publishing House
4. Bernard R. Glick and Jack J. Pasternack, Molecular Biotechnology – Principles and applications of recombinant DNA, ASM Press, Washington DC.
5. Alexander N. Glazer and Hiroshi Nikaido, Microbial Biotechnology – Fundamentals of applied microbiology, W. H. Freeman and Co, New York
6. InduShekar Thakur, Environmental Biotechnology – Basic concepts and applications, I. K. International Pvt. Ltd, Mumbai, New Delhi
7. John A. Thomas (Ed.), Biotechnology and safety assessments, 2nd Edition, Taylor and Francis
8. S. S. Purohit, Biotechnology – Fundamentals and applications, 3rd Edition, Agrobios, India
9. Patent Facility Centre (PTC) Technology information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology, New Delhi
10. R. S. Crespi; Patents – a basic guide to patenting biotechnology, Cambridge Univ. Press
11. R. E. Speir, J. B. Griffiths, W. Berthold (Ed), Animal Cell Technology – Products of today, prospects of tomorrow, Butterworth –Heinman Publishers
12. Martin Fransman, GerdJunne, AnnemiekeRoobeek (Ed), The Biotechnology revolution, Blackwell Scientific Publishers
13. Terence Cartwright, Animal Cells as Bioreactors, Cambridge Univ. Press
14. A. Rosevear, John F. Kennedy, Joaquim M. S. Cabral, Immobilized enzymes and cells, Adam Hilger Publishers, Bristol and Philadelphia
15. Micheal P. Tombs and Stepan E. Harding, An Introduction to polysaccharide biotechnology
16. T. A. Brown, Gene Cloning – An Introduction, 3rd Edition, Nelson Thornes
17. Bob Old and S. B. Primrose, Principles of Gene Manipulation, 5th Edition, Wiley Blackwell Publishers
18. U. Satyanarayan, Biotechnology, 2007 Reprint, Uppala Author Publisher Inter

SEMESTER IV

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

M.Sc. Zoology: BIOTECHNOLOGY ENDOCRINOLOGY

Paper: III Credits-4(100M)

BPSZOOENDO403: Vertebrate Endocrinology and Reproductive Biology:

Learning objectives: *The paper mainly focuses on male and female reproduction and endocrinology. The main objective is to teach details of hormonal control of various aspects of reproduction and family planning.*

Course outcome:

1. *Students will understand the structures and functions of various female reproductive organs. They will also learn the comparative anatomy of female reproductive system across the vertebrate classes.*
2. *Students shall understand scientific processes such as menstruation, pregnancy, lactation and breast cancer.*
3. *Students will learn the structures and functions of various male reproductive organs, process of spermatogenesis and disorders related to male reproductive systems.*
4. *Students will learn about the various methods of contraception and the risk associated with these methods.*

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
Unit I	**Comparative Studies of Female Reproduction**	**15 L**
1.1	Comparative study of female reproductive systems. One example of every class of subphylum vertebrata.	
1.2	Study of mammalian ovary (eg. Human ovary): Structure, folliculogenesis, Oogenesis and Ovulation.	
1.3	Sources of ovarian hormones, Ovarian androgen, inhibin	
1.4	Endocrine regulation of ovarian functions and dysfunctions: Role of age, Role of nutrition, Endocrine active ovarian tumors	
1.5	Morphological and histological comparisons of normal ovary with endocrine active ovarian tumor.	
Unit II	**Functional Aspects of Female Reproduction**	**15L**
2.1	Study of Uterus: Uterus and fallopian tube- Structure, function and hormonal regulation.	
2.2	Reproductive cycles in vertebrates: Estrous cycle, menstrual cycles.	
2.3	Mammary gland- Structure, function and regulation.	
2.4	Disorders of female reproduction:Breast Cancer, Polycystic ovary, Problems related to menstruation.	
2.5	Fertilization and conception.	
2.5.1	Placenta: Types of placenta, structure of human placenta, Foetal placental hormones.	
2.5.2	Pregnancy and its pathology, parturition, Lactation and their hormonal control.	
2.5.3	Ectopic pregnancy.	
2.5.4	Pregnancy investigation : Immunological method and HCG estimation	
Unit III	**Functional Aspects of Male Reproductive System.**	15L
3.1	Testis- Structure, spermatogenesis, spermiogenesis, steroidogenesis	
3.1.1	Endocrine, paracrine and autocrine regulation.	
3.1.2	Epididymis- Structure, function and regulation	
3.1.2	Accessory sex organs-Prostate, seminal vesicles, bulbourethral gland-structure, function and regulation.	
3.2	Physiology: Action of Testosterone (Effects on the genital system, effects on the secondary sexual characters, metabolic effects, psychic effects)	
3.3	Hypogonadism in male	
3.4	Cryptorchidism, gynaecomastia	

3.5	Symptoms of testicular hormonal overproduction	
3.6	Morphological and histological comparison of normal testis with testis in hypogonadism.	
Unit IV	**Contraception**	**15L**
4.1	Natural methods of contraception: Abstinence, Withdrawal or Coitus interruptus, Calendar methods - based on calculations of cycle length, Methods based on symptoms and signs, Lactational Amenorrhea Method (LAM), New Simple Calendar-Based Method, New simpler observation-based method, Advantages and disadvantages of family planning	
4.2	Regulation of female fertility	
4.2.1	Intrauterine and intra cervical devices (IUDS and IUCDS), medicated and non-medicated IUD's	
4.2.2	Long acting steroidal contraceptives	
4.2.3	Surgical sterilization and medical termination of pregnancy (MTP)	
4.2.4	Recent advances in female contraception (inhibin, prostaglandin, hormone analogues, subdermal implants	
4.3	Regulation of male fertility	
4.3.1	Vasectomy and reversible vas occlusion	
4.3.2	LH-RH antagonist, estrogen antagonist, GH antagonist	
4.3.3	Anti-androgen and anti-spermiogenic compounds (LDH-Cy and Sp-10), Inhibin.	
4.3.4	Antibodies for acrosomal enzymes and sperm surface proteins.	

Semester IV

Practical Course Code BPSZOOENDOP4: Based onBPSZOOENDO403 and BPSZOOENDO404

BPSZOOENDO403: Vertebrate Endocrinology and Reproductive Biology

Practical 3 Credits-2 (50M)

1.	Estimation of Proteins, carbohydrates and total fats from commercially available human milk analogues.
2.	Study of different types of placenta and histology of human placenta.
3.	Study of female reproductive system of garden lizard, rat and human.
4.	Study of male reproductive system of garden lizard, rat and human.
5.	Study of different stages of spermatogenesis using electron micrographs.
6.	Estimation of total number of eggs produced by normal human female.
7.	Study of polycystic ovary (Method and study of permanent slide)
8.	Study of histology of normal mammary gland and breast cancer.
9.	Study of implantation and stages of pregnancy using videos.
10.	Study of ectopic pregnancy using videos.
11.	Study of molecular structure of Testosterone, estrogen, progesterone and HCG using appropriate bioinformatics tool.
12.	Morphological and histological comparison of normal testis with testis in hypogonadism.
13.	Morphological and histological comparisons of normal ovary with endocrine active ovarian tumor.

B. K. BIRLA COLLEGE OF ARTS, SCIENCE AND COMMERCE (AUTONOMOUS), KALYAN
DEPARTMENT OF ZOOLOGY
Skeleton Paper MSC-II SEMESTER- IV(BPSZOOENDOP4)
Time: 5 Hrs **TOTAL MARKS-50**

Q.1	Estimate total proteins and carbohydrates from commercially available human milk analogue and compare the results with given data.	14
	OR	
Q.1	Estimate total proteins and total fats from commercially available human milk analogue and compare the results with given data.	14
	OR	
Q.1	Estimate total fats and carbohydrates from commercially available human milk analogue and compare the results with given data.	14
Q.2	Identify and label the parts of reproductive system of garden lizard / rat / human. (Using chart / Photographs etc.)	05
	OR	
Q.2	Identify and comment on the stages of estrous cycle.	05
Q.3	Identify and describe (any 5) mammary gland / breast cancer/Hypogonadism / ovarian tumor / electron micrograph of spermatogenesis / different types of placentae /histology of human placenta / Polycystic ovary / Corpus luteum/ stages in ovulation	15
Q.4	Retrieve the _____ structure of estrogen/Progesterone/ HCG/Testosterone using appropriate bioinformatics tool (any 2).	06
Q.5	Viva voce and Journal	10

SEMESTER IV

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

M.Sc. Zoology: BIOTECHNOLOGY ENDOCRINOLOGY

Paper: IV Credits-4(100M)

BPSZOOENDO404: Comparative and Molecular Endocrinology.

Learning objectives: *This paper have main objectives of dealing with comparative aspects of endocrinology of various classes of subphylum vertebrata and teach biochemistry and molecular biology of hormones.*

Course outcome:

1. *Students will understand the evolutionary development of endocrine systems among the various classes across subphylum vertebrata.*
2. *Students will learn the role of hormones in metabolism and the interconnections of various metabolic pathways.*
3. *Students will learn the functional differences between the peptide and steroid hormones, their regulation and clinical uses.*
4. *Students will understand the applications of hormones in production of pharmaceuticals, IVF techniques etc.*

UNITS	TITLE OF THE UNIT	Total no. of lectures (60)
Unit I	**Phylogeny and Ontogeny of endocrine glands**	**15 L**
1.1	Comparative Phylogeny and Ontogeny of Pituitary in Pisces, Amphibia, Reptiles and Mammals	
1.2	Comparative Phylogeny and Ontogeny of Pancreas in Pisces, Amphibia, Reptiles and Mammals	
1.3	Comparative Phylogeny and Ontogeny of Adrenal gland in Pisces, Amphibia, Reptiles and Mammals	
1.4	Comparative Phylogeny and Ontogeny of Thyroid gland in Pisces, Amphibia, Reptiles and Mammals	
1.5	Comparative Phylogeny and Ontogeny of Testis in Pisces, Amphibia, Reptiles and Mammals	
1.6	Comparative Phylogeny and Ontogeny of Ovary in Pisces, Amphibia, Reptiles and Mammals Testis	
Unit II	**Biochemical Aspects of Hormones in metabolism.**	**15L**
2.1	Types of hormones in metabolism.	
2.1.1	Peptide hormones	
2.1.2	Thyroid hormones	
2.1.3	Steroid hormones	
2.2	Role of hormones in metabolism	
2.2.1	Hormonal control of feeding behaviour and gastrointestinal tract functioning including acid release, gall bladder contraction and relaxation.	
2.2.2	Pancreatic enzyme secretion, and GI tract motility	
2.2.3	Hormonal regulation of Carbohydrate and Lipid metabolism	
Unit III	**Mechanism of action of peptide and steroid hormones**	15L
3.1	Peptide Hormone	
3.1.1	Cell surface receptors	
3.1.2	Cascade of reaction linked to signal transduction.	
3.1.3	Prostaglandins	
3.1.4	Calcium-magnesium-protein Kinase	
3.1.5	Nuclear binding and degradation	
3.1.6	Regulation of gene expression by cell surface receptors	
3.1.7	Defects in receptors-clinical uses	
3.1.8	G-proteins and G-binding protein receptors	

3.2	Steroid hormones	
3.2.1	Steroid hormones receptors- expression, distribution, regulation	
3.2.2	Interaction with DNA-post transcription and post translational effects	
3.2.3	Clinical uses of steroid receptors.	
Unit IV	**Applied Endocrinology**	**15L**
4.1	Hormones in growth, development and Pregnancy	
4.2	Production of hormones as Pharmaceuticals/Role of genetic engineering in the production of hormones	
4.2.1	Production of somatotropin (Growth Hormone) and Production of human insulin.	
4.3	*In vitro* fertilization and embryo transplantation.	

Practical-4 Credits-2(50M)

Comparative and Molecular Endocrinology - Practical 4

Course Code: **BPSZOOENDOP4**

1	Detection of hCG by RIA Kit
2	Study of phylogenetic relation between Pisces, Amphibia, Reptiles and Mammals based on structure of Pituitary, Pancreas, Adrenal, Thyroid, Testis and ovary
3	Study of phylogenetic relation between Pisces, Amphibia, Reptiles and Mammals based on molecular structure of insulin and somatotropin
5.	Study of thyroxin on the metamorphosis of frog (With the help of chart)
6.	Study of epinephrine and nor epinephrine on the glucose metabolism in fish model.
7.	Finding the molecular weight of different hormones using TLC
8.	Finding the molecular weight of various hormones using PAGE.
9.	Finding the molecular weight of various hormones using 2D paper chromatography
10.	Separation of hormones using PAGE and western blotting
11	Study of signal transduction pathway using chart or the video.
12.	Study of G Protein coupled receptors using charts or the video.
13.	Visit to IVF laboratory and submit a report.

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DEPARTMENT OF ZOOLOGY
Skeleton Paper MSC-II SEMESTER- IV (BPSZOOENDOP4)
Time: 5 Hrs **TOTAL MARKS-50**

Q. 1	Establish the phylogenetic relation between Pisces, Amphibia, Reptiles and Mammals based on structure of Pituitary / Pancreas / Adrenal / Thyroid / Testis / Ovary.	12
	OR	
Q.1.	Establish the phylogenetic relation between Pisces, Amphibia, Reptiles and Mammals based on molecular structure of insulin / somatotropin.	12
Q.2	Find the effect of epinephrine and nor epinephrine on glucose metabolism from the sample provided.	12
	OR	
Q.2	Find the molecular weight of the hormones provided using TLC/PAGE/ 2D Paper chromatography (Minimum two hormones).	12
Q.3	Confirm the presence of hCG from given samples.	04
Q.4	Complete the given chart to explain the effect of thyroxin on metamorphosis in amphibians.	04
	OR	
Q.4	Complete the given chart to explain the feedback control by thyroid gland	04
Q.5	Submit a report on *In vitro* fertilization and embryo transplantation.	08
Q. 6	Viva-voce and Journal	10

References:

1. Barrington (1979) Hormones and evolution Vol I&II Academic press, New York.
2. John F- Laycock and Peter H. Wise, Essential of Endocrinology
3. Wiliaimas R.H. (1974). Textbook of Endocrinology V.Ed. Saunders Press, London
4. Endocrinlogy- Hadley
5. General endocrinology Bagrara and Tumer, W.B. Saunders.
6. The Physiology of Reproduction, Vol I& II E.K .Nobil and JU. D.Neil, Raven Press, New York, 1988.
7. Benjamin Levin-Gene VII, Oxford University Press.
8. Lodish et al Molecular Cell Biology