

Kavayitri Bahinabai Chaudhari
North Maharashtra University,
Jalgaon



Proposed Structure of Syllabus for B.Sc.
T. Y. B. Sc. (ZOOLOGY)
Choice Based Credit System (CBCS)

2020-21

T. Y. B. Sc. ZOOLOGY (CBCS Structure)

(With Effect from June 2020)

Semester V and VI

Preamble:

The choice based credit system (CBCS) was introduced at FYBSc since academic year 2018-19. It was then opted for SYBSc during academic year 2019-20 and CBCS system shall be effective for third year students from 2020-21. The contents have accommodated the widening horizons of the discipline of Biological Sciences. They reflect the current changing needs of the students; specifically, the subjects on biotechnology, bioinformatics and research methodology have been incorporated. The well organized curricula including basic as well as advanced concepts in Zoology from first year to third year. The course content also lists the new practical exercises so that the students get a hands-on experience of the latest techniques that are in current usage. The curricula shall inspire the students for pursuing higher studies in Zoology and for becoming an entrepreneur and also enable students to get employed in the Biological research Institutes, Industries, Educational Institutes and in the various concerning departments of State and Central Government based on subject Zoology.

Introduction:

At first year of under-graduation the topics related to the fundamentals of zoology, including exposure to diversity of animals, comparative anatomy of vertebrates and developmental biology are covered in semester I and II. The practical course is aimed at to equip the students with skills required for animal identification, morphological, technical description, classification, anatomical, developmental phenomenon and also applications of zoology in the various fields.

At second year under-graduation, in semester III and IV courses such as Physiology, Biochemistry, Genetics and Evolutionary Biology, the level of the theory and practical courses increased one step ahead of the first year B.Sc.

At third year under-graduation: Theory and practical courses in semester V shall deal with the further detailed studies of the various disciplines of the Zoology in form of core courses such as Reproductive biology, Cell and Molecular Biology, Mammalian Histology, and

Animal Biotechnology. Skill based course on Public health and hygiene is included as well as students can select either Pest Management or Apiculture as discipline elective course. Semester VI shall cover the theory and practical courses such as Comparative study of representative of invertebrate and vertebrate, Chick embryology, Applied Zoology, Microtechnique as core courses. Research Methodology shall skill enhancement course that shall help students for research in Zoology and students can also select either Bioinformatics or Sericulture as discipline elective course.

Learning Objectives:

- To provide thorough knowledge about animal classification and associated taxonomic groups various animal sciences from primitive to highly evolved animal groups.
- To develop an understanding of and ability to apply basic zoological principles.
- To provide quality education in different specializations in Zoology.
- To facilitate higher education and research in zoology.
- To make the students aware of applications of Zoology subject in various industries
- To equip the students with skills related to laboratory as well as field based studies.
- To make the students aware about conservation and sustainable use of biodiversity.
- To inculcate interest and foundation for further studies in Zoology.
- To address the socio-economical challenges related to animal sciences.
- To provide quality education offering skill based programs and motivate the students for self employment in applied branches of Zoology.

Program specific objectives (PSO)

- To achieve excellence in academic and scientific research in the field of Zoology.
- To develop and implement ways and means to ensure quality performance and outputs of Zoology program.
- To use modern technology in education and scientific research in Zoology.
- To implement advanced training to improve the skills of graduates in Zoology and related fields.
- To create academic and scientific environment to attract outstanding faculty, researchers and students.
- To improve the national and international partnerships with academic institutions and research centres.

Program outcome (PO)

- To possess a good command of fundamentals in Zoology and its relationship to other disciplines.
- To know the theories and scientific facts in the sections of Zoology and interrelations among organisms and their biosphere
- To memorize the concepts of laboratory management, organization and evaluation.
- To recognize the management and concepts of bio-systems, organization and evaluation.
- To outline the policy and legislation of animal Science and ethics.
- To design and conduct experiments in Zoology
- To communicate effectively through writing reports, giving presentations, and participating in discussions.
- To demonstrate skill in the usage of computers, networks, and software packages relevant to Zoology
- To learn the principles of research methodology.

Course outcome (CO)

- Describe the diversity in form, structure and habits of invertebrates and vertebrates
- Explain the reproductive patterns in animal world
- Develop deeper understanding of life is and how it functions at cellular level as well as histological structure of tissues.
- Understand applications of animal biotechnology, bioinformatics and research methodology
- Familiar with various stages involved in the developing embryo
- Acquire skills in the microtechniques, apiculture, sericulture and other applied branches of Zoology.

Duration: The duration of B.Sc. degree program shall consists of three years.

Medium of instruction: The medium of instruction for the courses shall be English.

Examination pattern

- Each theory and practical course will be of 100 marks comprising of 40 marks internal and 60 marks external examination.
- Theory examination (60 marks) will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks (12 marks each).
- Internal examination (40 marks) and
- Practical examination (CA of 40 marks and UA of 60 Marks)

Structure of curriculum of TYBSc (Zoology)
Semester V

Discipline	Course Type	Course Code	Course title	Credits	Hours/week (Clock Hours)	Total Teaching hours	Marks (Total 100)	
							CA	UA
Discipline Specific Course (DSC)	Core I	Zoo-501	Reproductive Endocrinology	3	3	45	40	60
	Core I	Zoo-502	Cell and Molecular Biology (CMB)	3	3	45	40	60
	Core III	Zoo-503	Mammalian Histology	3	3	45	40	60
	Core IV	Zoo-504	Animal Biotechnology	3	3	45	40	60
DSC Skill Enhancement Course [SEC]	Skill Based	Zoo-505	Public health and hygiene	3	3	45	40	60
DSC Elective Course	Elective Course (Any one)	Zoo-506 (A)	Pest Management	3	3	45	40	60
		Zoo-506 (B)	Aquarium Fish Keeping					
DSC	Core (Practical)	Zoo-507	Practical related to Zoo-501 & Zoo502 (CB)	2	4 (Per batch)	60	40	60
		Zoo-508	Practical related to Zoo 502 (MB) & Zoo 503	2	4 (Per batch)	60	40	60
		Zoo-509	Practical related to Zoo504	2	4 (Per batch)	60	40	60
Non Credit Audit Course	Elective audit course (Any one)	AC-501A	NSS	No credit	2	30	100	----
		AC-501 B	NCC					
		AC-501 C	Sports					

Structure of curriculum of TYBSc (Zoology)

Semester VI

Discipline	Course Type	Course Code	Course title	Credits	Hours/week (Clock Hours)	Total Teaching hours	Marks (Total 100)	
							CA	UA
Discipline Specific Course(D SC)	Core I	Zoo-601	Study of Leech & Calotes	3	3	45	40	60
	Core I	Zoo-602	Chick Embryology	3	3	45	40	60
	Core III	Zoo-603	Applied Zoology	3	3	45	40	60
	Core IV	Zoo-604	Microtechnique	3	3	45	40	60
DSC Skill Enhancement Course [SEC]	Skill Based	Zoo-605	Research Methodology	3	3	45	40	60
DSC Elective Course	Elective Course (Any one)	Zoo-606(A)	Bioinformatics	3	3	45	40	60
		Zoo-606 (B)	Sericulture					
DSC	Core (Practical)	Zoo-607	Practical related to Zoo-601	2	4 (Per batch)	60	40	60
		Zoo-608	Practical related to Zoo 602 & Zoo 603	2	4 (Per batch)	60	40	60
		Zoo-609	Practical related to Zoo 604	2	4 (Per batch)	60	40	60
Non Credit Audit Course	Elective audit course (Any one)	AC-601 A	Soft skill	No credit	2	30	10	0
		AC-601 B	Yoga					
		AC-601 C	Practicing Cleanliness					

CA: Class assessment {Internal examination}; UA: University assessment

Semester V

DSC Core Courses			
Zoo - 501: Reproductive Endocrinology			
	<p>Course objective</p> <ul style="list-style-type: none"> • To learn about the various aspects of reproductive biology and endocrinology. • To acquire a broad understanding of the hormonal regulation of physiological processes. • To create awareness of new technologies in assisted reproduction as well as contraceptive methods. 	<p>Teaching Hours :45</p>	<p>Credits : 03</p>
	<p>Learning outcomes</p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> • understand the functioning of male and female reproductive systems particularly in humans. • comprehension of the interplay of various hormones in the functioning and regulation of the male and female reproductive systems • know about modern contraceptive devices. 		
Unit	Topics	Lectures 45	Marks 60
Unit I	Introduction: Definition and Scope of Reproductive endocrinology	02	05
Unit II	Structure, Morphology, Histology and Reproductive functions of - Pituitary gland, Thyroid and Adrenal gland.	10	13
Unit III	<p>Male and Female Gonads:</p> <p>3.1 Testis:</p> <p>3.1.1 Structure (Histology) and Endocrine Regulation.</p> <p>3.1.2 Hypophysial Control (Testicular androgens).</p> <p>3.1.3 Role of testosterone in the foetal development.</p> <p>3.1.4 Effect of testosterone on development of sexual characteristics.</p> <p>3.2 Ovary:</p> <p>3.2.1 Structure (Histology) and Endocrine Regulation.</p> <p>3.2.2 Hypophysial Control.</p>	13	17
Unit IV	<p>Female Reproductive Cycle:</p> <p>4.1 a)Oestrous cycle, b)Menstrual cycle, c) Endocrine Regulation of female Sexual cycle.</p> <p>4.2 Function of Ovarian Hormone.</p> <p>4.3 Regulation of Endometrial cycle by ovarian Hormone.</p> <p>4.4 Hypophysial Control.</p>	10	13
Unit V	Hormonal Control on Pregnancy, Parturition, Lactation and Fertility	10	12

<p>Suggested Readings</p>	<ol style="list-style-type: none"> 1) Austin C. R. and R. V. Short, 1972 Reproduction in Mammals, Vol-1-8, Cam. Uni. Press. 2) Copenhaver Wilfred M., Douglas E. Kelly and Richard L. Wood- Bailey's text book of histology, Williams and Wilkins, Baltimore / London. 3) Gibian P. and E. J. Platz, eds, 1970, Mammalian Reproduction, Springer Verlag. 4) Guide to learning in Reproductive Endocrinology and Infertility ABO+ G. First in women health. The American Board of Obstetrics and Gynaecology, Inc. 2915, Vine Street: Dallas, TX 75204 Fellowship @ obog.org.www.obog.org. 5) Hogarth P. J., 1978- Biology of Reproduction Wiley, New York. 6) Lohar Prakash S. - 2012- Endocrinology-Hormones and Human Health, MJP Publishers, Chennai. 7) Perry J. S., 1971, The Ovarian cycle of animals, Oliver and Boyed. 8) Williams Robert H., 1981, Text Book of Endocrinology, W. B. Saunders Company. 		
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DSC Core Courses			
Zoo - 502: Cell and Molecular Biology (CMB)			
	Course objective: <ul style="list-style-type: none"> To understand the basic structure of cells, tissues and their working system. Know the handling skill in laboratory methods of estimation, determination, working of cells and their molecules. Use of binocular research microscope and bioinstrumentation in laboratory. 	Teaching Hours :45	Credits : 03
	Learning outcomes: After successful completion of this course, students are expected to: <ul style="list-style-type: none"> achieve the knowledge of cell structure and cellular system. predict the outcome of various cellular reactions carried out in cell and cellular system under various conditions. predict the role of genes and its relevance to human genetics and diseases. 		
Unit	Topics	Lectures 45	Marks 60
Unit I	Introduction to Cell and Molecular Biology: <ol style="list-style-type: none"> Cell Biology. Molecular Biology. Prokaryotic and Eukaryotic cells, Virus, Mycoplasma. Structure of plasma membrane: <ol style="list-style-type: none"> Bilayer model of Danielli and Devon, Fluid mosaic model. Study of cell organelles with reference to ultrastructure and functions of: Nucleus, Endoplasmic Reticulum, Golgi bodies, Lysosomes and Mitochondria 	12	15
Unit II	Cell Division and Cell Signaling: <ol style="list-style-type: none"> Cell division – Definition, Stages of mitosis and meiosis. Stages of cell cycle – G1, S, G2 and M- Phase. G-Protein coupled receptor and role of second messenger (cAMP) 	10	10
Unit III	Nucleic Acid: <ol style="list-style-type: none"> Salient features of DNA and RNA Watson and Crick model of DNA molecule. Forms of DNA and Types of RNA(Genetic & non genetic) DNA replication in Prokaryotes and Eukaryotes. 	10	12

Unit IV	Protein Biosynthesis: a) Transcription in Eukaryotes: RNA polymerase, Transcriptional Unit, Mechanism of transcription, Processing of m-RNA and r-RNA. b) Translation: Genetic Code, Wobble hypothesis, Synthesis and charging of t-RNA.	08	15
Unit V	Gene Regulation: Principles of transcriptional regulation in Eukaryotes: Activators, Enhancer, Gene silencing, Genetic imprinting	05	08
Suggested Readings	<ol style="list-style-type: none"> 1) Conn et al: Outline of Biochemistry (Wiley) 2) De Roberties and De Roberties: Cell and Molecular Biology, Saunders College. 3) Edward Gasque: Manual of Laboratory Exp. in Cell Biology, W.C. Brown Publishers. 4) Geoffrey M. Cooper and Robert E. Housman: The Cell – A Molecular Approach. 4th edition. 5) Lodish et al: Molecular and Cell Biology, Scientific American Book. 6) Lohar Prakash S. (2014) Cell and Molecular biology, MJP Publishers, Chennai. 7) Prescott, DM: Reproduction in eukaryotic cells, Academic Press. 8) Strickberger, M.W.: Genetics, 2nd edition, Macmillan Publishing Co. Inc. New York. 9) Verma P. S. and V. K. Agrawal: Cytology 10) Watson J. D. et al: Molecular Biology of Gene (Benzamin / Cumming) 11) Wilson, EB: Cell in Development and Inheritance (MacMillan) 		

DSC Core Courses			
Zoo - 503: Mammalian Histology			
	Course objective: <ul style="list-style-type: none"> To study the Histology of different tissues and systems of mammals. 	Teaching Hours :45	Credits : 03
	Learning outcomes: After successful completion of this course, students are expected to: <ul style="list-style-type: none"> enrich themselves with histology of different tissues and systems for research and job opportunities in Pathology and Cancer research centers. 		
Unit	Topics	Lectures 45	Marks 60
Unit I	Tissue and Skin: 1.1 Definitions of Histology. Differentiation and derivative of three germinal layers 1.2 Tissue: Types and Characteristics (Definition and location only). 1.3 Types – 1.3.1 Epithelial tissues- a) Simple epithelial tissues, b) Compound epithelial tissues, 1.3.2 Connective tissue, 1.3.3 Muscular tissue and 1.3.4 Nervous tissue- a) Structure and types of neurons (nerve cell), b) Medullated and non-medullated nerve fibres. 1.4 Skin: Structure and function. 1.5 Derivatives of skin - Horns, Nails, Hair, Sweat and Sebaceous gland.	13	12
Unit II	Digestive and Respiratory system: 2.1 Histology of tooth and tongue: Structure and functions. 2.2 Histology of alimentary tract: histological structure of oesophagus, stomach, duodenum, colon and rectum. 2.3 Histology of digestive glands – salivary gland, liver, pancreas (exocrine and endocrine). 2.4 Histological structure of trachea and lung.	08	12
Unit III	Circulatory, Excretory system: 3.1 Structure and function of blood vessels: Artery, Vein and Capillary. 3.2 Blood: Composition, types of blood cells and their functions. 3.3 Histology of Kidney: L.S. of Kidney, microscopic structure of uriniferous tubules, Juxtra Glomerular complex (JG complex), Bowman's capsule & Glomerulus.	08	12

Unit IV	Nervous system and Sense Organs: 4.1 Brain meninges:Structure and function. 4.2 Spinal cord:Structure and function. 4.3 Eye: Structure- V. S. of eye ball. 4.4 Ear: Structure of external, middle and internal ear	08	12
Unit V	Reproductive and Endocrine system: 5.1 Histological structure of Testis, Structure of sperm 5.2 Histological structure of Ovary, Structure of ovum 5.3 Histological structure of Pituitary gland. 5.4 Histological structure of Thyroid and Parathyroid gland. 5.5 Histological structure of Adrenal gland	08	10
Suggested Readings	1) Arthur W. Ham: Ham's Histology, 9th ed. Philadelphia: Lippincott, 1987.Freeman W. H.; An advanced atlas of Histology 2) Muzammih Ullah: Histology and Genetics 3) Roy O. Greep.: Histology 4) Turner and Bungera: General Endocrinology 5) William F.Windle: Text book of Histology		

DSC Core Courses			
Zoo - 504: Animal Biotechnology			
	<p>Course objective:</p> <ul style="list-style-type: none"> • Studying animal cell and tissue culture techniques • Developing genetically engineered products for human animal welfare, • Developing gene transfer technologies, cloning, transgenic animals • Studying hybridoma technique and production of antibodies • Impart knowledge about stem cell research 	Teaching Hours :45	Credits : 03
	<p>Learning outcomes: After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> • acquire knowledge about animal cell and tissue culture techniques. • become familiar with genetically engineered products for human animal welfare. • developing embryo - transfer technology, cloning, transgenic animals. • understand applications of hybridoma technique and functions of antibodies. • acquire knowledge about stem cell research and its ethical issues. 		
Units	Topics	Lectures	Marks
	45	60	
Unit I	1.1 Introduction, scope and significance of Biotechnology 1.2 Animal cell and tissue culture 1.2.1 Definition and Types of culture media 1.2.2 Advantages and disadvantages of animal cell/tissue culture 1.2.3 Laboratory facility for animal tissue culture 1.2.4 Applications of animal cell and tissue culture 1.2.5 Primary culture, Examples of Cell lines 1.2.6 Applications of somatic cell fusion 1.3 Examples of Tissue and organ cultures	12	15
Unit II	<p>Recombinant DNA technology</p> 2.1 Introduction 2.2 Restriction enzymes- classification with examples 2.3 Identification and isolation of desired gene 2.4 Types and properties of vectors 2.5 Construction of genomic and cDNA libraries 2.6 Application of genetic engineering e.g. production of human Insulin, Growth hormone, TPA and vaccines	12	15

Unit III	Transgenic animals 3.1 Introduction 3.2 Methods of Transfection (Physical, Chemical, Viral and Bacterial) 3.3 Examples and significance of transgenic animals	08	10
Unit IV	Hybridoma technology 4.1 Introduction 4.2 Methods for production of monoclonal and polyclonal antibodies 4.3 Significance of Monoclonal antibodies 4.4 Types and significance of immunoglobulin	08	12
Unit V	Stem Cell Biotechnology 5.1 Introduction 5.2 Types of Stem Cell and their uses 5.3 Now and Future of Stem cell Biotechnology 5.4 Ethical issues in stem cell technology	05	08
Suggested Readings	<ol style="list-style-type: none"> 1) Brooks G (ed.) (2002) Gene therapy. <i>The use of DNA as a drug</i>. Pharmaceutical Press, London. 2) Gerald C., (1996) <i>Cell and Molecular Biology – Concept and Experiment</i>, John Wiley and Sons, Inc., U.S.A. 3) Lewin, B., (2004), <i>Genes VIII</i>, Oxford University Press, New York 4) Lohar Prakash S. (2012) Textbook of Biotechnology ISBN: 9788180941047 MJP Publishers, Chennai 5) Sing, B.D.(2014) Biotechnology Expanding horizons. Kalyani Publishers, Delhi. 6) Stem Cell Biology (2001) Cold Spring Harbor Laboratory Press 7) Watson, J.D. <i>et al</i>, (1987) <i>Molecular Biology of Gene</i>, 4th ed., The Benjamin / Cummings Publishing Company, Inc. U.S.A. 		

DSC Skill Enhancement Course [SEC]			
Zoo - 505: Public Health and Hygiene			
	Course objective <ul style="list-style-type: none"> • To provide knowledge and understanding regarding life style diseases. • To promote an understanding of the value of good life style practices, physical fitness and healthy food habits for life style disease management. • To motivate them to practice yoga and meditation in day-to-day life 	Teaching Hours :45	Credits : 03
	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> • get familiarised with various aspects of environmental risks and hazards. • acquire knowledge regarding epidemiology, prevention, control and management of diseases of public health importance. • learn about diagnosis of various diseases and methods to prevent them. 		
Units	Topics	Lectures 45	Marks 60
Unit I	Public Health and Hygiene: 1.1 Introduction and scope, 1.2 Nutrition and health, 1.3 Classification of food, 1.4 Nutritional deficiencies, 1.5 Vitamin deficiencies, 1.6 Hygiene: Introduction, definition and types of hygiene.	10	12
Unit II	Environment and health hazards: 2.1 Environmental degradation, 2.2 Pollution and associated health hazards	08	12
Unit III	Sanitation and Diseases: 3.1 Definition and concept, 3.2 Disposal of human & animal waste, refuse sewage.	08	12
Unit IV	Communicable disease and their control measures: 4.1 Malaria 4.2 Typhoid 4.3 Hepatitis-types 4.4 Tuberculosis 4.5 Chikungunya 4.6 Dengue and 4.7 AIDS.	10	12
Unit V	Non-communicable diseases and their preventive measures: 5.1 Hypertension, 5.2 Coronary Heart disease,	09	12

	5.3 Stroke, 5.4 Obesity and 5.5 Mental ill health		
Suggested Readings	<ol style="list-style-type: none"> 1) Basu, S.C. Preventive and Social Medicine. 2) Cliford Anderson R., Your Guide to Health. 3) Gibney, Clinical Health, Blackwell. 4) Gibney, Public Health Nutrition, Blackwell. 5) Goel, S.O.L. Public Health Administration. 6) Mahajan B.K., M.C. Gupta, Preventive and social medicine in India, 2013, 4thEdn.,JaypeeBroyhers Medical Publishers, New Delhi, India. 7) Park K. and Park S, 1995, Text Book of Preventive and Social Medicine. Banarsidas Bhanot Publishers, 1167 Prem Nager, Jabalpur – 482001. 8) Sanitarrians Hand Book. Theory and Administrative Practice. Pearles Publications, New Orleans, USA. 9) Seshu Babu V.V.R, Review of community medicine, 2006, 2ndEdn.,Paras Medical Books Pvt. Ltd., Hydrabad. 10) Shoryock Harold and Hubert O. Swartout You and Your Health illustrated Dealing with Diseases.. 11) Sobti R. C., Medical Zoology and Medical Technology, Shobanlal and Co., Jalandher. 		

DSC Skill Enhancement Course [SEC]			
DSC ELELCTIVE COURSE (Any one from 506 A or 506 B)			
Zoo – 506 (A): Pest Management			
	Course objectives: <ul style="list-style-type: none"> • To acquire basic skills in the observation and study of nature. • To inculcate interest in adopting biological control strategies for pest control. • To know various pests affecting our local crops and select the best method for their control. • To acquire basic knowledge and skills in agriculture management to enable the learner for self-employment. 	Teaching Hours :45	Credits : 03
	Learning outcomes: After successful completion of this course, students are expected to: <ul style="list-style-type: none"> • impart basic awareness regarding pest problem and crop loss due to their dominance. • understand various pests affecting our local crops and select the best method for their control. • acquire basic knowledge and skills in agriculture management to enable the learner for self-employment 		
Unit	Topics	Lectures	Marks
		45	60
Unit I	Introduction 1.1 Definition of pest 1.2 Classification of pest w.r.t. Systematic position, Marks of identification, Life cycle, Nature of damage and Control measures. 1.2.1 Agricultural pests: <ul style="list-style-type: none"> a) Pest of Cotton – <i>Dysdercus cingulatus</i> b) Pest of Banana – <i>Odoiporus longicollis</i> c) Pest of Vegetable (Brinjal) – <i>Leucinodes orbonalis guenee</i> d) Pest of Sugarcane – <i>Pyrilla perpusilla</i> e) Pest of Onion- <i>Thrips tabaci</i> 1.2.2 Stored grain pest – <i>Sitophilu soryzae</i> 1.2.3 Veterinary pest - <i>Flea</i> 1.2.4 Public health pest – <i>Cimex</i> 1.2.5 Structural pest – <i>Odontotermes obesus</i>	13	15
Unit II	Insect Vector: 2.1 Definition of vector 2.2 Types of vector (Mosquito, house fly, cockroach)	07	10
Unit III	Control Measures: 3.1 Primary control and their types.	09	13

	3.2 Chemical control and their types. 3.3 Biological control and their types. 3.4 Concept of IPM		
Unit IV	Types of Pesticides and Their Mode of Action: 4.1 Stomach poison 4.2 Contact poison 4.3 Systemic poison 4.4 Fumigants 4.5 Pesticide appliances: a) Sprayer and b) Duster	08	12
Unit V	Non Insect Pests: Study of Non insect pests with reference to habit, habitat, Breeding potential, Nature of Damage and control techniques. 5.1 Rat 5.2 Birds. 5.3 Snail	08	10
Suggested Readings	1) Crop Pests and How to Fight Them, Director of Publicity, Govt. of Maharashtra. 2) Fadt,: Fundamental of Entomology. 3) Gupta: Essentials of biotechnology. 4) Little and Little: General and Applied Entomology. 5) Pedigo: Entomology and Pest management. 6) Pradhan,: Insect Pest of Crops. 7) Pruthi, H.S.: Textbook of Agricultural Entomology. 8) Ravindranathan K. R.: Economic Zoology, Dominant Pub., New Delhi 9) Shukla and Upadhyay: Economic Zoology, Rastogi publication. 10) Tembhare D.B.: Text Book of Modern Entomology.		

DSC Skill Enhancement Course [SEC]			
DSC ELECITIVE COURSE (Any one from 506 A or 506 B)			
Zoo – 506 (B): Aquarium Fish Keeping			
	Course objective <ul style="list-style-type: none"> To impart basic knowledge of ornamental fish Industry and inculcate its scope as an Avenue for career development in Entrepreneurship or as an Aquariculturist. To equip the students with self-employment capabilities. To acquire basic knowledge and skills in aquarium management 	Teaching Hours :45	Credits : 03
	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> Acquire knowledge about different kinds of fishes, their compatibility in aquarium. Know the basic needs to set up an aquarium and the ways to make it cost-effective. Become aware of Aquarium as commercial, decorative and of scientific studies. Develop personal skills on maintenance of aquarium. 		
Unit	Topics	Lectures 45	Marks 60
Unit I	Introduction to Aquarium Fish Keeping: 1.1 Introduction to Aquarium Fish Keeping 1.2 The potential scope of Aquarium Fish Industry as a Cottage Industry, 1.3 Varieties of aquarium fishes - Exotic and Endemic	10	12
Unit II	Biology of Aquarium Fishes: Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes: Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish.	15	18
Unit III	Food and feeding of Aquarium fishes: 3.1 Use of live fish feed organisms. 3.2 Preparation and composition of formulated fish feeds.	06	10
Unit IV	Fish Transportation: 4.1 Live fish transport – Fish handling, packing and forwarding techniques.	05	8
Unit V	Maintenance of Aquarium: 5.1 Maintenance of Aquarium: 5.1.1 Aquarium maintenance;	09	12

	<p>5.1.2 Equipments,</p> <p>5.1.3 Water analysis</p> <p>5.1.4 Aquarium fish diseases and treatment</p> <p>5.2 Budget for setting up an Aquarium Fish Farm as a Cottage Industry;</p>		
Suggested Readings	<p>1) Bailey Mary, Gina Sandford; The Complete Guide to Aquarium Fish Keeping (Practical Handbook) Publishers: Lorenz Books.</p> <p>2) Dawes, J. A. (1984), The Freshwater Aquarium, Roberts Royee Ltd.London.</p> <p>3) Gunther, A. (1980), An Introduction to the Study of Fishes. A and C. Black Edinburgh.</p> <p>4) Jhingran, V.G.(1982),Fish and Fisheries in India. Hindustan publ.Corp, India.</p> <p>5) Mills, Dick; Keeping Aquarium Fish (Teach Yourself General) Publisher : Teach Yourself</p> <p>6) Pandey, K and J.P. Shukla (2013),Fish and Fisheries, Rastogi Publication.</p>		

DSC Core Practical			
Zoo - 507: Corresponding practical to DSC Zoo 501& Zoo502 (CB)			
	Course objective <ul style="list-style-type: none"> • To learn the various aspects of reproductive biology and endocrinology. • To know the basic structure of cells, tissues and their working system. 	Teaching Hours :45	Credits : 03
	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> • understand the functioning of male and female reproductive systems particularly in humans. • achieve the Knowledge of cell structure and cellular system. 		
	Reproductive Endocrinology		
Practical	Major Experiments:		
1	Estimation of total gonadal cholesterol from Ovary / Testis.		
2	Estimation of Ascorbic acid from Ovary / Testis.		
3	Estimation of Protein from Ovary / Testis by Lowry's method		
4	Estimation of Glycogen from Ovary / Testis by Anthrone Method		
	Minor Experiment:		
5	Study of Histological Structure of Ovary, Testis and Fallopian tube with the help of Permanent slide.		
6	Demonstration of various endocrine glands from Rat / Mice with the help of chart / model / figure.		
7	Cellular structure of Pituitary, thyroid and Adrenal gland with the help of permanent slide.		
8	Pregnancy test (any suitable method)		
	Cell Biology		
9	Preparation of permanent slide to show the presence of Barr body in human female Blood / Cheek cells. (E)		
10	Preparation of temporary stained squash of onion root tip to study various stages of Mitosis. (E)		
11	Study of various stages of Meiosis. (D)		
12	Study of cell organelles from photomicrographs (D)		
Suggested Readings	1) Austin C.R. and R.V. Short, 1972, Reproduction in Mammals, Vol-1-8, Cam. Uni. Press. 2) De Roberties and De Roberties: Cell and Molecular Biology (Saunders College) 3) Lohar Prakash S., 2012, Endocrinology, MJP Publishers, Chennai		

Zoo - 508: Corresponding practical to DSC Zoo 502 (MB)& Zoo503			
	Course objective <ul style="list-style-type: none"> To know the handling skill in laboratory methods of estimation, determination, working of cells and their molecules. To study the histology of different tissues and systems of mammals. 	Teaching Hours :45	Credits : 03
	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> predict the outcome of various cellular reactions carried out in cell and cellular system under various conditions. enrich with Histology of different tissues and systems for research and job opportunities in Pathology and Cancer research centers. 		
Practical	Molecular Biology		
1	Quantitative estimation of RNA from suitable material by Orcinol reagent. (E)		
2	Quantitative estimation of DNA from suitable material by Diphenylamine reagent. (E)		
3	Preparation of Polytene chromosome from Chironomus /Drosophila larva. (E)		
4	Study and interpretation of electron micrographs/photographs showing. (D) a) DNA replication, b) Transcription, c) Split genes.		
	Mammalian Histology		
5	Study of following tissue with the help of chart / permanent slides /simulations (D). a) Squamous epithelial tissue b) Cuboidal epithelial tissue c) Columnar epithelial tissue d) Ciliated epithelial tissue e) Areolar connective tissue f) Blood smear permanent slide.		
6	Temporary preparation of the following tissue of preserved Rat (E). a) Striated muscle fibre b) Smooth muscle fibre c) Medullated nerve fibres d) Hyaline cartilage.		
7	Study of histological permanent slide of mammalian skin.		
8	Study of following histological permanent slide of digestive and respiratory organs. (D) a) V. S. of Tooth b) V. S. of Tongue c) C. S. of Salivary gland(Parotid gland) d) T. S. of oesophagus e) T. S. of stomach f) T. S. of duodenum g) T. S. of rectum		

	<p>h) T. S. of pancreas i) C. S. of liver j) C. S. of trachea k) C. S. of lung</p>		
9	<p>Study of following histological permanent slide of blood vessels, excretory and reproductive systems. (D) a) T. S. of artery b) T. S. of vein c) T. S. of capillary. d) L. S. of kidney e) T. S. of testis f) L. S. of ovary</p>		
10	<p>Study of following histological permanent slide of endocrine glands. (D) a) T. S. of pituitary gland b) T. S. of adrenal gland c) C. S. of thyroid gland</p>		
Suggested Readings	<p>1) De Roberties and De Roberties: Cell and Molecular Biology (Saunders College) 2) Freeman W. H., An advanced atlas of Histology 3) Lodish et al: Molecular and Cell Biology (Scientific American Book) 4) Lohar Prakash S. (2014) Cell and Molecular biology, MJP Publishers, Chennai 5) Pearse A.G.E., Histochemistry – Vol. I and II 6) Tembhare D.B., Techniques in Life Sciences. 7) William F.Windle, Text book of Histology</p>		

DSC Core Practical			
Zoo - 509: Corresponding practical to DSC Zoo 504			
	<p>Course objective</p> <ul style="list-style-type: none"> • Studying animal cell and tissue culture techniques • Developing genetically engineered products for human animal welfare, • Developing gene transfer technologies, cloning, transgenic animals • Studying hybridoma technique and production of antibodies • Impart knowledge about stem cell research. 	Teaching Hours :45	Credits : 03
	<p>Learning outcomes</p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> • acquire knowledge about animal cell and tissue culture techniques • become familiar with genetically engineered products for human animal welfare, • developing embryo - transfer technology, cloning, transgenic animals • understand applications hybridoma technique and functions of antibodies • acquire knowledge about stem cell research and its ethical issues. 		
Practical	Animal Biotechnology		
1	Estimation of DNA in a given sample by Diphenylamine method		
2	Estimation of RNA in a given sample by Orcinol method		
3	Working principle and application of laminar air flow and autoclave (D)		
4	Isolation of microorganisms on nutrient agar by streak plate/dilution plate method (E)		
5	Production ethanol by fermentation using yeast.(E)		
6	Culture of bacteria in liquid medium and agar plates.(E)		
7	Preparation of primary culture media for cell, tissue, organ. (D)		
8	Separation of serum proteins by Agarose or polyacrylamide gel electrophoresis(E)		
9	Study of Biogas plant/ model (D)		
10	Visit to dairy / pharmaceutical / tissue culture laboratory and submission of report.		

<p>Suggested Readings</p>	<ol style="list-style-type: none"> 1) Brooks G (ed.) (2002), Gene therapy. The use of DNA as a drug. Pharmaceutical Press, London. 2) Gerald C., (1996), Cell and Molecular Biology – Concept and Experiment, John Wiley and Sons, Inc., U.S.A. 3) Lewin, B., (2004), <i>Genes VIII</i>, Oxford University Press, New York 4) Lohar Prakash S. (2012), Textbook of Biotechnology ISBN: 9788180941047 MJP Publishers, Chennai 5) Sing, B.D.(2014), Biotechnology Expanding horizons.Kalyani Publishers, Delhi. 6) Stem Cell Biology (2001), Cold Spring Harbor Laboratory Press 7) Watson, J.D. <i>et al</i>, (1987),Molecular Biology of Gene,4th ed., The Benjamin / Cummings Publishing Company, Inc. U.S.A. 		
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SEMESTER VI

DSC Core Courses			
Zoo - 601: Study of Leech And Calotes			
	Course objective <ul style="list-style-type: none"> • To understand habit, habitat and taxonomic status of Leech as invertebrates and Calotes as vertebrates • To explain the basic aspects of structural and functional details of Leech and Calotes 	Teaching Hours :45	Credits : 03
	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> • understand the systematic position, habit and habitat of Leech and Calotes • acquire the knowledge about structural and functional details about Leech as invertebrates and Calotes as vertebrates • compare structural and functional details in Leech and Calotes. 		
Unit	Topics	Lectures	Marks
		45	60
Unit I	Study of Leech: <ol style="list-style-type: none"> a) Systematic position, habit, habitat external characters, body wall. b) Digestive system, food, feeding and digestion. c) Excretory system 	10	12
Unit II	<ol style="list-style-type: none"> d) Nervous system and sense organs. e) Reproductive system, copulation, f) Fertilization, cocoon formation, and development. 	10	14
Unit III	Study of Calotes <ol style="list-style-type: none"> a) Systematic position, habit, habitat external characters, b) Digestive system, food feeding and digestion 	05	10
Unit IV	<ol style="list-style-type: none"> c) Respiratory system and respiratory mechanism d) Excretory system and physiology of excretion 	10	12
Unit V	<ol style="list-style-type: none"> e) Nervous system and sense organs f) Reproductive system, copulation, fertilization and development. 	10	12
Suggested Readings	<ol style="list-style-type: none"> 1) Hall B.K. and Hallgrímsson B. (2008), Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc. 2) Jordan E. L., Invertebrate Zoology, S.C.Chand, New Delhi. 3) Jordan E.L. and P.S.Verma, Chordate Zoology, S.Chand and Company New Delhi. 4) Kotpal R.L (1991), Zoology phylum Annelida, 		

	<p>Rastogi publication. Meerut.</p> <p>5) Kotpal R.L. (2016), Modern text book Vertebrate zoology. Fourth edition. Rastogi Publication, Meerut</p> <p>6) Lal S.S. (1996), Textbook of Practical Zoology Invertebrates, Rastogi Publications.</p> <p>7) Lal S. S. (1996), Textbook of Practical Zoology Vertebrates, Rastogi Publications.</p> <p>8) Prasad S. N., Life of Invertebrates.</p> <p>9) Young, J. Z. (2004),The Life of Vertebrates. III Edition. Oxford university press.</p>		
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DSC Core Courses			
Zoo - 602: Chick Embryology			
	Course objective <ul style="list-style-type: none"> • To study the various stages involved in the developing embryo • To study the initial developmental procedures involved in chick • To know the processes involved in embryonic development and practical applications of studying the chick embryology. 	Teaching Hours :45	Credits : 03
	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> • Understand various stages involved in the developing embryo • Understand the initial developmental procedures involved in chick. • Understand the processes involved in embryonic development and practical applications of studying the chick embryology. 		
Unit	Topics	Lectures	Marks
		45	60
Unit I	Embryology: 1.1 Definition and Concept of embryology 1.2 Spermatogenesis and 1.3 Oogenesis.	05	08
Unit II	Fertilization: 2.1 General mechanism of fertilization 2.2 Eggs: Structure of Hen's egg	05	08
Unit III	Cleavage: 3.1 Patterns of cleavages. 3.2 Blastulation 3.3 Gastrulation	10	12
Unit IV	Development of Chick Embryo: 4.1 18 hours chick embryo - (Primitive streak formation, mesogenesis, somite formation) 4.2 24 hours chick embryo 4.3 33 hours chick embryo 4.4 48 hours chick embryo 4.5 72 hours chick embryo	15	18
Unit V	Extra-embryonic membranes: 5.1 Yolk Sac, structure and its functions. 5.2 Amnion, structure and its functions. 5.3 Chorion, structure and its functions. 5.4 Allantois, structure and its functions	10	14

<p>Suggested Readings</p>	<ol style="list-style-type: none"> 1) Agarwal, V.K. and UshaGuptha, S (1998). Chand's simplified course in Zoology, Chordate Embryology and Histology. S. Chand & Co Ltd. 2) Balinsky. B.I. (2004). An Introduction to Embryology. W.B. Saunders & Co. 3) Berry, A.K. (2008). An Introduction to Embryology. Emkay Publications. 4) Boby Jose et al., Developmental biology, Experimental biology, Manjusha Publications, Calicut. 5) Gibbs. (2006).Practical Guide to Developmental Biology. Oxford University Press. 6) Gilbert. S.F. (2000). Developmental Biology. Sinauer Associates, Inc. Publishers. 7) Goel, S.C. (1984). Principles of animal developmental biology. Himalaya Publ. House, Bombay. 8) Huettner,A.F. (1959). Comparative Vertebrate Embryology. MacMillan. 9) Mc Even. (1970). Vertebrate Embryology. Oxford-IBH 10) Nelson. (1960). Comparative Embryology of Vertebrates. MacMillan. 11) P.C.Jain. (2007). Elements of Developmental Biology, 6th Edn. Rastogi Publications. 12) Rough. (1960). Frog- Reproduction and development. Oxford University Press. 13) Verma, P.S. and V.K. Agarwal (2007). Chordate Embryology. S. Chand and Co. Ltd. 		
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DSC Core Courses			
Zoo - 603: Applied Zoology			
	Course objective: <ul style="list-style-type: none"> • To acquire basic knowledge and skills in applied branches of zoology • To equip the students with self-employment capabilities. • To provide scientific knowledge of profitable farming. • To get technical awareness of vermitechnology and vermicomposting technique. • To convert unwanted, organic matter, particularly food scraps and paper into fertile soil. • To learn about all aspects of raising poultry for their meat and eggs. • To know the economics, problems and prospects of Vermicomposting and Poultry. 	Teaching Hours :45	Credits : 03
	Learning outcomes: After successful completion of this course, students are expected to: <ul style="list-style-type: none"> • practice of vermicomposting,vermiculturing and poultry farming. • aspire to work in preparing bio compost, vermicomposting and vermiculturing and get employment accordingly. • start business for rearing and production of birds and get employment accordingly. 		
	Topics	Lectures	Marks
		45	60
Units	Vermiculture		
Unit I	1.1 Introduction and scope 1.2 Characteristics features of earthworm 1.3 Species of Earthworm – <i>Eisenia foetida</i> and <i>Eudrilus eugeniae</i>	05	08
Unit II	2.1 Methods of vermicomposting – Small and Large scale. 2.2 Set up of Vermiwash unit. 2.3 Role of earthworm in solid waste management. 2.4 Economic importance of vermicompost and vermiwash	10	12
Unit III	3.1 Introduction : Definition and concept 3.2 Study of Indian fowl, <i>Gallus gallus domesticus</i> w.r.t. <ol style="list-style-type: none"> a) Systematic position b) Habits and Habitat c) External Morphology 	05	05
	Poultry		
Unit IV	4.1 Types of Poultry breeds: with respect to origin, characters and standard weight.	20	30

	<p>a) American breed – White Plymouth rock b) Mediterranean breed – White Leghorn c) The English breed – White Cornish d) Asiatic breed – Brahma e) Indian breed – Assel, Kadaknath</p> <p>4.2 Brooding and Rearing :</p> <p>a) Natural and artificial breeding b) Housing and Equipment of poultry c) Poultry house equipment d) Poultry Nutrition</p> <p>4.3 Poultry Diseases:</p> <p>a) Viral Diseases – Fowl pox, Infectious bronchitis (IB) and Infectious bursitis (IBD), b) Bacterial Diseases - Pullorum and Chronic Respiratory Disease (CRD), c) Fungal Diseases – Aspergillosis, Thrush, d) Parasitic Diseases – i) Ectoparasites – Lice and Ticks, ii) Endoparasites – Round worm and Caecal worm, e) Protozoal Diseases – Coccidiosis – Caecal and Intestinal.</p>		
Unit V	<p>5.1 Economics of poultry :</p> <p>a) Nutritive value of egg of hen b) Economic importance of poultry manure</p> <p>5.2 Poultry care management and marketing</p>	05	05
Suggested Readings	<p>1) Banerjee, G. C., A textbook of Animal Husbandry, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi. 2) Banerjee, G. C., Animal Husbandry, Oxford and IBH publishing Co. 3) Gupta P.K., Vermicomposting for sustainable agriculture - Publisher - Agrobios, Jodhpur (India). 4) Shukla and Upadhyay, Economic Zoology, Rastogi publication. 5) Singh, R. A., Poultry introduction, Kalyani publishers, New Delhi. 6) Singh, R. A., Poultry production, Kalyani publishers, New Delhi. 7) Srivastava P. D. and N. C. Pant, Economic Zoology Vol. I and II, Commercial Publication Bureau, New Delhi. 8) YadavManju, Applied Entomology, Discovery publishing house, New Delhi 9) YadavManju, Economic Zoology, Discovery publishing house, New Delhi</p>		

DSC Core Courses			
Zoo - 604: Microtechnique			
	Course objectives: To prepare the whole mounts microscopic slides and staining reactions.	Teaching Hours :45	Credits : 03
	Learning outcomes: Cell tissue structure, histology of tissues and details of morphology of animals. Job opportunities in Health institutes, Hospitals and Pathological labs.		
Unit	Topics	Lectures 45	Marks 60
Unit I	Introduction, Collection and Fixation 1.1 Definition, Scope and Applications of Microtechnique. 1.2 Collection of specimen or tissue. 1.3 Kinds of preparation of specimen or tissue: 1.3.1 Whole mounts, Teasing and smearing. 1.4 Preparation whole mounts: Euglena, Paramoecium, Chick embryo. 1.5 Fixation: Definition and Importance and Theory of fixation. 1.6 Qualities of good fixative. 1.7 Types of fixative – 1.7.1 Primary-- Formaline, Ethyl alcohol.(Ethanol) 1.7.2 Compound fixatives- Bouin's fluid, Zenker's Fluid and Carnoy's fluid.	10	12
Unit II	Washing, Dehydration, Clearing 2.1 Washing: 2.1.1 Theory of washing 2.1.2 Significance of washing 2.2 Dehydrating agents: 2.2.1 Definition and types - Ethanol, Methanol, Acetone 2.2.2 Significance and use of dehydrating agents. 2.3 Clearing: 2.3.1 Definition and importance of clearing. 2.3.2 Clearing agents their merits and demerits - Xylene, Toluene, Benzene, Cedar wood oil, Clove oil. 2.4 Cold and hot infiltration.	08	
Unit III	Embedding, Block making, Trimming and Mounting 3.1 Cold and hot infiltration 3.2 Paraffin 3.2.1 Selection of paraffin according to need. 3.2.2 Melting and handling of paraffin. 3.3 Types of ovens and its uses.	10	12

	<p>3.4 Embedding:</p> <p>3.4.1 Embedding containers:</p> <p>a) Paper trays b) L-shaped metal Pieces c) Glass dishes/Lids.</p> <p>3.4.2 Embedding procedure, multiple embedding and embedding faults.</p> <p>3.5 Block making, labelling of block and storage of block.</p> <p>3.6 Trimming</p> <p>3.7 Mounting of trimmed block on microtome peg.</p>		
Unit IV	<p>Section cutting and affixing</p> <p>4.1 Microtome: Types, its uses, precautions and handling of Rotary and Rocking microtome.</p> <p>4.2 Microtome knives: Types, care, sharpening, honing and stropping of knife.</p> <p>4.3 Section cutting: Defects, Possible causes and remedies during section cutting.</p> <p>4.2 Affixing and processing of sections:</p> <p>i) Mayer's albumen, ii) Slide warmers.</p>	08	12
Unit V	<p>Staining, Mounting, Clearing and camera lucida</p> <p>5.1 Theory of staining.</p> <p>5.1.1 Types of stain: Acidic, basic, neutral and vital stain.</p> <p>5.1.2 Preparation of Haematoxylin and Eosin stain.</p> <p>5.1.3 Mordants: Definition, importance and common mordants.</p> <p>5.1.4 Double staining: Processing of paraffin section during staining.</p> <p>5.1.5 Special staining methods for Mitochondria and chromosomes.</p> <p>5.2 Mounting media: DPX and Canada balsam.</p> <p>5.3 Clearing, labelling and preservation of permanent slides.</p> <p>5.4 Use of camera lucida and Micrometer scale.</p>	09	12
Suggested Readings	<ol style="list-style-type: none"> 1) Baker F.I and R.E Silvertan, Introduction to Medical Laboratory Technique. 2) Baker J. R, Cytological Techniques 3) Davenport H.A., Histological and Histochemical Technique. 4) Gray P., Hand book of basic Microtechnique. 5) Indurkar A.K., Practical course in Cytology. 6) Lillie R.D., Histopathogenic Microtechnique. 7) Me Mann J.F.A and R.W Mowry, Staining Methods (Histology and Histochemical) 8) Pathak, Microtechnique (Theory and Practical) 9) Patki, Bhalchanda and Jeevaji, Introduction to Microtechnique, S. Chand Publication. 10) Pearse A.G.E., Histochemistry – Vol. I and II 		

DSC Skill Enhancement Course [SEC]			
Zoo - 605: Research Methodology			
	<p>Course objective</p> <ul style="list-style-type: none"> • To understand some basic concepts of research and its methodologies. • To select and define appropriate research problem and parameters. • Understand the various techniques of Data Collection- Observation, Questionnaire, Interview Schedule; Case Study, Social Survey, Content Analysis. • Describing various types of Sampling • Elaborate on Data Processing and Data Analysis • Writing of dissertations, project proposals, project reports, research papers. 	Total Hours: 45	Credits: 3
	<p>Learning outcomes</p> <p>After successful completion of this course, students are expected to:</p> <ul style="list-style-type: none"> • understand some basic concepts of research and its methodologies. • differentiate between the Quantitative and Qualitative Research and understand different types of Research Design • select and define appropriate research problem and parameters. • organize and conduct research project in a more appropriate manner. • writing of dissertations, project proposals, project reports, research papers. • understand intellectual Property Rights – Biopiracy, copyrights, patent and traditional knowledge and plagiarism. 		
Unit	Topics	Lectures	Marks
		45	60
Unit I	<p>Foundations of Research</p> <p>1.1 Meaning of research</p> <p>1.2 Objectives of research</p> <p>1.3 Motivation in research</p> <p>1.4 Research methods versus methodology</p> <p>1.5 Types of research</p> <p>a) Analytical vs Descriptive</p> <p>b) Quantitative vs Qualitative</p> <p>c) Basic vs Applied</p> <p>d) Conceptual vs Empirical</p>	06	06

<p>Unit II</p>	<p>Research Design</p> <p>2.1 Meaning of research design</p> <p>2.2 Need of research design</p> <p>2.3 Features of good design</p> <p>2.4 Importance concepts of research design</p> <p>a) Observation and Facts</p> <p>b) Prediction and Explanation</p> <p>c) Development of Models</p> <p>2.5 Developing a research plan by using</p> <p>a) Problem identification</p> <p>b) Experimentation</p> <p>c) Determining experimental and sample designs</p>	<p>10</p>	<p>15</p>
<p>Unit III</p>	<p>Data Collection, Analysis and Presentation</p> <p>3.1 Observation and Collection of Data</p> <p>3.2 Methods of data collection - Sampling Methods</p> <p>3.3 Data Processing and Analysis Strategies</p> <p>a) Tabulation of data:</p> <p>i. Variables(Definition, types with example); Frequency distribution(Definition, types and example);</p> <p>ii. Measurement of central tendency(Definition, types of average – mean, median, mode with example);</p> <p>iii. Standard deviation(SD) and</p> <p>iv. Standard error(SE)</p> <p>b) Data Analysis Strategies</p> <p>i. Testing hypothesis</p> <p>ii. Chi-square test</p> <p>iii. Student ‘t’ test</p> <p>3.4 Data presentation using MS Excel application of MS office.</p> <p>a) Charts: Types of Charts</p> <p>i) Column charts, ii) Line charts</p> <p>iii) Pie charts iv) Bar charts</p> <p>v) Area charts vi) Scatter charts</p> <p>vii) Stock charts viii) Surface charts</p> <p>ix) Radar charts x) Tree charts</p> <p>xi) Sunburst charts xii) Histogram</p> <p>xiii) Box and whisker charts xiv) Water fall charts</p> <p>xv) Funnel charts</p> <p>b) Elements of Bar charts</p> <p>c) Creation of Bar Charts using MS Excel application</p> <p>d) Creation of Sparkline Charts using MS Excel.</p>	<p>12</p>	<p>18</p>

Unit IV	Technical Reports and Thesis writing 4.1 Prepare Title, Author and Addresses, key words and Abstract (summary and synopsis) 4.2 Writing of technical report and thesis - IMRAD system (Introduction, Material methods, Result and Discussion), Acknowledgement,	12	15
	Summary, Conclusion and references. 4.3 Concept of scientific writing 4.4 Meaning of scientific paper 4.5 Write a letter to Editor of scientific journal for publishing a research paper.		
Unit V	Ethical Issues 5.1 Intellectual property Rights, 5.2 Commercialization, 5.3 Copyright, 5.4 Royalty, 5.5 Patent law, 5.6 Plagiarism, 5.7 Citation, 5.8 Impact factor 5.9 h-index	05	06
Suggested Readings	1) Anthony, M., Graziano, A. M. and Raulin, M. L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon. 2) Coley, S. M. and Scheinberg, C. A. 1990, "Proposal writing". Stage Publications. 3) Gurumani, N. Research methodology for biological science, MJP publisher, Chennai. 4) Kothari C. R. Research Methodology, New Age International, 2009 5) Robert A. Day, How to write and publish a Scientific papers (4th edition). 6) Tejinder Singh and N. G. Madhav, Better Thesis Writing 7) Wadhwa, B. L. Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing 8) Walliman, N. 2011. Research Methods - The Basics. Taylor and Francis, London, New York.		

DSC ELECITIVE COURSE (Any one from 606 A or 606 B)			
Zoo – 606 (A) Bioinformatics			
	Course objective <ul style="list-style-type: none"> To get introduced to the basic concepts of Bioinformatics and its significance Explain generation and different types of computers with basic programming languages. Overview about types of Biological data and database search tools. To get exposed to computational methods, tools and algorithms employed for proteomics and genomics 	Total Hours: 45	Credits: 03
	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> understand the basic concepts of Bioinformatics and its significance apply their knowledge of generations, types of computers and programming languages understand the process of sequence alignment methods using web resources Appreciate the tools used in proteomics and genomics their significance 		
Unit	Topics	Lectures 45	Marks 60
Unit I	1.1 Definition, Objectives and scope of Bioinformatics 1.2 Application of Bioinformatics in various Fields.	04	5
Unit II	2.1 Computer generations and Type of computer 2.2 Programming Languages: PERL and Java.	07	10
Unit III	3.1 Biological Databases- Concept and types of databases 3.2 Sequence alignment 3.2.1 BLAST, types and applications. 3.2.2 FASTA, format and application	10	10
Unit IV	4.1 Proteomics: Definition, Protein structure visualization tools-RasMol and SwissPDB viewer 4.2 Protein sequence databases- PIR, SWISS-PROT, TrMBL 4.3 Structural classification databases- SCOP, CATH, 4.4 Protein folding and disorders 4.5 Applications of Proteomics	12	15
Unit V	5.1 Genomics: Gene, Genotype, Genome of <i>E. coli</i> , <i>S. cerevisiae</i> , <i>C. elegans</i> , and <i>Homo sapiens</i> .	12	20

	<p>5.2 Single nucleotide polymorphisms (SNPs), Structure and application of DNA microarray.</p> <p>5.3 Nucleotide sequence database, GenBank (NCBI, EMBL and DDBJ), cDNA libraries and ESTs,</p>		
	<p>Databases of metabolic pathways- KEGG.</p> <p>5.4 Genomics in medicine- disease monitoring, Drug designing and development.</p>		
Suggested Readings	<ol style="list-style-type: none"> 1) Aluru, Srinivas, (2006) ed. <i>Handbook of Computational Molecular Biology</i>. Chapman & Hall/Crc, ISBN 1584884061 (Chapman & Hall/Crc Computer and Information Science Series) 2) Attwood, T.K., Michie, A.D. and Jones, M.L. (1996): DbBrowser: integrated access to database worldwide. <i>TiBS</i>. Vol. 21(5), 191. 3) Barnes, M.R. and Gray, I.C.(2003) eds., <i>Bioinformatics for Geneticists</i>, first edition. Wiley, ISBN 0-470-84394-2 4) Curtis Jamison. (2003) Perl Programming for Biologists. By Hoboken, NJ: John Wiley & Sons, Inc. 5) Prakash S.Lohar (2011) Bioinformatics ISBN 978-81-8094-066-8 MJP Publishers, Triplicane, Chennai. 6) Lesk, A.M. (2001): <i>Introduction to Protein Architecture: The Structural Biology of Proteins</i> (Oxford: Oxford University Press). 7) Pocock,M.R. et al. (2000) BioJava: open source components for bioinformatics. ACM SIGBIO 		

DSC ELELCTIVE COURSE (Any one from 606 A or 606 B)			
Zoo – 606 (B) Sericulture			
	Course objective <ul style="list-style-type: none"> To give scientific knowledge about mulberry cultivation, silkworm rearing techniques to the students. To train the students in compressive silk production techniques. 	Total Hours: 45	Credits : 03
	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> develop an expert manpower to handle the own sericulture units/entrepreneurship/corporate sector units. Provide gainful employment, economic development and improvement in the quality of life to the people in rural area. 		
Unit	Topics	Lectures	Marks
Unit I	Introduction 1.1 Sericulture: Definition, history, present Status 1.2 Scope of sericulture 1.3 Silk producing centres 1.4 Taxonomic position 1.5 Types of silkworms and their Distribution (Muga, Eri, Tussar, Mulberry)	09	12
Unit II	Biology of Silkworm: 2.1 Life cycle of <i>Bombyx mori</i> w. r. t. external and internal morphology of Egg, larva, Pupa, adult 2.2 Structure and function of silk gland and secretion of silk 2.3 Digestive system of <i>Bombyx mori</i>	09	12
Unit III	Cultivation of Mulberry: 3.1 a) Selection of mulberry variety, b) Propagation, c) Climate, d)Soils, e)Planting, f)Raising of commercial nursery, g) Manuring, h) Interculture, i) Water management, j) Pruning and k) Quality of leaves 3.2 Harvesting of mulberry- a) Shoot Cutting b) Leaf plucking and c) Bud plucking. 3.3 Advantages and disadvantages of shoot rearing	09	12
Unit IV	Silkworm Rearing: 4.1 Rearing technique: a) Selection of quality seeds, b) Brushing, c) Quality of food, d) Shape and size of leaves, e)	09	12

	<p>Preparation of feed bed for different rearing methods, f) Bed Cleaning methods, g) Spacing, moulting, mounting,</p> <p>h) Environmental conditions and care during spinning, i) Harvesting of cocoons, j) Sorting of cocoons and k) Post harvest processing of cocoons.</p> <p>4.2 Rearing house</p> <p>4.3 Rearing Appliances: a) Rearing stand, b) Ant wells,c) Rearing trays, d) Paraffin paper, e) Foam rubber strip, f) Chopsticks, g) Feathers, h) Leaf chamber, i) Chopping board, j) Chopping knives, k) Mats, l) Cleaning nets, m) Mountages, n) Feeding stand and o) Miscellaneous appliances</p>		
Unit V	<p>Important Diseases and Pests:</p> <p>5.1 Protozon disease: Pebrine</p> <p>5.2 Viral disease: Nuclear Polyhedrosis Virus (NPV)</p> <p>5.3 Fungal disease: Muscardine - White, green, yellow</p> <p>5.4 Pests of silkworm: Uzi flies, dermestid beetles, ants and vertebrates</p> <p>5.5 Prevention and control of diseases and pests</p>	09	12
Suggested Readings	<ol style="list-style-type: none"> 1) Handbook of silkworm rearing: Agricultural and Technical manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972. 2) Jolly Ed.M.S., Appropriate Sericulture Techniques; Director, CSR & TI Mysore. 3) Krishnaswamy S., Improved Method of Rearing Young age silkworm; reprinted CSB, Bangalore, 1986. 4) Narsimhanna M.N., Manual of Silkworm Egg Production; CSB, Bangalore 1988. 5) Sengupta K., A Guide for Sericulture; Director, CSIR & TI, Mysore1989. 6) Silkworm Rearing; Wupang- Chun and Chen Da-Chung, Pub. By FAO, Rome 1988. 7) Ullal S.R. and M.N. Narsimhanna Handbook of Practical sericulture: CSB, Bangalore 		

Zoo - 607: Corresponding practical to DSC Zoo 601			
	Course objective • To understand habit, habitat and taxonomic status of Leech as invertebrates and Calotes as vertebrates	Teaching Hours :45	Credits : 03
	• To explain the basic aspects of structural and functional details of Leech and Calotes		
	Learning outcomes After successful completion of this course, students are expected to: • understand the systematic position, habit and habitat of Leech and Calotes • acquire the knowledge about structural and functional details about Leech as invertebrates and Calotes as vertebrates • compare structural and functional details in Leech and Calotes		
Practical	Zoo - 601: Study of Leech and Calotes		
1	Study of systematic position and external characters of leech with the help of chart or diagram.		
2	Study of Digestive system of leech with the help of chart or diagram.		
3	Study of Nervous system of leech, with the help chart or diagram.		
4	Study of reproductive system of leech, with the help chart or diagram.		
5	Study of systematic position and external characters of calotes, with the help chart or diagram.		
6	Study of Digestive system of Calotes, with the help chart or diagram.		
7	Study of Nervous system of Calotes, with the help chart or diagram.		
8	Study of Reproductive system of Calotes, with the help chart or diagram.		
Suggested Readings	1) Jordan E. L. and P. S. Verma, Chordate Zoology, S.Chand and Company New Delhi. 2) Kotpal R.L (1991), Zoology Phylum Annelida, Rastogi Publication. Meerut. 3) Kotpal R.L. (2016), Modern text book Vertebrate Zoology. Fourth edition. Rastogi Publication, Meerut 4) Lal S.S. (1996): Textbook of Practical Zoology Invertebrates, Rastogi Publications 5) Lal S.S. (1996): Textbook of Practical Zoology Vertebrates, Rastogi Publications. 6) Young K.Z., A life of Vertebrate, ELBS Oxford University Press.		

Zoo - 608: Corresponding practical to DSC Zoo 602 and Zoo 603			
	Course objective <ul style="list-style-type: none"> To get technical awareness of vermitechnology, and poultry farming technique. To learn the stages of embryology through permanent slides/charts. To know the processes involved in embryonic development and practical applications of studying the chick embryology. 	Teaching Hours :45	Credits : 03
Practical	Learning outcomes After successful completion of this course, students are expected to: <ul style="list-style-type: none"> Practice of vermicomposting, vermiculturing and poultry farming. Aspire to work in preparing bio compost, vermicomposting and get employment accordingly. Rearing and production of birds and get employment accordingly. 		
	Zoo - 602: Chick Embryology		
1	Study of Hens egg With the help of Chart/ Model/ Permanent slides (D)		
2	Study of Cleavage, Blastula and Gastrula: With the help of Chart/ Model/ Permanent slides (D)		
3	Study of Whole mounts of 18, 24, 33, 48, 72 and 96 hours of chick embryos with the help of Permanent slides / Chart / Model (D)		
4	Temporary mounting of chick embryo (E)		
	Zoo-603 Applied Zoology		
5	Study of External morphology of Earthworm		
6	Study of species of Earthworm		
7	Establishment of Vermicompost unit		
8	Establishment of Vermiwash unit		
9	Study of External morphology of Indian fowl and sexual dimorphism		
10	Study of Poultry breeds		
11	Study of Poultry equipment's		
12	Compulsory visits to a Vermiculture unit / Poultry farm		
Suggested Readings	1) Shukla and Upadhyay, Economic Zoology, Rastogi publication. 2) Singh, R. A., Poultry production, Kalyani publishers, New Delhi. 3) Srivastava P. D. and N. C. Pant, Economic Zoology Commercial Publication Bureau, New Delhi.		

DSC Core Practical			
Zoo - 609: Corresponding practical to DSC Zoo 604			
	Course objectives: To prepare the whole mounts microscopic slides and staining reactions.	Teaching Hours :45	Credits : 03
	Learning outcomes: Cell tissue structure, histology of tissues and details of morphology of animals. Job opportunities in Health institutes, Hospitals and Pathological labs.		
Practical	ZOO 604 – Microtechnique		
1	Preparation of permanent whole mounts of different kinds-5 slides.		
2	Preparation of permanent slides of histological sections from different mammalian tissues-5 slides.		
3	Study of Rotary and Rocking microtome.		
4	Vital staining of mitochondria by Janus green B stain.		
5	Calibration of micrometer scale of cell diameter from the given permanent slide.		
6	Sketching by camera Lucida.		
7	Submission of permanent slide (5 Whole mounts and 5 histological sections).		
Suggested Readings	<ol style="list-style-type: none"> 1) Gray P., Hand book of basic Microtechnique. 2) Indurkar A.K., Practical course in Cytology. 3) Me Mann J.F.A and R.W Mowry, Staining Methods (Histology and Histochemical) 4) Pathak, Microtechnique (Theory and Practical) 5) Patki, Bhalchanda and Jeevaji, Introduction to Microtechnique, S. Chand Publication. 6) Pearse A.G.E., Histochemistry – Vol. I and II 7) Tembhare D.B., Techniques in Life Sciences 8) Weesner F.M., General Zoological Microtechnique. 		

KBC North Maharashtra University, Jalgaon

TYBSc Zoology

Equivalence for old courses

Semester V

Course code (Old syllabus 2017)	Course code (New syllabus 2020)
Zoo 351	Zoo 501
Zoo 352	Zoo 502
Zoo 353	Zoo 503
Zoo 354	Zoo 504
Zoo 355	Zoo 505
Zoo 356	Zoo 506
Zoo 357	Zoo 507
Zoo 358	Zoo 508
Zoo 359	Zoo 509

Semester VI

Course code (Old syllabus 2017)	Course code (New syllabus 2020)
Zoo 361	Zoo 601
Zoo 362	Zoo 602
Zoo 363	Zoo 603
Zoo 364	Zoo 604
Zoo 365	Zoo 605
Zoo 366	Zoo 606
Zoo 367	Zoo 607
Zoo 368	Zoo 608
Zoo 369	Zoo 609