

Progressive Education Society's
Modern College of Arts, Science and Commerce
[Autonomous],
Shivajinagar , Pune 5.

Framework of Syllabus
for

M. Sc. (Zoology)
(2019-20 Course)

(with effect from 2019-20)

Semester 1 (First Year)

Course Type	Course Code	Course / Paper Title	Teaching Scheme Hours / Week		
			Theory	Tutorial	Practical
CCT1	19ScZooP101	Biochemistry and Metabolic Pathways	4	-	-
CCT2	19ScZooP102	Cell Biology and Genetics	4	-	-
CCT3	19ScZooP103	Endocrinology and Fresh Water Zoology	4	-	-
DSET1	19ScZooP104	Biostatistics and Biochemical Techniques/ Biostatistics and Ichthyology	4	-	-
CCP1	19ScZooP105	Practical Lab - 1	-	-	4
AECCT-1	19ScZooP106	Human Rights-I	1	--	-
AECCT-2	19ScZooP107	Cyber Security-I	1	--	-
Total			18		4

Semester 2 (First Year)

Course Type	Course Code	Course / Paper Title	Teaching Scheme Hours / Week		
			Theory	Tutorial	Practical
CCT1	19ScZooP201	Molecular biology and r-DNA technology	4	-	-
CCT2	19ScZooP202	Developmental biology and Immunology	4	-	-
CCT3	19ScZooP203	Basic Entomology and Skills in Scientific communication and writing	4	-	-
DSET1	19ScZooP204	Bioinformatics and Fundamentals of Systematics/ Bioinformatics and Economic Zoology	4	-	-
CCP1	19ScZooP205	Practical Lab - 2			4
AECCT-1	19ScZooP206	Human Rights-II	1	--	-
AECCT-2	19ScZooP207	Cyber Security-II	1	--	-
		Total	18		4

Semester 3 (Second Year)

Course Type	Course Code	Course / Paper Title	Teaching Scheme Hours / Week		
			Theory	Tutorial	Practical
CCT1	19ScZooP301	Entomology I and Insect Physiology and Biochemistry	4	-	-
CCT2	19ScZooP302	Evolution and Ecology	4	-	-
CCT3	19ScZooP303	Comparative Animal Physiology and Mammalian Reproductive Physiology	4	-	-
DSET1	19ScZooP304	Parasitology and Research Project/ Pollution Biology and Research Project	4	-	-
CCP1	19ScZooP305	Practical Lab - 3			4
AECCT-1	19ScZooP306	Skill Development I	1	--	-
AECCT-2	19ScZooP307	Cyber Security-III	1	--	-
		Total	18		4

Semester 4 (Second Year)

Course Type	Course Code	Course / Paper Title	Teaching Scheme Hours / Week		
			Theory	Tutorial	Practical
CCT1	19ScZooP401	Entomology II and Biodiversity	4	-	-
CCT2	19ScZooP402	Bacterial and Phage Genetics and Histology and Histochemistry	4	-	-
CCT3	19ScZooP403	Genetic Toxicology and Animal Tissue Culture	4	-	-
DSET1	19ScZooP404	Animal Biotechnology and Research Project/Forensic Science and Research Project	4	-	-
CCP1	19ScZooP405	Practical Lab - 4			4
AECCT-1	19ScZooP406	Skill Development II	1	--	-
AECCT-2	19ScZooP407	Cyber Security-IV	1	--	-
		Total	18		4

M.Sc.Zoology
First Year
SEMESTER - I

Progressive Education Society's
Modern College of Arts, Science and Commerce,
 Shivajinagar, Pune – 5.

First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP101 Course Name : Biochemistry and Metabolic Pathways
Teaching Scheme: TH 4Hours/Week Credit - 04C
 Examination Scheme: CIA : 50Marks End-Sem : 50 Marks

Prerequisite : Bachelor of Science

Course Objectives:

- To introduce basic biochemistry
- To learn significance, structures of different biomolecules
- To give a detailed outline of metabolism
- To make students understand the changes in biochemical reactions under different physiological conditions

Course Outcomes:

On completion of the course, student will be able to–

- Use the learnt structures to understand metabolic reactions
- Understand the interrelationship between different biomolecules

Course Contents

Chapter 1	Water	2Lectures
	1.1 Structure and function 1.2 pH and Buffers 1.3 Biological Buffer System Problems and concepts related to mole, molarity, normality, buffers etc.	
Chapter 2	Carbohydrates	4Lectures
	2.1 Classification, basic Chemical Structures 2.2 Biological Significance. 2.3 Disorders of carbohydrate metabolism - Diabetes mellitus, glycogen storage diseases	
Chapter 3	Lipids	2Lectures
	3.1 Classification 3.2 Structure and function of major lipid subclasses.	
Chapter 4	Amino acids	3Lectures
	4.1 Classification 4.2 Properties and reactions (N / C terminal reactions, ninhydrin reaction)	
Chapter 5	Proteins	6Lectures
	5.1 Peptide bond and its formation 5.2 Protein structure : i. Primary structure and its importance	

	ii. Secondary structure-types iii. Tertiary structure: myoglobin iv. Quaternary structure- haemoglobin 5.3 Biological Role of Proteins	
Chapter 6	Enzymes	8Lectures
	6.1 Classification, nomenclature and properties 6.2 Enzyme kinetics , Factors affecting enzyme activity 6.3 Enzyme inhibition 6.4 Allosteric Enzymes. 6.5 Isozymes.(LDH) 6.6 Biochemical diagnosis of diseases by enzyme assays - SGOT, SGPT	
Chapter 7	Vitamins and Coenzymes	3Lectures
	7.1 Classification, water-soluble and fat-soluble vitamins 7.2 Coenzyme forms and their significance	
Chapter 8	Carbohydrate metabolism	12Lectures
	8.1 Glycolysis, gluconeogenesis, pentose phosphate pathway, Glyoxalate cycle, (emphasis on regulation) Glycogen metabolism and its hormonal regulation 8.2 The Citric acid cycle: Cyclic overview and reactions. Metabolic sources of acetyl CoA. Regulation and amphibolic nature of the cycle, Anapleurotic reactions 8.3 Dark reactions of Photosynthesis: CO ₂ fixation: C3, C4 and CAM pathways.	
Chapter 9	Lipid metabolism	6Lectures
	9.1 Oxidation of unsaturated and saturated fatty acid and its regulation. 9.2 Propionyl CoA metabolism, significance, synthesis and utilization of ketone bodies, Biosynthesis of palmitate and its regulation. 9.3 Mitochondrial and peroxisomal oxidation	
Chapter 10	Amino acid metabolism	5Lectures
	10.1 Oxidative degradation of amino acids: transamination, oxidative deamination 10.2 Urea cycle, Ammonia excretion	
Chapter 11	Nucleotide Metabolism	4Lectures
	11.1 Salvage and <i>de novo</i> pathways of purine and pyrimidine nucleotide 11.2 Biosynthesis. Formation of deoxyribonucleotides	
Chapter 12	Oxidative phosphorylation	4Lectures
Chapter 13	Experiential Learning	1Lecture

References

1. Biochemistry, 3rd Ed. (2005), Voet Donald and Voet Judith G. John, Publisher: Wiley and sons, New York.
2. Biochemistry 6th Ed, (2007) Berg Jeremy, Tymoczko John, StryerLubert, Publisher: W. H. Freeman, New York.
3. Lehninger's Principles of Biochemistry, 4th edition, (2005) Nelson D. L. and Cox M. M. W. H. Freeman and Co. NY.
4. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York. 5. Enzymes: Biochemistry, Biotechnology and Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.

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First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP102

Course Name : Cell Biology and Genetics

Teaching Scheme: TH 4Hours/Week

Credit - 04C

Examination Scheme: CIA : 50Marks

End-Sem : 50 Marks

Prerequisite: Bachelor of Science

Course Objectives:

- To study chemical nature of the Cell.
- To study role of Macro-molecules and functions of living systems.
- To introduce students to different branches of Genetics
- To make them understand heredity principles

Course Outcomes:

On completion of the course, student will be able to–

- Understand the significance and importance of cell as a structural and functional unit of life.
- Know the logic of the techniques used in cell biology
- Learn the complex functions and processes of the cell
- Design experiments related to rDNA technology and applications
- Predict the phenotype of organisms by studying genotypes

Course Contents

Chapter 1	Introduction to Cell	1 Lectures
	1.1 Types and Shapes of cell 1.2 Chemical nature of cell 1.3 Biological important molecules and their function in living systems 1.4 Stem Cells, types and characteristics	
Chapter 2	Plasma membrane	3 Lectures
	2.1 Structure, Fluid mosaic model 2.2 Intrinsic and extrinsic proteins 2.3 Hormone receptors on plasma membrane, their structure and role in signal transduction. 2.4 Membrane potential and synaptic transmission 2.5 Glycocalyx; cell junction, cell adhesion molecules, channels Active and passive transport, Types of pumps	
Chapter 3	Endomembrane system	3 Lectures
	3.1 EM Structure and functions of cell organelles (ER, Golgi complex, lysosomes) , Glyoxysomes, Peroxisomes	

	3.2 Protein trafficking.	
Chapter 4	Mitochondria and Chloroplast	3 Lectures
	4.1 Structure and Function 4.2 Protein import 4.3 Structure and function of F1 particles in mitochondria	
Chapter 5	Nucleus	5 Lectures
	5.1 Ultra structure, Nuclear pore complex, nuclear- cytoplasmic Interactions 5.2 Nucleolus 5.3 Nuclear lamina and its role in cell division	
Chapter 6	Cell Cycle	7 Lectures
	6.1 Phases, Check points of cell cycle mechanism of regulation (Cyclin and cyclin dependent kinases) Regulation of CDK cyclin activity. 6.2 Role of p53	
Chapter 7	Cytoskeleton	5 Lectures
	7.1 Types, Chemistry 7.2 Organisations, associated proteins and their role 7.3 Inhibitors	
Chapter 8	Mendelian Genetics	5 Lectures
	8.1 Recapitulation of Mendelian principles; Mono / dihybrid inheritance, types of dominance Practical applications of Genetics in brief. 8.2 Gene interactions (dominant and recessive epistasis) 8.3. Multiple alleles (Coat colour in rabbits, Eye colour in <i>Drosophila</i>) 8.4 Pleiotropy, Sex linked inheritance	
Chapter 9	Linkage	8 Lectures
	9.1 Linkage and crossing over: Linkage, linkage groups, types of crossing over, recombination maps in diploids for 3 point test cross, (determination of gene order with suitable examples) 9.2 Chromosome Mapping techniques	
Chapter 10	Quantitative Genetics	2 Lectures
	10.1 Inheritance of qualitative and quantitative traits: Polygenic traits and mode of inheritance, genetic and environmental factors 10.2 Heritability- broad sense and narrow sense	
Chapter 11	Population Genetics	3 Lectures
	11.1 Principles of Population Genetics: Hardy-Weinberg law and its application for autosomal genes. 11.2 Calculations of gene frequencies with suitable examples.	

Chapter 12	Cytogenetics and Operons	7 Lectures
	12.1 Chromosomal aberrations – Structural and numerical and its consequences 12.2 Organization and regulation of lac operon(emphasis on mutations) and arabinose operons.	
Chapter 13	Human Genome Project	3 Lectures
Chapter 14	<i>Drosophila</i> Genetics – Concept of Balancers, sex determination	2 Lectures
Chapter 15	Experiential Learning	1Lecture

References

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson. (1995). Molecular Biology of the Cell. Eds. 3, Garland Publi. New York and London.
2. Lodish, H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell. (1995). Molecular Cell Biology, Eds. 3, Scientific American and W. H. Freeman. New York.
3. Cell and Molecular Biology By De Robertis, EDP. And De Robertis EME, Molt Saunders Inc
4. Strickberger, M.W., Genetics, Edn.III, MacMillan, 1976.
5. Gardner, E.J., Peter and Simmons, M.J. and Snustad, D.P. Principles of Genetics, John Wiley and Sons, New York, 2006.
6. William S Klug and Michael R Cummings. Concepts of Genetics. Edn. IX. Prentice Hall International, Inc., New York, 2008.
7. Trends in Genetics. Elsevier Publications, Amsterdam.
8. Lewin, Benjamin. Genes IX. John Wiley and Sons, New York, 2008.
9. Genetics By Sarin, C., Tata McGraw Hill, New Delhi
10. Genetics: Daniel J Fairbanks, W. Ralph Andersen; Brooks / Cole Publ. co. (1999).
11. Genetics-A Molecular Approach: Peter J. Russell; Pearson Inc. publishing as Benjamin Cummings; 2006
12. Primrose S., Twyman R., Old D., Sixth Edition (2001) Principles of Gene Manipulation, Blackwell Science Ltd.

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First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP103 Course Name : Endocrinology and Fresh Water Zoology
Teaching Scheme: TH 4Hours/Week Credit - 04C
 Examination Scheme: CIA : 50Marks End-Sem : 50 Marks

Prerequisite:

- Bachelor of Science

Course Objectives:

- To introduce basic structure and function of different hormones
- To learn significance, structures of different receptors and signaling pathways
- To learn freshwater diversity and their interaction with the environment
- To study the basic properties of aquatic ecosystem and causes of water pollution

Course Outcomes:

On completion of the course, student will be able to–

- Understand the hormone - receptor interaction
- Know the different types of endocrine glands and their functions
- Understand importance of freshwater ecosystem
- Understand aquatic biodiversity and their adaptive features

Course Contents

Chapter 1	Regulation by chemical messenger	2Lectures
	1.1 Types of regulatory molecules: Hormones, Neurotransmitters 1.2 Endocrine glands and hormones 1.3 Paracrine regulators	
Chapter 2	Hormone Receptor	3Lectures
	2.1 Cell surface receptors, intracellular receptor 2.2 Receptor proteins and types of cell signaling	
Chapter 3	Mechanism of Hormone Action	2Lectures
	3.1 Signal Transduction cascade	
Chapter 4	Adenohypophysial hormones	3Lectures
	4.1 ACTH, PRL, STH and TSH	
Chapter 5	Neurohypophysial hormones	5Lectures
	5.1 Osmoregulatory Hormones -ADH, Oxytocin; Mineralcorticoids-renin-angiotensin	
Chapter 6	Pituitary and hypothalamus	3Lectures
	6.1 Control of chromatophore 6.2 Hypothalmo- releasing hormone	
Chapter 7	Hormonal Regulation	4Lectures

	7.1 Gastrointestinal hormones 7.2 Carbohydrates, protein and lipid metabolism 7.3 Pancreatic hormones glucocorticoids Control of calcium and phosphate metabolism.	
Chapter 8	Endocrine mechanism in crustacean	2Lectures
	8.1 X and Y organs, 8.2 Regulation of metabolism, heart, salt and water balance, reproduction, colour change, moulting	
Chapter 9	Hormones and reproduction in cephalopod mollusks and echinoderms	2Lectures
Chapter 10	Hormones regulation in insect larval development and metamorphosis	2Lectures
Chapter 11	Hormonal regulation of yolk synthesis, secretion and uptake in oogenesis w.r.t amphibians	2Lectures
	Freshwater Zoology	
Chapter 12	Types of Aquatic environment	3Lectures
	12.1 Lotic Habitat 12.2 Lentic Habitat 12.3 Ephemeral water bodies	
Chapter 13	Physical conditions of water	3Lectures
	13.1 Movement of water, Depth, Viscosity, Turbidity, Density, Buoyancy, Temperature and light, Stratification, Transparency	
Chapter 14	Chemical conditions of water	2Lectures
	14.1 Dissolved oxygen and Carbon di-oxide, phosphates, Nitrates. Acidity and alkalinity, Mg-hardness, Ca-hardness, dissolved solids, organic Matter. 14.2 Nutrient cycles in lakes	
Chapter 15	15.1 Diversity of animals from freshwater habitats 15.2 Different zooplanktons common in fresh water biome	5Lectures
Chapter 16	Physiological and protective adaptations of the following	2Lectures
	16.1 Protozoa, Rotifera, Crustaceans, Fishes	
Chapter 17	Diagnostic features and life cycle of	2Lectures
	17.1 Fairy shrimps and tadpole shrimps (temporary rainwater pool animals)	
Chapter 18	Respiratory and Locomotory adaptations in freshwater insects and their larvae	3Lectures
Chapter 19	Amphibia and water	2Lectures
	19.1 General life cycle of frog 19.2 Trophic status of Tadpole in freshwater habitat	
Chapter 20	Adaptations in freshwater reptiles:	2Lectures
	20.1 Turtles and Crocodiles 20.2 Regulation of metabolism, heart, salt and water balance, reproduction, colour change, moulting	
Chapter 21	Economic importance of freshwater animals, (molluscs, crustacean, fishes, reptiles, rotifers etc)	2Lectures

	21.1 Importance as food and medicine	
Chapter 22	Aquatic pollution	3 Lectures
	22.1 Causes of aquatic pollution: agricultural, industrial, thermal 22.2 Eutrophication 22.3 Biological changes in freshwater due to sewage pollution, sewage treatment	
Chapter 23	Experiential Learning	1 Lectures

References

1. Bentley, P.J. (1998). Comparative vertebrate endocrinology, edn.3, Cambridge University Press, London.
2. Bollander, F. (1994). Molecular endocrinology, edn.2, Acad. Press, San Diego.
3. Hadely, M.E. (1996). Endocrinology. Edn.4, Prentice Hall, Upper Saddle Park.
4. Thomdyke, M.C. and Goldsworthy, G.J. (1988). Neurohormones in Invertebrates. Cambridge University Press.
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8. Mellanby, H. (1975). Animal life in freshwater, 6th edition, Chapman-Hall
9. Limnology: Welch P.S. (1975). Mc. Grall and Hill Co. New York.
10. Treatise on Limnology: Hutchinson, G.E (1967) John Willy Pub, New York.

Progressive Education Society's
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Shivajinagar, Pune - 5
First Year of Master of Science
(2019 Course)

Course Code :19ScZooP104 Course Name: Biostatistics and Biochemical Techniques
Teaching Scheme: TH4Hours/Week Credit - 04C

Examination Scheme: CIA : 50Marks

End-Sem : 50Marks

Prerequisite:

- Bachelor of Science

Course Objectives:

- To study basic biostatistics
- To study different statistical tools used in biology
- To learn different techniques used in biology
- To study the applications and working of basic biological techniques

Course Outcomes:

On completion of the course, student will be able to–

- Apply different statistical tools by studying the data
- Understand the principle of biochemical techniques
- Design experiments using different biochemical techniques

Course Contents:

Biostatistics:

Chapter 1	Introduction	6 Lectures
	1.1 Applications and Uses of Statistics 1.2 Population and sample, Different types of Sample 1.3 Exercise and Problems.	
Chapter 2	Data classification	3Lectures
	2.1 Some important terms (Class frequency, class- limits, Class-width, class –mark) 2.2 Frequency distribution, Cumulative frequency, Graphical representation of data (Histogram, Pie-Diagram, Ogive- Curve.) 2.3 Exercise and Problems.	
Chapter 3	Measures of central tendency	3Lectures
	3.1 Concept of central tendency, Types of central tendency (Arithmetic mean, Median and mode) combined mean. 3.2 Partition values (Quartiles, Deciles, and Percentiles)	

	3.3 Exercise and Problems.	
Chapter 4	Measures of Dispersion	3 Lectures
	4.1 Concept of dispersion, absolute and relative measure of dispersion. 4.2 Different measures of dispersion (Range, Quartile- Deviation, Variance and standard-deviation, Coefficient of Variation) combined variance 4.3 Exercise and Problems.	
Chapter 5	Correlation and Regression	3 Lectures
	5.1 Bivariate data, concept of correlation, Types of Correlation, Scatter diagram, Karl Pearson's coefficient of correlation and its properties. 5.2 Concept of regression, Linear regression, regression Coefficients and its properties. 5.3 Exercise and Problems.	
Chapter 6	Probability	5 Lectures
	6.1 Some important terms (types of experiment, sample Space and types of sample space, events and types of events.) 6.2 Definition of probability (mathematical and classical) Conditional probability. Concept of random variable Univariate probability Distribution and its Mathematical expectation. 6.3 Some standard probability distributions (binomial, Poisson and normal)their probability distribution, mean, variance and properties of this distribution . 6.4 Exercise and Problems.	
Chapter 7	Test of Hypothesis	7 Lectures
	7.1 Some important terms (hypothesis, types of hypothesis, Test, Critical region, acceptance region, type I error, type II error, level of significance, p- value) 7.2 Test for mean and equality of two population means, Test for proportion and equality of two Population proportions. 7.3 chi-square test for goodness of fit,	

	Unpaired and paired t test. F test for equality of two population Variances. 7.4 Exercise and Problems.	
Biochemical Techniques		
Chapter 8	Chromatography	9Lectures
	8.1 Principles and applications of: Adsorption chromatography Partition chromatography 8.2 Ion-exchange chromatography, affinity chromatography, Molecular exclusion chromatography, thin layer chromatography, HPLC, RPLC 8.3 Selection of chromatographic system.	
Chapter 9	Electrophoresis	4Lectures
	9.1 Moving boundary electrophoresis, zone electrophoresis, 9.2 Different supports used for electrophoresis, electrophoresis under native, dissociating and denaturing conditions, isoelectric focusing	
Chapter 10	Centrifugation	3Lectures
	10.1 Principle, basic theory of ultracentrifugation 10.2 Molecular weight determination and its applications	
Chapter 11	DNA and protein sequencing	5Lectures
	11.1 Sangers and Maxam Gilbert method of sequencing, clone contig and shotgun approaches 11.2 Protein sequencing methods	
Chapter 12	Blotting	3Lectures
	12.1 Types of blotting - Southern, Northern and Western 12.2 Dot blots	
Chapter 13	Radioactivity	3Lectures
	13.1 Properties of radioisotopes, commonly used isotopes, structure and working of G.M. counter, isotopic dilution analysis, use of isotopes in biology 13.2 Radiation hazards.	
Chapter 14	Manometry	2Lectures

	14.1 Respiratory quotient determination, Principle of Warburg's apparatus, working and applications.	
Chapter 15	Experiential Learning	1 Lecture

References:

1. Principles and Techniques of Biochemistry and Molecular Biology, 6th edition (2008), Keith Wilson and John Walker, Publisher–Cambridge University Press.
2. Light Microscopy in Biology: A Practical Approach, 2nd edition (1999), Alan J. Lacey, Publisher–Oxford University Press.
3. Electron Microscopy: Principles and Techniques for Biologists, (1992), Lonnie D. Russell, Publisher-Jones and Bartlett
4. Principles And Practice of Biostatistics: Dr J.V. Dixit, 7th edition(2010)
5. Statistical Methods: Snedecor G.W. and Cochran W.G., 6th edition(Wiley publication)1997
6. Statistical Methods : Dixon W.S. and Massey, 4th edition (1985)

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First Year of Master of Science
(2019 Course)

Course Code :19ScZooP104 **Course Name: Biostatistics and Ichthyology**
Teaching Scheme: TH4Hours/Week **Credit - 04C**

Examination Scheme: CIA : 50Marks

End-Sem : 50Marks

Prerequisite :

- Bachelor of Science

Course Objectives:

- To Study basic biostatistics
- To study different statistical tools used in Biology
- To learn diversity of fishes
- To study feeding habits and physiology of different fishes

Course Outcomes:

On completion of the course, student will be able to–

- Apply different statistical tools by studying the data
- Understand the general morphology and physiology of fishes
- Understand fish behaviour

Course Contents

Biostatistics:

Chapter 1	Introduction	6Lectures
	1.1 Applications and Uses of Statistics 1.2 Population and sample, Different types of Sample 1.3 Exercise and Problems.	
Chapter 2	Data classification	3 Lectures
	2.1 Some important terms (Class frequency, class- limits, Class-width, class –mark) 2.2 Frequency distribution, Cumulative frequency, Graphical representation of data (Histogram, Pie-Diagram, Ogive- Curve.) 2.3 Exercise and Problems.	
Chapter 3	Measures of central tendency	3Lectures
	3.1 Concept of central tendency, Types of central tendency (Arithmetic mean, Median and mode) combined mean. 3.2 Partition values (Quartiles, Deciles, and Percentiles) 3.3 Exercise and Problems.	
Chapter 4	Measures of Dispersion	3Lectures
	4.1 Concept of dispersion, absolute and	

	<p>relative measure of dispersion.</p> <p>4.2 Different measures of dispersion (Range, Quartile- Deviation, Variance and standard-deviation, Coefficient of Variation) combined variance</p> <p>4.3 Exercise and Problems.</p>	
Chapter 5	Correlation and Regression	3 Lectures
	<p>5.1 Bivariate data, concept of correlation, Types of Correlation, Scatter diagram, Karl Pearson's coefficient of correlation and its properties.</p> <p>5.2 Concept of regression, Linear regression, regression Coefficients and its properties.</p> <p>5.3 Exercise and Problems.</p>	
Chapter 6	Probability	5 Lectures
	<p>6.1 Some important terms (types of experiment, sample Space and types of sample space, events and types of events.)</p> <p>6.2 Definition of probability (mathematical and classical) Conditional probability. Concept of random variable Univariate probability Distribution and its mathematical expectation.</p> <p>6.3 Some standard probability distributions (binomial, Poisson and normal)their probability distribution, mean, variance,and properties of these distribution .</p> <p>6.4 Exercise and Problems.</p>	
Chapter 7	Test of Hypothesis	7 Lectures
	<p>7.1 Some important terms (hypothesis, types of hypothesis, Test, Critical region, acceptance region, type I error, type II error, level of significance, p- value)</p> <p>7.2 Test for mean and equality of two population means, Test for proportion and equality of two population proportions.</p> <p>7.3 chi-square test for goodness of fit, Unpaired and paired t test. F test for equality of two population variances.</p> <p>7.4 Exercise and Problems.</p>	

Ichthyology Chapter 8	Classification	4Lectures
	8.1 Classification and diagnostic characters (up to orders) of extant Cyclostomata, Chondrichthyes and Osteichthyes (9 major orders of fishes)	
Chapter 9	Phylogeny	3Lectures
	9.1 Phylogeny of fishes, External morphology, body form, appendages, pigmentation, skin and scales. 9.2 Principles of morphometry, Locomotion	
Chapter 10	Endoskeleton	5Lectures
	10.1 Endoskeleton: Skull, axial and appendicular skeleton 10.2 Food and feeding habits 10.3 Digestive system and its anatomical modifications	
Chapter 11	Respiration	4Lectures
	11.1 Respiration: Structure and functions of gills; adaptations for air breathing; role of air bladder. Respiratory functions of food 11.2 Buoyancy mechanisms: Role of fat and swim bladder	
Chapter 12	Excretion	4Lectures
	12.1 Excretion and Osmoregulation; Glomerular and aglomerular kidneys; Nitrogen(ammonia,urea, TMAO) excretions; water and salt and balance in steno-and euryhayline fishes. 12.2 Role of skin and gills, Catadromous and anadromous fishes	
Chapter 13	Reproduction	4Lectures
	13.1 Reproduction: Structure of gonads, gametogenic cycles; spawning, Parental care	
Chapter 14	Nervous and Endocrine system	5Lectures
	14.1 Nervous system and Sense organs: Organization of the central and peripheral nervous systems. Eye, lateral line organs and chemoreceptors 14.2 Endocrine organs: Functions of the pituitary, thyroid, inter-renal and chromaffin tissues, ultimaobranchial	

	and corpuscles of Stannius	
Chapter 15	Experiential Learning	1Lectures

References:

1. Principles And Practice of Biostatistics: Dr J.V. Dixit, 7th edition(2010)
2. Statistical Methods: Snedecor G.W. and Cochran W.G., 6th edition(Wiley publication)1997
3. Statistical Methods : Dixon W.S. and Massey, 4th edition (1985)4.Bal, D. V. and K.V.Rao (1984). Marine Fisheries. Tata McGraw-Hill, New Delhi.
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First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP105

Teaching Scheme: TH 4Hours/Week

Examination Scheme: CIA : 50 Marks

Course Name : Lab Practicals 1

Credit - 04C

End-Sem : 50Marks

Prerequisite Courses:

Bachelor of Science

Course Objectives:

- To understand basic biochemistry, cell biology, genetics and endocrinology by actually performing related experiments
- To observe fresh water fauna in the field as well as in the laboratory

Course Outcomes:

- The students will have an hands on training experience in biochemistry, cell biology, genetics and endocrinology
- Students shall be able to understand the interrelationship between different biotic and abiotic factors in fresh water ecosystems

Course Contents (Any 35 to be conducted)

Sr. No.	Name of the Practical	No. of Practicals
	Biochemistry and Metabolic Pathways	
1.	Principle and working of Colorimetry and spectrophotometry	1P
2.	Preparation of Buffers of given pH and molarity and measurement of pH of various samples.	1P
3.	Estimation of protein by Folin Ciocalteu method.	1P
4.	Estimation of glucose by DNSA	1P
5.	Estimation of Vitamin C	1P
6	Units and specific activity of enzymes and progressive curve	2P
7.	Effect of substrate concentration on enzyme activity	1P
8.	Effect of pH and temperature on enzyme activity.	2P
9.	Effect of activators and inhibitors on enzyme activity.	1P
10	Estimation of amino acids by paper chromatography.	1P

11	Estimation of amino acids by TLC.	1P
12.	To find absorption spectrum of haemoglobin, BSA, Tyrosine.	1P
	Cell Biology and Genetics	
13	Study of different stages of mitosis in suitable material and Effect of colchicine on mitosis and polyploidy	1P
14.	Cell fractionation- Nuclei, mitochondria observation, nuclear count.	2P
15.	Preparation of blood smears: Cell type identification and differential counts	1P
16.	Ultra structure of cell organelles.	1P
17.	Study of Cyclosis in <i>Paramecium</i>	1P
18.	Study of meiosis in Grasshopper testes / Onion flower buds / <i>Aloe vera</i> with emphasis on all stages of prophase.	1P
19.	Study of sex linked inheritance in <i>Drosophila sp.</i>	1P
20.	Study of monohybrid and Dihybrid ratio in <i>Drosophila sp</i>	2P
21.	Polytene chromosomes of <i>Drosophila or Chironomous</i> -examination of puff and bands.	1P
22.	Pedigree Analysis: Sex-Linked, Autosomal dominant and recessive	1P
23.	Estimation of allelic frequencies, heterozygote frequencies in human populations.	1P
24.	Study of basic microbiology techniques and bacterial growth curve	2P
25	Determination of gene distances and gene order for a given three point test cross	1P
	Endocrinology and Fresh Water Zoology	
25	Histology of invertebrate and vertebrate neurosecretory and endocrine structures.	1P
26	Blood sugar regulation in the crab- role of eye stalk.	1P
27	Study of retro-cerebral complex of the cockroach.	1P
28	Effect of insulin on blood sugar, hepatic and muscle glycogen of the rat/human.	1P
29	A qualitative and quantitative analysis of zooplankton from a given sample of water using Sedgwick rafter counting cell.	1P
30	Study of aquatic and semiaquatic adaptations in amphibians and reptiles.	1P

31	Study of locomotory and respiratory adaptations in aquatic insects and their larvae.(Ranatra, Notonecta, Gerris, Bellostoma, Dytiscus)	1P
32	Estimation of Chlorides in given sample of water, Water analysis with regards to hardness (Total and Calcium).	2P
33	Identification of commercially important freshwater fishes and crustaceans.	1P
34	Determinations of LC50 using fish/insect larvae for known pollutant like Heavy metal/any Pesticide/industrial effluent.	1P
35	Compulsory Visit to ZSI, Pune and water purification plant and submission of tour report.	1P
36	Visit to freshwater body for the study of aquatic ecosystem.	1P

M.Sc.Zoology
First Year
SEMESTER - II

Progressive Education Society's
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First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP201 Course Name : Molecular Biology and rDNA Technology

Teaching Scheme: TH 4Hours/Week
 Examination Scheme: CIA : 50Marks

Credit - 04C
 End-Sem : 50 Marks

Prerequisite :

- Bachelor of Science

Course Objectives:

- To understand the central dogma of life
- To study different types of mutations
- To study and understand the importance of different transposable elements

Course Outcomes:

On completion of the course, student will be able to–

- Understand the flow of genetic information
- Understand the differences in genomes and life processes of prokaryotes and eukaryotes.

Course Contents

Chapter 1	Genome organization	5Lectures
	1.1 C value, C value paradox, Cot curves, repetitive and non-repetitive DNA sequence, Cot ½ values, Pseudogenes , Gene families, Gene clusters, 1.2 Organelle genomes 1.3 DNA structure and topology - Structure of chromatin, nucleosome, chromatin organization and remodeling, higher order organization - chromosome, centromere, telomere Histone and its effect on structure and function of chromatin 1.4 Physical properties of DNA : Tm, hypo and hyper chromicity, solubility, mutarotation and buoyancy. Types of RNA and their significance	
Chapter 2	DNA damage and repair	6Lectures
	2.1 Different types in DNA damages, Different DNA repair systems: Direct repair, Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair, Double strand break repair, transcriptional coupled repair, Nick 2.2 Translation and SOS Repair.	
Chapter 3	DNA Replication	10Lectures
	3.1 DNA replication in E. coli, Origin of replication, types of E. coli	

	DNA polymerases, details of replication process, regulation of replication, connection of replication to cell cycle. 3.2 Different models of replication for linear and circular DNA, Eukaryotic DNA replication, multiple replicons, eukaryotic DNA polymerases, details of eukaryotic replication, regulation of replication.	
Chapter 4	Transcription	11 Lectures
	4.1 Transcriptional Chapter in prokaryotes and eukaryotes, role and significance of promoter, enhancer, silencer, Transcriptional factors, mechanism of prokaryotic gene transcription, structure of RNA polymerase II, details of transcription process 4.2 Post transcriptional processing: Capping, polyadenylation and splicing in eukaryotes. Ribonucleoproteins (SnRNPs and ScRNPs)	
Chapter 5	Translation	5 Lectures
	5.1 Protein synthesis: Genetic Code ribosome structure, activation of amino acids, peptide bond formation and translocation of peptides 5.2 Post-translational modifications, inhibitors of protein synthesis	
Chapter 6	Mobile DNA elements	4 Lectures
	6.1 Transposable elements in bacteria, IS elements, composite transposons, replicative, non-replicative transposons, Mu transposition controlling elements in Tn A and Tn 10 transposition, 6.2 SINES and LINES. Retroviruses and retrotransposon	
Chapter 7	Techniques in Molecular Biology	4 Lectures
	7.1 Determination of gene function - Gene silencing - RNAi, Gene knockout 7.2 DNA footprinting, DNA binding motifs - helix turn helix, zinc fingers, leucine zippers, helix loop helix	
Chapter 8	Enzymes in rDNA Technology	2 Lectures
	8.1 Introduction, DNA modifying and degrading enzymes used in recombinant DNA technology	
Chapter 9	Vectors in rDNA technology	3 Lectures
	9.1 Cloning vectors - plasmid vectors, cosmids, BACs, YACs. Animal viruses derived vectors - SV40	
Chapter 10	Genomic libraries	2 Lectures
	10.1 Construction of genomic and cDNA libraries.	
Chapter 11	Screening methods	4 Lectures
	11.1 Screening for transformants, Characterisation of transformants: different hybridization techniques, probe preparation using radioactive and nonradioactive ligands detection of hybrids 11.2 DNA sequencing, site directed mutagenesis	
Chapter 12	Gene Therapy	3 Lectures
Chapter 13	Experiential Learning	1 Lecture

References

1. Genes IX, 9th edition (2008), Benjamin Lewin, Publisher - Jones and Barlett Publishers Inc.
2. Molecular Biology of the Gene, 5th Edition (2004), James D. Watson, Tania Baker,
3. Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick. Publisher –
4. Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. 26
5. Molecular Biology, 4th Edition (2007), Weaver R., Publisher-McGraw Hill Science.
6. Molecular Biology of the Cell, 4th Edition (2004), Bruce Alberts, Dennis Bray, Julian
7. Lewis, Martin Raff, Keith Roberts, and James D. Publisher: Garland Publishing.
8. Essential Cell Biology, 2nd Edition (2003) Bruce Albert, Dennis Bray, Karen Hopkin,
9. Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Publisher: Garland Publishing.
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13. Alcamo I. Second Edition (2001) DNA Technology, the awesome skill, Harcourt Academic Press
14. Brown T.A., Third Edition (2007) Genomes 3, Garland Science , Taylor and Francis Group.

Progressive Education Society's
Modern College of Arts, Science and Commerce,
 Shivajinagar, Pune – 5.

First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP202 Course Name :Developmental Biology and Immunology
Teaching Scheme: TH 4Hours/Week Credit - 04C
 Examination Scheme: CIA : 50Marks End-Sem : 50 Marks

Prerequisite :

- Bachelor of Science

Course Objectives:

- To provide a glimpse of scope and historical background of developmental biology to the students.
- To impart knowledge regarding basic concepts of differentiation and growth, differential gene expression as well as cytoplasmic determinants to the students.
- To develop detailed understanding of essential events of developmental biology
- To provide adequate explanation to the students regarding concepts of late embryonic developmental events

Course Outcome:

- Students would be aware about modern implications of developmental biology by impartment of knowledge regarding teratogenesis, in-vitro fertilization, stem cells and amniocentesis techniques

Course Contents: Developmental Biology

Chapter 1	Basic concepts of Developmental Biology:	2 Lectures
	1.1 Model systems :Fish, Frog, Chick, Mouse and <i>Drosophila</i>	
Chapter 2	Spermatogenesis	3 Lectures
	2.1 Origin of Primordial germ cells 2.2 Structure of sperm, 2.3 Regulation of sperm motility 2.4 Factors controlling spermatogenesis 2.5 Role of dyenin ATPase, role of pH and divalent cation.	
Chapter 3	Oogenesis	2 Lectures
	3.1 Structure of egg, synthesis and storage of maternal transcripts, proteins and cell organelles, 3.2 rDNA amplification,transcription lampbrush chromosomes, vitellogenesis, 3.3 Types of yolk, Functions, formation of egg membranes	
Chapter 4	Fertilization	3 Lectures
	4.1 Mechanism of fertilization : Species specific sperm attraction, recognition of egg and sperm, acrosome reaction, signal transduction, 4.2 Activation of ovum, regulation of cell cycle and utilization of maternal macromolecules and organelles during early development	

	4.3 Molecular strategy to ensure mono-spermy and polyspermy species specificity in fertilization 4.4 Significance	
Chapter 5	Cleavage , Blastulation, Gasrulation and Neurulation	5 Lectures
	5.1 Types of eggs and cleavage patterns: Concepts in Pattern formation, animal vegetal axis, gradients, origin, and specification of germ layers, Fate maps 5.2 Tubulation: Neurogenesis , growth and differentiation	
Chapter 6	Organizers:	2Lectures
	6.1 Role of Spemann's organizers in frog and Hensen's node in birds .Functions of Organizers	
Chapter 7	Mesoderm induction in <i>Xenopus</i>	4Lectures
	7.1 Role of signals in dorsal, intermediate and ventral mesoderm induction, Progressive Determination of the Amphibian Axes 7.2 Neural competence and molecular signaling during neural induction	
Chapter 8	Pattern formation in <i>Drosophila</i>	4Lectures
	8.1 Bicoid , Nanos and Torso Morphogen gradients and regulation of Hunchback	
Chapter 9	Stem cells and Growth and development	5Lectures
	9.1 Origin, Types of stem cells, Characteristics, functions 9.2 Concept of growth, differential cell proliferation, shaping of organ primordia and programmed morphogenetic cell death. 9.3 Growth and post embryonic development: Apoptosis, aging and senescence. Hayflicks experiment.	
	Immunology:	
Chapter 10	Immune System	4Lectures
	10.1 Introduction to Immunology 10.2 Tissue, cells and molecules of the human immune system. 10.3 Concept of immChapterry (self –nonself, antigen, antibody, immune response, immunological tolerance, autoimmune disease) and active and passive immunization, 10.4 Primary and Secondary lymphoid organs.	
Chapter 11	Types of Immunity	4Lectures
	11.1 Humoral immunity, and cell mediated immunity, T cell receptors. 11.2 Immediate response to infection: Inflammation, cell migration, acute phaseresponse interferon's and NK cell..	
Chapter 12	Antibody:	9 Lectures
	12.1 Structure, antibody classes, subclasses, structure- function relationship, iso, idio and allo types, 12.2 Theories of antibody synthesis, generation of antibody diversity 12.3 molecular basis, Antibody class switching	

	12.4 Antigen antibody reaction and complement fixation pathways	
Chapter 13	Immunogenetics:	4 Lectures
	13.1 HLA and Disease association, immune deficiencies and disorders. Antigen processing and MHC	
Chapter 14		5 Lectures
	14.1 Hybridoma principle and application, ELISA, Immunofluorescence, Immunoelectrophoresis, RIA and 14.2 Monoclonal and Polyclonal Antibody and its application	
Chapter 15	Immunological Memory and Vaccination	3 Lectures
Chapter 16	Experiential Learning	1 Lecture

References:

1. *Developmental Biology*, 9th edition (2010), S.F. Gilbert. Publisher - Sinauer Associates Inc.
2. *Principles of Development*, 3rd edition (2007), Lewis Wolpert, Publisher- Oxford University Press.
3. *An Introduction to Embryology*, 5th edition (2004), B. I. Balinsky. Publisher - Thomas Asia Pvt. Ltd.
4. *Developmental Biology*, (2001), R. M. Twyman, Publisher - Bios Scientific Publishers LTD.
5. *Analysis of Biological Development*, 2nd edition (2001), Klaus Kalthoff, McGraw Hill Higher Education
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6. *Immunology*, I.V. Roitt, Butterworth publishers, USA
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Progressive Education Society's
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First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP203

Course Name : Basic Entomology and Skills in Scientific Communication and Writing

Teaching Scheme: TH 4Hours/Week

Credit - 04C

Examination Scheme: CIA : 50Marks

End-Sem : 50 Marks

Prerequisite:

- Bachelor of Science

Course Objectives:

- To introduce basic entomology
- To learn origin, evolution and basic morphology of insects.
- To introduce Scientific English

Course Outcomes:

- Basic knowledge of entomology
- An idea about the typical morphological features of insect
- Evolutionary significance of insect
- To know about different types of insects and their different interactions with humans and other organisms
- Students shall be able to apply IMRAD format in research with proper usage of the English language

Course Contents

Chapter 1	Introduction to entomology	5Lectures
	1.1 Definition and scope 1.2 Origin of insects 1.3 Evolution of Arthropods and inter-relationship of different classes 1.4 Overview of common insect orders – General characters	
Chapter 2	General morphology of Insect	5Lectures
	2.1 Head and its different appendages 2.2 Thorax and appendages 2.3 Abdomen and appendages.	
Chapter 3	General Anatomy of Insect : Brief Outline	14 Lectures
	3.1 Digestive system 3.2 Respiratory system 3.3 Circulatory system 3.4 Nervous system 3.5 Reproductive system 3.6 Excretory system 3.7 Endocrine system	

Chapter 4	Insect life cycle	2Lectures
	4.1Life cycle stages: egg, larva, pupa, adult 4.2Metamorphosis and its significance	
Chapter 5	Beneficial insects and their interactions	2Lectures
	5.1 Insects as pollinators 5.2Insects in Apiculture, Sericulture, Lac culture 5.3Insects as bio-control agents	
Chapter 6	Harmful insects and their interaction	2Lectures
	6.1Introduction of different types of pests. 6.2Damage caused by pests 6.3Introduction to pest control and management	
	Skills in Scientific Communication and Writing	
Chapter 7	Introduction	1Lecture
	7.1 Language as a communication tool, relationship among reading, writing, hearing and speaking, synonyms and antonyms 7.2 Jargons	
Chapter 8	Errors	1Lecture
	8.1Common errors in written and spoken presentation: tautology, double negative, superfluous words, sequence and tenses.	
Chapter 9	Oral Presentation	2 Lectures
	9.1 Oral presentation: How to prepare a presentation, power point slides, use of communication and IT, Voice, speed of delivery 9.2 obstacles in effective communication	
Chapter 10	Basics of Scientific writing	2 Lectures
	10.1 Scientific writing basics: Style and composition- Words, Technical sentences, Paragraphs	
Chapter 11	Introduction	2Lectures
	11.1 Introduction: Survey of literature, defining the problem and justification	
Chapter 12	Materials and Methods	2Lectures
	12.1Materials and Methods: components, format, references, importance of measurements, reproducibility	
Chapter 13	Observations and Results	4Lectures
	13.1Observations and Results: text and data presentation, tables, graphs, histograms, diagrams, photographic plates, legends and captions	
Chapter 14	Discussion	3Lectures
	14.1Discussion: Logical sequence, dealing with discrepancies, unexpected findings and limitations, first draft and revision of draft. 14.2Importance of discussion	
Chapter 15	Title, Summary, Acknowledgements	1 Lecture
	15.1Title designing, Key words, Abstract, Summary and Acknowledgements	
Chapter 16	Citation	2Lectures

	16.1 Citation: How to find references from journals, books and data bases, styles of citations	
Chapter 17	Editing	1 Lecture
	17.1 Editing and correcting: proof- reading symbols, and abbreviations	
Chapter 18	Posters and Conference Abstracts	2 Lectures
	18.1 Posters and Conference Abstracts: Different formats, Elements of a poster and their location, preparation and presentation 18.2 Conference abstract	
Chapter 19	Proposal Writing	3 Lectures
	19.1 Research grant proposal writing: types of proposals, basic sections of a proposal, different sponsoring agencies, letters of inquiry, online resources	
Chapter 20	Writing for Job Applications	3 Lectures
	20.1 Curriculum vitae and different styles of resumes, Application with research statements, teaching statements; Cover letters; 20.2 Letters of recommendation	
Chapter 21	Experiential Learning	1 Lecture
	21.1 Self-learning assignment	

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2. Principles of Insect Morphology- By R. E. Snodgrass, (Tata, McGraw- Hill, Bombay.
3. Introduction of Comparative Entomology- By R. M. Fox and J. W. Fox, (Reinhold, New York,).
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Progressive Education Society's
Modern College of Arts, Science and Commerce,
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**First Year of Master of Science
(2019 Course)**

Course Code : 19ScZooP204 Course Name : Bioinformatics and Economic Zoology
Teaching Scheme: TH 4Hours/Week Credit - 04C
Examination Scheme: CIA : 50Marks End-Sem : 50 Marks

Prerequisite :

- Bachelor of Science

Course Objectives:

- To introduce basic Bioinformatics
- To create awareness amongst students about human health and hygiene
- To promote entrepreneurship in the field of Zoology

Course Outcomes:

- Students shall be able to understand the applications of Bioinformatics
- Understand different DNA and protein databases
- Students shall get an exposure to various applications of Zoology also in commercial sector

Course Contents

Chapter 1	Introduction	2Lectures
	1.1 Introduction to Bio-informatics, Goal and scope 1.2 Application and limitations	
Chapter 2	Biological Databases	3Lectures
Chapter 3	Protein Databases	4Lectures
	3.1 Protein sequence Database – UniProtKB / Swiss – Prot	
Chapter 4	Literature Database:	5Lectures
	4.1 Introduction to sequence alignment, Needleman and Wunsch algorithm. 4.2 Local alignment of sequences, Smith and Waterman algorithm.	
Chapter 5	Basic Local alignment Search Tool	3Lectures
	5.1 Basic Local alignment Search Tool - Introduction, Types, Applications	
Chapter 6	Molecular Phylogeny	5Lectures
	6.1 Multiple Sequence alignment and Molecular Phylogenetics	
Chapter 7	Databases	4Lectures
	7.1 Genome Database, Gene prediction and Genome comparison	

Chapter 8	Prosite databases	4Lectures
	8.1 ProSite – derived database 8.2 Protein Structure database and structure visualization	
	Economic Zoology	
Chapter 9	Introduction	2Lectures
	9.1 Parasitic protozoans and their role in human welfare, soil protozoans and their role in agriculture.	
Chapter 10	Sponges	1Lecture
	10.1 Sponge culture and its importance in industry.	
Chapter 11	Corals	1Lecture
	11.1 Concept of Coral reef and its significance.	
Chapter 12	Helminths	3Lectures
	12.1 Helminths as human and animal parasites. 12.2 Nematodes- parasitic roundworms of animals and plants.	
Chapter 13	Vermitechnology	1Lecture
	13.1 Vermiculture industry in India.	
Chapter 14	Applied Zoology [Invertebrates]	10 Lectures
	14.1 Household insects, Apiculture, Lac culture, Sericulture, 14.2 Prawn culture, Insects of commercial value and stored grain pests.	
Chapter 15	Applied Zoology [Vertebrates]	11Lectures
	15.1 Economic importance of amphibian, reptiles and birds 15.2 Poultry, Piggery, Dairy industry and wool industry 15.3 Model animals in pharmaceutical industry	
Chapter 16	Experiential Learning	1 Lecture

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1. Introduction to Bioinformatics. Arthur M. Lesk (3rd ed.). Oxford University Press.
2. Bioinformatics: Sequence and Genome Analysis. David Mount (2nd ed.). Cold Spring Harbor Laboratory Press.
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Progressive Education Society's
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First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP204

**Course Name : Bioinformatics and
 Fundamentals of Systematics**

Teaching Scheme: TH 4Hours/Week

Examination Scheme: CIA : 50Marks

Credit - 04C

End-Sem : 50 Marks

Prerequisite :

- Bachelor of Science

Course Objectives:

- To introduce basic Bioinformatics
- To make students understand the basic concepts of classification and systematics and its importance
- To clear the concept of species and its types.
- To enable the student classify and identify different organisms by running taxonomic keys

Course Outcomes:

- Students shall be able to understand the applications of Bioinformatics
- Understand different DNA and protein databases
- The students can run taxonomic keys and identify different organism based on keys
- The students will have a clear idea about the modern methods of classification and identification based on molecular phylogenetics.

Course Contents

Chapter 1	Introduction	2 Lectures
	1.1 Introduction to Bio-informatics, Goal and scope 1.2 Application and limitations	
Chapter 2	Biological Databases	3 Lectures
Chapter 3	Protein Databases	4 Lectures
	3.1 Protein sequence Database – UniProtKB / Swiss – Prot	
Chapter 4	Literature Database:	5 Lectures
	4.1 Introduction to sequence alignment, Needleman and Wunsch algorithm. 4.2 Local alignment of sequences, Smith and Waterman algorithm.	
Chapter 5	Basic Local alignment Search Tool	3 Lectures
	5.1 Basic Local alignment Search Tool - Introduction, Types, Applications	
Chapter 6	Molecular Phylogeny	5 Lectures

	6.1 Multiple Sequence alignment and Molecular Phylogenetics	
Chapter 7	Databases	4 Lectures
	7.1 Genome Database, Gene prediction and Genome comparison	
Chapter 8	Prosite databases	4 Lectures
	8.1 ProSite – derived database	
	8.2 Protein Structure database and structure visualization	
	Fundamentals of Systematics	
Chapter 9	Introduction	5 Lectures
	9.1 Biological classification	
	9.2 Taxonomic Characters: procedure and keys	
	9.3 Species concept: varieties, subspecies, sibling species, race.	
Chapter 10	Kingdoms of life	3 Lectures
	10.1 General outline of Kingdom Monera, Protista, Fungi, Plantae.	
	10.2 Broad outline of Kingdom Animalia	
Chapter 11	Methodologies of systematics	8 Lectures
	11.1 Morphology based taxonomy	
	11.2 Numerical taxonomy, Cyto-taxonomy and chemo taxonomy	
	11.3 Molecular Systematics	
	11.4 DNA fingerprinting	
	11.5 Molecular Markers and detection of polymorphism RFLP, RAPD.	
Chapter 12	Taxonomic Keys	3 Lectures
	12.1 Types of keys	
	12.2 Merits and demerits of different keys	
Chapter 13	International Code for Zoological Nomenclature	5 Lectures
	13.1 Operative principles	
	13.2 Interpretation and application of different rules.	
	13.3 Zoological nomenclature: formation of names	
Chapter 14	Taxonomic Procedures	5 Lectures
	14.1 Taxonomic collection, preservation and curation process	
	14.2 Molecular phylogenetics	
Chapter 15	Experiential Learning	1 Lecture

References:

1. Introduction to Bioinformatics. Arthur M. Lesk (3rd ed.). Oxford University Press.
2. Bioinformatics: Sequence and Genome Analysis. David Mount (2nd ed.). Cold Spring Harbor Laboratory Press.
3. Bioinformatics for Geneticists: A Bioinformatics Primer for the Analysis of Genetic Data. Michael R. Barnes (2nd ed.). John Wiley and Sons Inc.
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Progressive Education Society's
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First Year of Master of Science
(2019 Course)

Course Code : 19ScZooP205

Teaching Scheme: TH 4Hours/Week

Examination Scheme: CIA : 50 Marks

Course Name : Lab Practicals 2

Credit - 04C

End-Sem : 50Marks

Prerequisite Courses:

Bachelor of Science

Course Objectives:

- To understand Molecular biology and rDNA technology, Developmental biology, Immunology and Entomology
- To train students in efficient usage of English language in scientific communication

Course Outcomes:

- The students will have an hands on training experience Molecular biology and rDNA technology, Developmental biology, Immunology and Entomology
- Students shall be able to communicate effectively in scientific community

Course Contents (Any 35 to be conducted)

Sr. No.	Name of the Practical	No. of Practical
	Molecular Biology and rDNA Technology	
1.	Lab Safety Techniques and sterilization.	1P
2.	Isolation of bacterial DNA and estimation by UV spectrophotometry	2P
3.	Isolation of Liver DNA and quantification by Agarose gel electrophoresis	2P
4.	Absorption studies of isolated DNA	1P
5.	To analyse protein on native PAGE and SDS-polyacrylamide gel electrophoresis	2P
6	Study of Restriction digestion of DNA and Electrophoretic analysis	2P
7.	Study of ligation of DNA and Electrophoretic analysis	2P
8.	Amplification of given DNA by PCR. and Electrophoretic analysis	2P
	Developmental Biology and Immunology	
9.	Mounting of chick embryos and preparation of permanent mounts, Gross	1P

	anatomy and histology of chick embryo upto 72 hrs. Brain, heart, lens, development.(18 hrs., 24 hrs., 33hrs., 48 hrs. WM)	
10	<i>Drosophila</i> development on live material: egg structure, egg laying and early development in culture by phase contrast	2P
11.	Study of effect of ligature in <i>Drosophila</i> / House fly larva	1P
12.	Study the imaginal disc in <i>Drosophila</i> larva	1P
13.	Chick limb bud staining with neutral red for morphogenetic cell death	1P
14	Regeneration of <i>Hydra/Planaria</i>	1P
15	Histology of Lymphoid organ- Skin, Spleen, Thymus, Ilium, Lymph node, Bone marrow	1P
16	Blood smear preparation to study various blood cells	1P
17	Ouchterlony technique of agar gel diffusion	2P
18	Immunoelectrophoresis	2P
19	To estimate the antigen concentration using rocket electrophoresis	1P
20	To perform ELISA	2P
21	Visit to IVF center/BAIF	1P
	Basic Entomology and Skills in Scientific Communication and Writing	
22	Methods of collection, preservation and presentation of insects	2P
23	Study of head capsules, mouth parts and antennae and their modification	1P
24	Study of generalized wings and their modifications with significance	1P
25	Study of beneficial insects and harmful insects	1P
26	Dissection of cockroach for digestive and reproductive systems	2P
27	Syntax, paraphrasing and précis writing, synonyms, antonyms, abbreviations	1P
28	Outline of a scientific paper; preparation of a project and writing Introduction	1P
29	Writing abstracts, conclusion/ summary and acknowledgements, key words, To suggest a title to the given abstract/paper	1P
30	Study of proof correction symbols; proof- reading the given text and correcting the proofs	1P
31	Assigning legends to given graphs, figures and captions to given tables, Deciphering the given pictorials, Designing of tables and graphs from the given data,	1P
32	How to write materials and methods ,observation section of a research paper	1P
33	Write discussion section for the given research paper [without discussion]	1P

	and Citations/ Bibliography: how to find and cite references from journals, books and databases	
34	Oral presentation: Rhythm, style, mock presentation for 10 minutes	1P
35	Research grant proposal writing	1 P