



**Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS), PUNE – 411004.**

Syllabus
for
T. Y. B. Sc. (Zoology)
[NEP - 2020]
(B.Sc. Zoology Semester-V & Semester-VI)



Syllabi NEP 1.0 Implemented from Academic Year 2025-26

T.Y. BSc Semester: V/VI

Program Specific Outcomes (PSOs)

PSO	Outcomes
PSO1	Academic Competence: Students will demonstrate a solid understanding of core concepts in zoology, including animal physiology, ecology, evolution, and genetics. They will be capable of applying this knowledge to understand biological systems, analyze data, and solve complex biological problems
PSO2	Personal and Professional Competence: Students will develop the necessary skills to communicate scientific findings effectively in both written and oral formats. They will be prepared for professional careers in research, wildlife conservation, or environmental consulting, demonstrating leadership, teamwork, and ethical decision-making skills.
PSO3	Research Competence: Students will be skilled in conducting scientific research in zoology, including formulating hypotheses, designing and executing experiments, analyzing biological data using statistical methods, and presenting research findings in peer-reviewed formats.
PSO4	Entrepreneurial and Social Competence: Students will explore entrepreneurial opportunities in fields such as eco-tourism, wildlife conservation, environmental education, and bioinformatics. They will also engage in social responsibility by addressing global challenges like biodiversity loss, climate change, and public health through awareness campaigns and community-based projects.
PSO5	Use of modern Tools: Students will learn and gain hands on experience of modern/ recent tools and techniques used in biological sciences and their application in science.
PSO6	Community Sensitization: Students will be undertaking a special community engagement programme which will foster social sensitization and responsibility.

T.Y. B.Sc. NEP 1.0						
Semester	Paper	Paper Code	Title	Type	Credits	Exam Type
V	Major	ZOO-301	Developmental Biology	Theory	2	CE+ESE
		ZOO-302	Biochemistry	Theory	2	CE+ESE
		ZOO-303	Ecology And Environmental Biology	Theory	2	CE+ESE
	Elective	ZOO-304 OR ZOO-305	Introduction to Bioinformatics Or Immunology	Theory	2	CE+ESE
				Theory	2	CE+ESE
		ZOO-306 OR ZOO-307	General Endocrinology Or Poultry Science	Theory	2	CE+ESE
				Theory	2	CE+ESE
	Major	ZOO-311	Zoology Practical-5	Practical	2	CE+ESE
		ZOO-312	Zoology Practical-6	Practical	2	CE+ESE
	VSC	ZOO-331	Fundamentals Of Histology	Theory	2	CE
		ZOO-332	Zoology Practical-7	Practical	2	CE
	Minor	ZOO-321	Human Genetics	Theory	2	CE+ESE
	FP	ZOO-345	Field Project	Theory / Practical	2	CE
VI	Major	ZOO-351	Evolutionary Biology	Theory	2	CE+ESE
		ZOO-352	Molecular Biology	Theory	2	CE+ESE
		ZOO-353	Mammalian Physiology	Theory	2	CE+ESE
	Elective	ZOO-354 OR ZOO-355	Animal Pathology Or Forensic Zoology	Theory	2	CE+ESE
				Theory	2	CE+ESE
		ZOO-356 OR ZOO-357	Biostatistics Or Insect Pest Management	Theory	2	CE+ESE
				Theory	2	CE+ESE
	Major	ZOO-361	Zoology Practical-8	Practical	2	CE+ESE
		ZOO-362	Zoology Practical-9	Practical	2	CE+ESE
	VSC	ZOO-382	Zoology Practical-10	Practical	2	CE
	Minor	ZOO-371	Bee Keeping	Theory	2	CE+ESE
	OJT	ZOO-395	On Job Training	Theory / Practical	4	CE

	ZOO 301-Developmental Biology Major-Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Define and describe developmental biology with its relevance in life science research	1
CO2	Articulate different phases in developmental biology with different bench mark events in the entire process of animal development.	2
CO3	Demonstrate different stages of development in chick.	3
CO4	Categorize embryo development in humans with special reference to embryo development, implantation, structure and functions of placenta.	4
CO5	Evaluate the effect of teratogens on growth and development of embryo and in vitro fertilization.	5
CO6	Compile factors affecting growth and development with special reference to the process of ageing.	6

**ZOO-301-Developmental Biology
(Major-Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction, Developmental Biology and Embryology, Historical perspectives and Scope of Developmental biology, basic concepts in developmental biology, Theories of developmental Biology- Preformation, Germplasm, (Weismann), Mosaic (Roux), Regulation (Driesch), Gradient (child), Organizer (Spemann), Epigenesis, Baer's Law, and Biogenetic law.	04
II	Basic Embryology Gametogenesis, Fertilization, Cleavages/ Segmentation, Gastrulation, Organogenesis, Growth and Differentiation.	03
III	Gametogenesis Origin of primordial cells (mammals), Spermatogenesis, Oogenesis (Mammals), Functions of ovarian tissue Fertilization Basic requirement, Mechanism, Capacitation and contact, acrosome reaction, penetration, activation of ovum, migration of pro-nuclei and amphimixis, post fertilization changes in egg, cytoplasm, monospermatic and poly-spermatic fertilization and significance	03
IV	Cleavage Particulars of cell division, planes of cleavage, patterns of cleavage, rate of cleavage and significance of cleavage. Morulation and Blastulation Morulation and blastulation in isolecithal or microlecithal egg, blastulation in telolecithal egg, microlecithal/ polylecithal egg, blastulation in mammals, significance of blastulation Fate Maps	10

	Construction of fate maps (natural and artificial marking) Gastrulation- general process, morphogenic movements, gastrulation in isolecithal and telolecithal egg, Significance of gastrulation, tabulation, neurogenesis, notogenesis and mesogenesis	
V	Embryology of chick Chick Embryo- As Model for studying embryology Study of Egg, Primitive Streak, Somite formation, The Structure of: 24 hrs , 33 hrs , 48 hrs and 72 hrs of incubation.	10

Learning Resources- References

Sr. No.	References
1.	Developmental Biology, Arumugam N. Saras Publication.
2.	The early Embryology of the Chick. Bradley Patten.
3.	Essential Developmental Biology. Slack, J.M.W. (2013) III Edition, Wiley- Blackwell.
4.	Developmental Biology. Gilbert, S. F. (2010) IX Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA
5.	Foundations of Embryology. Carlson, B.M. (2007) VI Edition, Tata McGraw-Hill Publishers
6.	An Introduction to Embryology. Balinsky B. I. and Fabian B. C. (2006). VIII Edition, International Thompson Computer Press
7.	Developmental Biology: Principles and Concepts. Arora, R. and Grover, A. (2018) I Edition, R. Chand & Company.
8.	Principles of Development. Wolpert, L. (2002) II Edition, Oxford University Press.
9.	Developmental Biology, Sastry and Shukla, Rastogi Publication, Meerut, India
10.	http://bgc.ac.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf
11.	https://thebiologynotes.com/category/developmental-biology/
12.	https://www.stuvia.com/en-us/doc/508791/developmental-biology-notes
13.	https://link.springer.com/content/pdf/bfm%3A978-1-4615-6823-0%2F1.pdf
14.	https://www.researchgate.net/publication/309032743_Developmental_biology
15.	https://www.goodreads.com/book/show/658865.Developmental_Biology

	ZOO-302 - Biochemistry	
	Major-Theory	
	Number of Credits: 02	
	No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Recall the concept of pH and buffer, its importance and explain types of bond and buffers in biological systems. Describe structure and properties of water.	1
CO2	Classify types of sugars and demonstrate stereochemistry of carbohydrates and their properties.	2
CO3	Examine amino acids based on their structures. Differentiate structures of proteins.	3
CO4	Differentiate examples and bonds responsible for protein structures. Analyse amino acids based on various tests.	4
CO5	Justify the role of enzymes as biochemical catalysts, learn classification of enzymes, factors affecting enzyme activity.	5
CO6	Hypothesize enzyme kinetics, MM equation and its importance and LB plot. Iso- enzymes, co-enzymes (NAD, NADP, FAD, FMN, Co-A, TTP), cofactors, Immobilized enzymes Ribozymes.	6

ZOO-302 - Biochemistry
(Major- Theory)

Unit No.	Title of Unit and Contents	No. of hours
I	Basic Biochemistry: Structure of water molecule (liquid, ice and colloid) Physicochemical properties of water, Concept of acid and base, pH, Sorenson's scale, derivation of Henderson - Hassel Balch equation and its applications, Concept of Buffer-types of buffers, buffering capacity and buffers in biological system.	07
II	Carbohydrates: Definition and classification of carbohydrates. Properties of carbohydrates, Stereoisomerism, Enantiomers, anomers, epimers, racemization. Detection techniques for carbohydrates, biological significance of carbohydrates.	08
III	Proteins: Amino acids - structure, properties, and classification. Essential, non-essential, non-protein amino acids, Physical properties of amino acids, Reactions related to R group, COOH group and NH ₂ group, titration curves - (reference to Alanine), isoelectric point, Zwitterion. Determination of N-terminal and C-terminals. Types of protein structure and bonds responsible for protein structure, Biological significance of proteins.	09
IV	Enzymes: Classification of enzymes, Reversible and irreversible enzyme inhibition, Factors influencing enzyme activity, MM equation and its importance and LB plot. Iso-enzyme, Co-enzymes ,NAD, NADP, FAD, FMN, Co-A, TTP, cofactors, Immobilized enzymes and Ribozymes.	06

Learning Resources- References

Sr. No.	References
1.	Principles of Biochemistry, 1993, 2nd Edn, Lehninger A. L. Nelson D.L. & Cox M.M. CBH Publisher and distributors, Delhi.
2.	Biochemistry, 1995 5th Edn. Zuby G. Wm, C. Brown Communications USA
3.	Harper's Biochemistry, 1996, 26th Edn., Murray R. K., Granner D. K., Mayes P. A. & Rodwell V. W. Prentice Hall international USA.
4.	Outline of Biochemistry, 1995 5th Edn., Conn E. E., Stumph P. K. Bruening G. & Doi, R. H. John Wiley & Sons, USA
5.	Principals of Biochemistry, 1993, 1st Edn., Pattabhiraman T. N., Gajanan Book Publishers and distributors, Bangalore
6.	Clinical Biochemistry, 1994, B. P. Godkar, Bhalini Publishing House, Mumbai
7.	Biochemistry - 1995 5th Edn, Stryer Sanfrancisco, W. H. Freeman & Co.
8.	Biochemistry, 1990, 8th Edn., D. Voet & J. Voet, John Willey, New York
9.	Principles and techniques of Biochemistry and molecular biology - 2009, 7th Edition, Keith Wilson and John Walker, Cambridge University.
10.	Biochemistry- 2012, Seventh International Edition, Jeremy Berg and Tymoczko and Stryer, Freeman and Company, New York
11.	Biochemistry - 2011, Fourth International Student Edition, Voet and Voet, John Wiley and Sons.
12.	Essentials of Biochemistry -U. Satyarayana, U. Chakrapani Second Edition Books and Allied(P) Ltd
13.	https://openlearning.mit.edu/mit-faculty/residential-digital-innovations/online-resources-biochemistry-enhance-learning-well
14.	https://libguides.cam.ac.uk/biochem/onlineresources
15.	https://libguides.library.usyd.edu.au/c.php?g=508174&p=3476667
16.	https://www.researchgate.net/publication/264309515_Impact_of_e-resources_on_learning_in_biochemistry_First-year_medical_students_perceptions
17.	https://openlearning.mit.edu/mit-faculty/residential-digital-innovations/online-resources-biochemistry-enhance-learning-well
18.	https://openlearning.mit.edu/mit-faculty/residential-digital-innovations/online-resources-biochemistry-enhance-learning-well
19.	https://libguides.cam.ac.uk/biochem/onlineresources
20.	https://libguides.library.usyd.edu.au/c.php?g=508174&p=3476667
21.	https://www.researchgate.net/publication/264309515
22.	https://openlearning.mit.edu/mit-faculty/residential-digital-innovations/online-resources-biochemistry-enhance-learning-well

	ZOO-303 - Ecology and Environmental Biology (Major-Theory)	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe basic concept of ecology, structure and function of ecosystem and its management, different types of pollutants, their effects, control measures and how they interact in the environment. Define the large-scale patterns of temperature regulation.	1
CO2	Represent interactions between organisms and their environments drive the dynamics of individuals, populations, communities, and ecosystems.	2
CO3	Demonstrate the characteristics of population and its dynamics and illustrate how population data can be analysed using statistics, graphs, life tables, and survivorship curves.	3
CO4	Differentiate between environmental conditions of aquatic ecology, terrestrial ecology and desert ecology. Classify organisms ecologically.	4
CO5	Asses role of remote sensing for sustainable development and its application in environmental biology,.	5
CO6	Write about interdisciplinary relationship of global environmental issues related to acid rain, ozone depletion and global warming and explain them.	6

**ZOO-303 - Ecology and Environmental Biology
(Major - Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Environmental Biology Introduction Definition, basic concepts and scope. Introduction to biodiversity.	3
II	Ecosystem structure and function Concept and definition of ecosystem - structure and function; Abiotic components - temperature relations, water relations. Biotic components - relationship among organisms Positive interactions Negative interactions. Major Ecosystems Natural ecosystem (one example) Artificial ecosystem (one example) Ecological pyramids. Energy flow in ecosystem and flow models.	7
III	Habitat Ecology Aquatic ecology - Habitat conditions. - Ecological classification of organisms. Terrestrial ecology - Environmental conditions. Desert ecology - The great Indian desert (Thar desert)	5
IV	Environmental Pollution: Definition and its types. Introduction to different environmental pollutants.	5

	Air pollution: Definition, Kinds of pollutants ,Different sources of air pollutants Air pollution and its relation with the following: Acid rain , Greenhouse effect, Ozone layer Water pollution: Definition, different sources of water pollutants. Effect of pollution on aquatic ecosystem Noise pollution: Definition. different sources of noise pollutants. Effects and control	
V	Population structure and dynamics: Basic concept Population characteristics	6
VI	Remote sensing for sustainable development: Introduction to remote sensing Introduction to geographic information system	4

Learning Resources- References

Sr. No.	References
1.	Ecology and Environment, P. D. Sharma, Rastogi Publ. Meerut.
2.	Environmental Biology, 1996, P. S. Sharma, V. K. Agrawal, S. Chand and Co. New Delhi.
3.	Ecology, 1995 Mohan P. Arora Himalaya Publ. House Delhi.
4.	Fundamentals of ecology, 1993 M. C. Dash, Tata McGraw Hill, New Delhi.
5.	Elements of ecology, George L. Clarke, John Wiley and Sons, New York.
6.	Ecology of Natural resources, 1995 John Wiley and Sons, New York.
7.	Concepts of Ecology, 1996, E. J. Kormondy, Pentice Hall of India, New Delhi.
8.	Modern Concepts of Ecology, H. D. Kumar, Vikas Pub. House, New Delhi. Ecology, E. P. Odum, Oxford & IBM Pub. Co., New Delhi.
9.	Environmental Problems and Solution, D. K. Asthana, Meera Asthana, S. Chand Pub. Ramnagar, New Delhi.
10.	https://www.researchgate.net/publication/225223282_Basics_of_Remote_Sensing
11.	https://www.sciencelearn.org.nz/resources/
12.	https://www.sciencedirect.com/topics/neuroscience/bioindicatorsbioindicators
13.	https://www.who.int/health-topics/air-pollution#tab=tab_1
14.	https://www.nrdc.org/stories/water-pollution-everything-you-need-know
15.	https://cfpub.epa.gov/watertrain/pdf/issue2.pdf

	ZOO-304 - Introduction to Bioinformatics Elective –Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe the concepts of Bioinformatics, its importance/ relevance in life sciences.	1
CO2	Discuss varied aspects in Genome and its relation with bioinformatics.	2
CO3	Apply the knowledge of computer science, internet and web applications for genome analysis	3
CO4	Explain and analyse the data obtained from sequencing of genomes and its applications in life sciences.	4
CO5	Discriminate the features of biological databases and review their importance for application research in bioinformatics.	5
CO6	Compilation of databases, information storage and retrieval of biological information from databases.	6

**ZOO-304 - Introduction to Bioinformatics
(Elective - Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to Bioinformatics Use of Internet and Web sites for biological information, search engines and computer programs useful in Biology/ life sciences Definition, Goal and Scope of Bioinformatics, Applications of Bioinformatics, Research in Bioinformatics, Bioinformatics Applications and Research Three levels of Bioinformatics in structural Biology, Specific Applications of Bioinformatics in Life Sciences, Tools used in Bioinformatics	08
II	Introduction to Databases General Information of databases, Types of Databases, Biological Databases, Information Retrieval from Biological Databases and Types of sequences used in Bioinformatics	05
III	Biological Databases General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum)	10
IV	Sequence Alignment and Visualization Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).	07

Learning Resources- References

Sr. No.	References
1.	Fundamentals of Bioinformatics, Claverie, J. M. and Notredame C.
2.	Fundamentals of Bioinformatics, Lesk A. M.
3.	Essential Bioinformatics, Jin Xiong, 2006
4.	https://www.slideshare.net/GOVINDYADAV28/ppt-on-glp
5.	https://www.labmanager.com/lab-health-and-safety/biohazard-management-770
6.	https://www.mohfw.gov.in/pdf/National%20Guidelines%20for%20IPC%20in%20HCF%20-%20final%281%29.pdf
7.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4412124
8.	https://academic.oup.com/cid/article/49/1/142/371797
9.	https://www.olympus-lifescience.com/en/microscope-resource/primer/techniques/confocal/resolutionintro/
10.	https://www.leica-microsystems.com/science-lab/pinhole-effect-in-confocal-microscopes/
11.	https://micro.magnet.fsu.edu/primer/techniques/confocal/index.html
12.	http://www.physics.emory.edu/faculty/weeks//confocal
13.	https://www.kbsi.re.kr/
14.	https://www.google.com/search?client=firefox-b-d&q=structure+of+atoms,+molecules+and+chemical+bonds&sa=X&ved=2ahUKEwj5xv-LnK_sAhX2zTgGHc2lDsIQ1QIoA3oECBYQBA&biw=1536&bih=750
15.	https://sites.google.com/site/intermolecularforcesnonbonding/home?tmpl=%2Fsystem%2Fapp%2Ftemplates%2Fprint%2F&show_hPrintDialog=1
16.	https://blog.sepscience.com/gaschromatography/basis-of-interactions-in-gas-chromatography-part-1-non-polar-interactions
17.	https://www.innovatechlabs.com/newsroom/1841/how-to-interpret-gas-chromatography-mass-spectrometry-results/
18.	https://www.slideshare.net/anurag_yadav/centrifugation-principle-and-types
19.	https://www.slideshare.net/TapeshwarYadav1/ultracentrifugation-55335455
20.	https://conductscience.com/ultracentrifugation-basics-and-applications/

	ZOO-305 - Immunology Elective-Theory	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Define the basic terms and concepts of immunological processes at cellular and molecular level. Describe the components of immune system	1
CO2	Explain autoimmune disorders and exemplify their adverse effect on the body. Illustrate various mechanisms that regulate immune responses.	2
CO3	Employ the principle of antigen-antibody reaction and outline basic techniques and application in diagnostics.	3
CO4	Explain the structure and functions of cells and organs of immune system	4
CO5	Compare and contrast innate and adaptive immune system.	5
CO6	Discriminate different types of antigens, antibodies, their interactions and propose a specific detection test.	6

**ZOO-305 - Immunology
(Elective - Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction of Immune system: Introduction to immunology, Definition and scope of immunology, Concept of Immunity Innate and Acquired Immunity. Cells of Immune system. Organs of immune system Primary lymphoid organs: Thymus, bone marrow, Lymphatic system. Secondary lymphoid organs: Lymph nodes, Spleen, Associated lymphoid organs.	12
II	Antigen, antibody and their interaction: Types of Antigens - Complete antigens and haptens Antibodies Structure and types of immunoglobulin. Antigen antibody interactions Precipitation reaction: Definition, characteristics and mechanisms, in fluids (tube test) and in gels (slide test) Radial immunodiffusion (Mancini method) Double immunodiffusion (Ouchterlony method) Immuno-electrophoresis Agglutination reaction: definition, Haemagglutination (slide and micro-tray agglutination), Bacterial agglutination (tube agglutination), passive agglutination, Coomb's test	12

III	Autoimmune disorders Study of autoimmune disorders: Myasthenia Gravis. Systemic Lupus Erythematosus. Rheumatoid arthritis. Thyroiditis and types of hypersensitivity	06
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Learning Resources- References

Sr. No.	References
1.	Roitt's Essential Immunology, 13 th Edition, Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt.
2.	Fundamentals of Immunology, 5 th edition, Edited by William E Paul, Lippincott Williams & Wilkins, 2003.
3.	Immunology 7 th Ed. - D. Male, J. Brostoff, D. Roth, I. Roitt (Elsevier, 2006)
4.	Veterinary Immunology, 9 th Edition, Ian Tizard
5.	Immunology, 4 th Ed. Janis Kuby, W. H. Freeman & Co.
6.	Immunology, 6 th Ed. Ivan M. Roitt
7.	Immunology - Goldsby R. A., Kindt T. K., Osborne B. A. and Kuby J. (2003), 5 th Edition, W. H. Freeman and Company, New York.
8.	Immunobiology - Janeway C. A., Travers P, Walport M. and Shlomchik M. (2001), 6 th Edition, Garland Publishing, New York.
9.	Lymphocyte Traffic and Homing
10.	Basic Immunology Overview by Prof.Vladimir V.Klimov
11.	Biodesign : frequently referenced antibody tables and graphs
12.	Biodesign : frequently referenced antibody tables and graph
13.	<u>Immunology Lecture</u>

	ZOO-306 - General Endocrinology Elective-Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe endocrine glands and physiological functions of hormones synthesized and secreted by them.	1
CO2	Explain hormonal regulations of different hormones.	2
CO3	Illustrate feedback mechanism of hormones secreted by Pituitary gland, other endocrine glands and neuroendocrine system.	3
CO4	Classify different classes of hormones and their mechanism of action.	4
CO5	Review different Assisted Reproductive technologies.	5
CO6	Write a report on hormonal dysfunctions and disorders.	6

**ZOO-306 - General Endocrinology
(Elective - Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction, brief history and scope of Endocrinology Overview of Endocrine glands in vertebrates/ man	5
II	The Concept of Homeostasis Feedback System for hormones and Hormones and Homeostasis	2
III	General characteristics of Hormones and Classes of Hormones: Definition of Hormone, Chemical Structure and Synthesis of Hormones, Control of Hormone Secretion and overview of functions. (Location, Structure and Function, Hypoactivity and Hyperactivity of Hormones)	3
IV	Hormones of Adenohypophysis and Neurohypophysis Physiological Role/ Functions	3
V	Osmoregulatory Hormones ADH, Mineralocorticoids and renin- angiotensin mechanism.	3
VI	Neurotransmitters/ Neurohormones- nature and mechanism of action; brief account of Neurotransmitters	6
VII	Hormone Receptors and the Mechanisms of action of hormones and Feedback mechanism	4

Learning Resources- References

Sr. No.	References
1.	Williams Text Book of Endocrinology - Tenth Edition, Saunders, 2003.
2.	Endocrinology - Mac E. Hadley, Fifth Edition, Pears on Education, 2004.
3.	Molecular Endocrinology - Bolander, F. F., Academic, San Diego, 1989.
4.	Textbook of Endocrinology - Griffin J.E., S. R. Ojeda, Oxford, New York, 1988.
5.	Basic and Clinical Endocrinology - Greenspan, F. S., 3rd ed., Appleton and Lange
6.	Endocrinology - Mac E. Hadley, Fifth Edition, Pears on Education, 2004.
7.	Molecular Endocrinology - Bolander, F. F., Academic, San Diego, 1989.
8.	Textbook of Endocrinology - Griffin J.E., S. R. Ojeda, Oxford, New York, 1988.
9.	Basic and Clinical Endocrinology - Greenspan, F. S., 3rd ed., Appleton and Lange.

10.	https://openlearning.mit.edu/mit-faculty/residential-digital-innovations/online-resources-biochemistry-enhance-learning-well
11.	https://openlearning.mit.edu/mit-faculty/residential-digital-innovations/online-resources-biochemistry-enhance-learning-well
12.	https://youtu.be/bY6IWVgFCrQ
13.	https://www.google.com/search?q=Insulin+regulation&client=firefox-b-d&tbm=isch&source=iu&ictx=1&fir=YSMH8Whiod2ubM%252CvNxQJ55vO7tILM%252C&vet=1&usg=AI4 -kQUXbsqxueesbdSbGm014l_aOI9eQ&sa=X&ved=2ahUKEwjX2LPgiKrvAhV1yzgGHSHhCgoQ9QF6BAgKEAE#imgsrc=YSMH8Whiod2ubM
14.	https://www.google.com/search?q=superior+cervical+ganglia&client=firefox-b-d&tbm=isch&source=iu&ictx=1&fir=cmPURCdvDgKOSM%252CjD6Ck-FSPSvT1M%252C &vet=1&usg=AI4 -kRB2KV506amMw1P9cfbt-tuFuNEZw&sa=X&ved=2ahUKEwjAsv291vjuAhUnwTgGHVa DJcQ9QF6BAgJEAE&biw=1536&bih=750#imgsrc=xekovO542FHafM

	ZOO-307 - Poultry Science Elective –Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe poultry science and different systems of fowl farming.	1
CO2	Explain formation, structure, and nutritive value of eggs.	2
CO3	Illustrate breeding mechanism of poultry.	3
CO4	Classify different breeds of fowls	4
CO5	Review of different poultry equipment's and poultry feeding.	5
CO6	Write a report on infectious and non-infectious diseases of fowl.	6

ZOO-307 - Poultry Science
(Elective - Theory)

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to poultry science, Definition of poultry. Historical background of poultry farms, Economic importance of poultry farming.	03
II	Classification of different fowls and study of different breeds.	04
III	Breeding of poultry, Natural mating and Artificial insemination	04
IV	Formation, structure, and nutritive value of eggs. Abnormal types of eggs.	05
V	Hatching of eggs. Brooding and rearing	04
VI	Different systems of fowl farming.	04
VII	Study of poultry equipment's and poultry feeding.	03
VIII	Study of infectious and non-infectious diseases (two each)	03

Learning Resources- References

Sr. No.	References
1.	Mead, G. C. & Wells, R. G. 1999. Poultry meat science. Wallingford, UK, CAB International Publishing.
2.	Scientific poultry production Book · January 2006, Edition III, ISBN - 81-8189-1473, Publisher: International Book Distributing Co., Sreenivasaiah P.
3.	Text Book of Poultry Science by Sreenivasaiah P. V. (2008).
4.	Danish Poultry Network - www.poultry.kvl.dk
5.	Poultry Information Network - www.wattnet.com
6.	International Egg Commission - www.internationalegg.com
7.	Egg - Nutrition Centre - www.enc-online.org
8.	American Egg Board - www.aeb.org

	ZOO-311 - Zoology Practical-5	
	Major –Practical	
	Number of Credits: 02	
	No. of Hours:30	
	Course Outcomes (COs)	Bloom's cognitive level
	On completion of the course, the students will be able to:	
CO1	Describe basic concept and principle of remote sensing and describe the structure of starch and its digestion with salivary amylase.	1
CO2	Differentiate between endangered, threatened and rare species	2
CO3	Relate biochemical analysis and physiological mechanisms with real life situations, Relate the isolation and precipitation of casein.	3
CO4	Analyse the physico- chemical properties of soil sample and abiotic factors , analysis and Identification of carbohydrates	4
CO5	Discriminate life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data	5
CO6	Write the different developmental stages of chick embryo., Write the effect of factors affecting enzyme activity.	6

ZOO-311 - Zoology Practical-5
(Major-Practical)

Practical No.	Title and Contents
1	Study of the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data. (E)
2	Study of physico chemical properties of soil sample. (E)
3	Study any two endangered, threatened and rare species. *(D)
4	Study of Principle of remote sensing (D)
5	Identification of carbohydrates. (E)
6	Isolation of Casein from milk by isoelectric precipitation. (E)
7	Isolation of starch from potato (Microscopic examination of starch) and digestion of starch by salivary amylase. (E)
8	Protein estimation by Lowry method. (E)
9	Study of types of eggs (Insect, Frog and Hen's egg) (D)
10	Study of cleavage, blastula, gastrula, tail bud stage and hind limb stage of frog tad-pole. (D)
11	Mounting of Blastula of Chick embryo. (E)
12	To study types of Placenta in mammals (D)

Note:

- 1 No live animals will be used for practical as per ethical guidelines.
2. Any ten practicals to be conducted.
3. * - with the help of images / charts.
4. Any other practical suggested by the faculty members

	ZOO-312-Zoology Practical-6 Major-Practical	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Relate effect of pH, temperature and inhibition on urea-urease Reaction.	1
CO2	Differentiate different instruments and devises used in ecological studies.	2
CO3	,Differentiate quantitative analysis of Cholesterol,	3
CO4	Calculate Population Density using Mark-recapture method.	4
CO5	Compare different types of eggs, blastula and gastrula., compare different types of amino acids with paper chromatographic separation.	5
CO6	Determine basic techniques in chick embryology., determine the process of principle of density gradient centrifugation.	6
	Write about biotic and abiotic components of any simple ecosystem and measurement of various parameters.	

**ZOO-312 - Zoology Practical-6
(Major-Practical)**

Practical No.	Title and Contents
1	To study the effect of pH, temperature and inhibition (urea-urease reaction). (E)
2	Quantitative analysis of cholesterol. (E)
3	Separation of amino acid by Paper Chromatography. (E)
4	To study the principle of density gradient centrifugation. (E)
5	Calculate Population Density using Mark-recapture method. (E)
6	Study of instruments and devices used in ecology for different purpose (D)
7	Study of abiotic factors like temperature, atmospheric pressure and density. (E)
8	Study of biotic and abiotic components of any simple ecosystem (natural or human modified ecosystem). (D)
9	Study of Chick embryo by using whole mount permanent slides. (D)
10	Mounting of chick embryo. (E)
11	Study of T.S. of testis and ovary of Rat.
12	Study of regeneration in Planaria. (D)

	ZOO-331 - Fundamentals of Histology Vocational Skill Course-Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe concept of histology, basic structure of tissues and identify and label microscopic structure of organs.	1
CO2	Differentiate between histological structure of different regions of alimentary canal and explain the structure of skin, lungs, and kidney.	2
CO3	Illustrate histological structures of various cell types, tissues, and organs.	3
CO4	Explain the histological organization of endocrine, exocrine glands, gonads and correlate it with the health issues.	4
CO5	Compare the characteristics of epithelial, connective, muscular, nervous tissues and the types of blood vessels.	5
CO6	Specify the importance of histological studies for the services provided by clinical and pathological laboratories.	6

**ZOO-331 - Fundamentals of Histology
(Vocational Skill Course)**

Unit No.	Title of Unit and Contents	No. of hours
I	Tissues and Integumentary system. Definition and types of tissues: Epithelial, Connective, Muscular, Nervous and types of glands, Histology of Skin, structure of hair, sweat gland, sebaceous gland.	08
II	Alimentary canal. Histology of tooth and tongue, types of papillae, structure of taste buds, Basic histological organization of alimentary canal, microscopic structure of oesophagus, stomach, small intestine (duodenum and ileum) and large intestine (rectum).	08
III	Respiratory organs, Blood vessels. Histology of Trachea and Lung, Histological structure of artery, vein and capillaries.	04
IV	Excretory organs and Reproductive organs. Histology of mammalian kidney, structure of uriniferous tubule, ureter and urinary bladder, Histology of mammalian testes, mature spermatozoa, histology of mammalian ovary and ovarian follicles.	05
V	Endocrine and Exocrine glands: Embryological origin, histological structure, blood supply of Pituitary, Adrenal, Thyroid, Salivary gland, Liver and Pancreas.	05

Learning Resources- References

Sr. No.	References
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1.	Inderbir Singh's Textbook of Human Histology (With Colour Atlas and Practical Guide), 2014, 7th Edn., Neelam Vasudeva and Sabita Mishra, Jaypee Brothers Medical Publishers, New Delhi, India.
2.	Essential Histology, 2001, 2nd Edition, David H. Cormack, Lippincott Williams & Wilkins, Philadelphia.
3.	A text book of Histology, 2014, 5th edn. Krishna Garg, Indira Bahl & Mohini Kaul CBS Publication & Distributors, Delhi.
4.	Histology, 1977, 4th Edn. R. O. Greep and L. Weiss, McGraw Hill Int. Book Co. New York.
5.	Hand book of Basic Microtechnique, 1964, 3rd Edn. Peter Gray, McGraw Hill Book Co. New York.
6.	Bailey's Textbook of Histology - Williams and Wilkins Baltimore and Scientific Book Agency, Culcutta Copenhagen W. M.
7.	Text book of Histology - Bloom W. and Fawcett D. W.
8.	Histology - Lippincott, Han A. W.
9.	Human Histology - Leslie Brainerd Arey (Khosla Pub. House, Delhi) Unit.

	ZOO-332 - Zoology Practical-7 Vocational Skill Course-Practical	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Identify the histological structure of various tissues and organs through permanent slides.	1
CO2	Identify and explain the sketches of histological structures of different tissues and organs.	2
CO3	Demonstrate the technique of preparation of permanent slides.	3
CO4	Compare the histological structures of different organs and explain their characteristics.	4
CO5	Apprise the procedures of preparation of various fixatives and outline the method of preservation of tissues.	5
CO6	Assemble the set of microtomy to prepare permanent slides of different tissues and prepare a flowchart for staining the permanent slides.	6

ZOO-332 - Zoology Practical-7
(Vocational Skill Course - Practical)

Practical No.	Title and Contents
1	Preparation of temporary mount from preserved Rodents: Striated muscle fibres and medullated nerve fibre. (E)
2	Observations of permanent histological slides of mammalian tissues: epithelial tissue, connective tissue, nervous tissue and muscular tissue. (D)
3	Observations of permanent histological slides of mammalian tooth, tongue, oesophagus, stomach, duodenum and ileum. (D)
4	Observations of permanent histological slides of mammalian trachea, lung, kidney, testis and ovary. (D)
5	Observations of permanent histological slides of endocrine glands: pituitary gland, thyroid gland and adrenal gland, (D)
6	Observations of permanent histological slides of digestive glands: salivary gland, liver, pancreas. (D)
7	Introduction to microtome and its working. (E)
8	Preparation of different fixatives for preservation of tissues. (D)
9	Study of collection and preservation of tissues. (E)
10	Study of process of embedding and block making. (E)
11	Study of Sectioning and mounting of preserved tissues. (E)
12	Study of staining of tissues for preparation of permanent slides. (E)

	ZOO-321 - Human Genetics Minor-Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe concept of Mendel's law of Inheritance and importance.	1
CO2	Classify types Chromosomes and explain human karyotype	2
CO3	Categorize Genetic diseases and explain mechanism of inheritance pattern.	3
CO4	Explain Pedigree Studies and categorize stages of genetic Counselling	4
CO5	Explain inborn errors of metabolism and assess the processes of parental diagnosis.	5
CO6	Specify the Genetics and Society (Eugenics, Euthenics, Euphenics, Human genome project, Gene Therapy, Stem Cells, Cord Blood Banking and Stem Cell Therapy. processes of gene regulation and operon concepts).	6

**ZOO-321 - Human Genetics
(Minor-Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to Genetics: Introduction to Genetics, Mendel and his experiments: law of segregation, Law of independent assortment, Applications of laws of probability (product rule, sum rule), Allelic variation and gene function- Dominance-Recessive relationships. Human Chromosomes: Normal Human Karyotype.	05
II	Genetic Diseases and Inheritance Pattern: Autosomal inheritance- Dominant (E.g. -Adult polycystic kidney, Achondroplasia, and Neurofibromatosis) Autosomal inheritance – Recessive, (E.g. - Sickle cell anemia), Sex linked inheritance - The Lyon Hypothesis (X-Chromosome inactivation, Recessive: (E.g. - Duchenne muscular dystrophy - DMD) X-linked Dominant (E.g. - Goetz's syndrome, Oral Facial - Digital syndrome) Y-linked inheritance (Holandric gene - E.g. - Double Y Syndrome (XYY Syndrome).	09
III	Concepts of genome organization - split genes, overlapping genes, unique sequences, repetitive sequences, pseudogenes, Transposons, conserved genes. Proto-Oncogenes, Oncogenes, Cellular Oncogenes, Tumor Suppressor Genes, Properties of malignant cells. Chromosomal abnormalities associated with the specific malignancies – Burkitt's Lymphoma, CML & Retinoblastoma	06
IV	Inborn errors of metabolism, biochemical basis and inheritance of albinism, phenylketonuria, alkaptonuria. Prenatal Diagnosis: Amniocentesis, Chorionic villus sampling, Ultrasonography and Fetoscopy.	05
V	Genetics and Society: Eugenics- Positive and negative, Euthenics, Euphenics. Human genome project. Gene Therapy with reference to Haemophilia. Stem Cells - Definition types and sources. A brief account on Cord Blood Banking and Stem Cell Therapy.	05

Learning Resources- References

Sr. No.	References
1.	Genetics Strickberger Prentice Hall of India Pvt. Ltd. 1999
2.	Genetics Russell The Benjamin / Cummings Publishing Inc. 2002
3.	Genetics : A Conceptual Approach Benjamin Freeman 2003
4.	The Eukaryotic chromosome Bostok and sumner Elsevier 1980
5.	Chromosome structure and function Risley Reinhold 1985
6.	Human Chromosomes. Manual of Basic techniques Verma and Babu Pergamon 1989
7.	Chromosome aberration: Basic and applied aspects Obe and Natarajan Springer 1990
8.	Chromosome Sumner Blackwell 1990
9.	Lewin's Gene XII, Krebs, Goldstein and Kilpatrick

	ZOO-345-Field Project FP	
	Number of Credits: 02 Number Of Hours : 60	

	ZOO-351-Evolutionary Biology	
	Major-Theory	
	Number of Credits: 02	
	No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe about ancient and medieval beliefs of origin of life and discuss origin of eukaryotic cell.	1
CO2	Differentiate and compile different evidences of organic evolution and explain how they help in studying origin of life.	2
CO3	Illustrate aspects and patterns of animal distribution. Outline the factors influencing animal distribution and discuss about barriers to dispersal.	3
CO4	Differentiate between different micro-evolutionary changes, speciation and adaptive radiation. Classify isolating mechanisms.	4
CO5	Assess role of different kinds of adaptations in evolutionary pathway.	5
CO6	Prepare a world map of Zoogeographical distributions of different animals. Describe and compare the data of different realms	6

ZOO-351 - Evolutionary Biology
(Major - Theory)

Unit No.	Title of Unit and Contents	No. of hours
I	History of Life Major Events in History of Life: Ancient and medieval Ideas. Origin of eukaryotic cell. Theories of Evolution (Lamarckism, Darwinism, NeoDarwinism) Geological Time Scale	2
II	Direct Evidences of Evolution: Study of evidences from: Morphology and comparative anatomy. Embryology. Geographical distribution. Connecting links and missing links Paleontology- Types of fossils, Incompleteness of fossil record, Dating of fossils	8
III	Adaptations: Introduction. Kinds of adaptations. Divergent Evolution (Adaptive radiation)	4
IV	Isolation: Definition. Classifications of isolating mechanism Types of isolating mechanism	4

V	Species Concept: Concept of species Categories of species. Causative factors for speciation Modes of speciation Patterns of speciation Types of speciation.	4
VI	Animal Distribution and barriers to distribution: Aspects of animal distribution. Patterns of animal distribution. Factors influencing animal distribution. Barriers to dispersal. Means of dispersal. Major extinctions	4
VII	Zoogeographical distributions: Introduction. Types of zoogeographical distribution. Study of different realms.	4

Learning Resources- References

Sr. No.	References
1.	Organic Evolution, 1991 T. S. Gopalkrishnan, I. Sambashivarab Publ. House.
2.	Evolution, 2010 P. K. Gupta, Rastogi Publ., Meerut.
3.	Evolutionary Biology, 2010, Mohan P. Arora, Himalaya Pub. House, Delhi.
4.	Evolution, 1968, E. O. Dodson, Reinhold Pub. Corp., New York.
5.	American Museum of Natural History. The First Humans [Volume 1 of The Illustrated History of Humankind]. Harper Collins, 1993.
6.	Andrews, Peter, and Christopher B. Stringer. Human Evolution: An Illustrated Guide. University Press, 1989.
7.	Berger, Lee. "The Dawn of Humans: Redrawing Our Family Tree?" National Geographic 194 (August 1998): 90-99.
8.	Cartmill, Matt. "Lucy in the Sand with Footnotes," Natural History (April 1981): 90-
9.	The origin of species, 1959, Charles Darwin, New American Library, New York. 15. Diamond, Jared. The Third Chimpanzee: The Evolution and Future of the Human Animal. Harper Collins, 1992.
10.	Edey, Maitland A. and Donald C. Johanson. Blueprints: Solving the Mystery of Evolution. Viking, 1990
11.	Brunet, M., et al. 2002. A new hominid from the Upper Miocene of Chad, Central Africa. Nature 418:145-151.
12.	https://courses.lumenlearning.com/suny-wmopen-biology1/chapter/outcome-evidence-for-evolution/
13.	http://nsdl.niscair.res.in/jspui/bitstream/123456789/890/1/isolation%20and
14.	https://pubmed.ncbi.nlm.nih.gov/30459118/
15.	Zoogeography - an overview ScienceDirect Topics
16.	Amazing Animal Adaptations.pdf (mccdistrict.org)
17.	The Formation of Fossils (scienceviews.com)
18.	https://www.ncbi.nlm.nih.gov/books/NBK230201/

	ZOO-352-Molecular Biology	
	Major-Theory	
	Number of Credits: 02	
	No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Define the concept of nucleic acids, chromatin, packaging of DNA.	1
CO2	Differentiate prokaryotic and eukaryotic chromatin, Classify types of DNA, structure and function of plasmid.	2
CO3	Demonstrate mechanism of DNA replication, process of transcription and translation in pro and eukaryotes.	3
CO4	Compare the types of DNA.	4
CO5	Assess the processes of post-transcriptional and post-translational modifications and their importance	5
CO6	Formulate the processes of gene regulation and operon concepts.	6

ZOO-352-Molecular Biology
Major - Theory

Unit No.	Title of Unit and Contents	No. of hours
I	Nucleic acids: Purine and Pyrimidine bases, nucleoside, nucleotide, structure of DNA, types of DNA, Physico-chemical properties of DNA [T _m , Hypochromacity & Hyperchromicity], Chromatin-Heterochromatin, Euchromatin, histones, nucleosome, super coiling of DNA (positive and negative). DNA as genetic material – evidence: transformation, transduction, conjugation. Molecular basis of recombination.	08
II	Central Dogma of Molecular Biology: Replication- Process and types of replications, (Semi-conservative replication, rolling circle type of replication) Replication in prokaryotes and eukaryotes, Primo-some and replisome.	05
III	Transcription: Synthesis of RNA, types of RNA, transcriptional unit, RNA polymerase, Process of transcription in prokaryotes and eukaryotes, post transcriptional modifications.	05
IV	Translation: Genetic code, properties of genetic code, Structure of t-RNA and its role as an adaptor. Ribosome structure (prokaryotes and eukaryotes). Process of translation in prokaryotes and eukaryotes ,post translational modification	06
V	Operon Concept: Regulation of gene action, Lac operon , Trp operon	06

Learning Resources- References

Sr. No.	References
1.	Principles of Genetics, 1997, P. D. Snustad, M. L. Simmons J. B. Jenkins, John Wiley
2.	Molecular Biology of the Cell, 2007, 5th Edn. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Taylor & Francis, UK.
3.	Textbook of Cell and Molecular Biology, 2009, Second Edition, Ajoy Paul, Books and Allied (P) Ltd.
4.	Cell and Molecular Biology, 2010, Third Edition, P. K. Gupta, Rastogi Publications.
5.	Fundamentals of Molecular Biology, 2005, First Edition, Avinash and Kakoli Upadhyay, Himalaya Publishing House.
6.	Molecular Biology Genes to Proteins, 2008, Third Edition, Burton Tropp. Jones and Bartlett.
7.	Gene IX, X, XI, 1994, Lewin Oxford University Press, Oxford
8.	Molecular Biology of the gene, 1993, Watson J. Hopkins, Roberts, Steitz and Weiner, Benjamin Cummings.
9.	Textbook of Molecular biology, 1994, K. Shivrama Sastry, G. Padmanabhan & C. Subramanyan, Mc. Millan India.
10.	Cell and molecular biology, 2010, 8th ed., De Robertis EDP and De Robertis EMF Jr. Lippincott Williams & Wilkins, Philadelphia
11.	Principles of Biochemistry, 1993, 2nd ed., Lehninger A. L. Nelson D.L. & Cox M. M. CBH Publisher and distributors, Delhi.
12.	Principles and techniques of Biochemistry and Molecular biology, 2009, seventh edition, Keith Wilson and John Walker, Cambridge University.
13.	Eukaryotic Transcription Factors ©2004
14.	The Dictionary of Cell & Molecular Biology ©2013
15.	http://door.library.uinc.edu/bix/biologicalliterature/molbiol.HTM
16.	http://molbio.info.nih.gov/molbio

	ZOO-353 -Mammalian Physiology Major –Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe the concepts of physiology, its importance, functions of organs and organ systems. Explain the process of digestion, respiration, excretion, reproduction and physiological functions of hormones.	1
CO2	Discuss the mechanism of muscular contraction, impulse transmission, cardiac cycle and urine formation, feedback mechanism, hormone action.	2
CO3	Apply the knowledge of physiology to interpret BMR, respiratory quotient and functioning of hormones in the body.	3
CO4	Explain and analyse the causes, changes in the physiological parameters, respiratory quotient, functions of hormones.	4
CO5	Compare the mechanism of Bohr's effect and Haldane effect, inhalation and exhalation.	5
CO6	Compile the physiological data related to digestive, respiratory, circulatory, excretory systems.	6

**ZOO-353-Mammalian Physiology
(Major - Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Digestion and Respiration: Digestion of carbohydrates, proteins, and fats. Absorption in small intestine: water, ions, and nutrients. Absorption in large intestine and formation of faeces, Mechanism of Ventilation, exchange of gases at lungs and tissue level, Mechanism of transport of gases: Transport of Oxygen, Transport of Carbon-dioxide, Respiratory Quotient and BMR.	08
II	Circulation and Excretion: Blood coagulation mechanism, nodal tissues, cardiac cycle. Ornithine cycle: synthesis of urea, physiology of urine formation, counter-current multiplier theory for urine concentration. Osmoregulation	06
III	Nervous Co-ordination and Reproduction: Structure of Neuron, nerve impulse and its transmission, synaptic transmission. Neurotransmitters, Vision, hearing and olfaction in man. Reproductive cycles: physiological changes during oestrous cycle and menstrual cycle,	08
IV	Muscle Physiology and Temperature Regulation Ultrastructure of Skeletal Muscle, Physiology of Muscle contraction; sliding filament theory, physical and chemical changes in muscles, All or None Law. Normal body temperature, heat production, heat loss, Role of hypothalamus in temperature regulation,	08

Learning Resources- References

Sr. No.	References
1.	Textbook of Medical Physiology, Guyton A.C. & Hall J. E., 2006, 11th Edition, Hercourt Asia Pvt. Ltd. / W.B. Saunders Company.
2.	Principles of Anatomy and Physiology: G. J. Tortora and S.R. Grabowski, Harper Row Publishers
3.	Human physiology, Vol. I & II, 1980, 12th Edn. Dr. C. C. Chatterjee, Medical applied agency, Kolkata.
4.	Medical Physiology, 2006, Asis Das, Books and Allied Pvt. Ltd., Kolkata.
5.	Chandra Negi. 2015. Introduction to Endocrinology, PHI Learning Private Limited, Delhi
6.	Bentley, P. J. (1998). Comparative Vertebrate Endocrinology, edn.3, Cambridge University Press, London.
7.	Bollander, F. (1994). Molecular Endocrinology, edn. 2, Acad. Press, San Diego.
8.	Hadely, M. E. (1996). Endocrinology. Edn. 4, Prentice Hall, Upper Saddle Park.
9.	Hoar, W. S. and Hickman, C.P., Jr. (1983). A laboratory companion for general and comparative physiology. Edn. 3, Prentice - Hall, Englewood Cliffs, N. J., USA.
10.	Sastry K. V. Endocrinology and Reproductive Biology, Rastogi Publications
11.	https://textbookequity.org/Textbooks/anatomy+phys+vol2a.pdf
12.	https://www.researchgate.net › publication › 28645609...
13.	https://www.moscomm.org/pdf/Guyton%20physiology.pdf
14.	https://textbookequity.org/Textbooks/anatomy+phys+vol2a.pdf

	ZOO-354 -Animal Pathology Elective-Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Identify the pathogen and state pathogenesis prognosis and prevention	1
CO2	Explain various microscopic changes in cells and macroscopic changes in body of diseased animals.	2
CO3	Illustrate the process of circulatory disturbances in human.	3
CO4	Identify the pathological condition and explain its effects on cells, different organs and systems of animals.	4
CO5	Differentiate between microscopic and macroscopic changes during pathogenesis of human diseases and disorders.	5
CO6	Analyse the process of cloudy swelling and degeneration in early and late stage of necrotic cells.	6

**ZOO-354 -Animal Pathology
(Elective- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Common diseases of animals Etiology, pathogenesis, prevention and control measures of dropsy and fin rot in ornamental fishes. Etiology, pathogenesis prevention and control measures of fowl pox, Newcastle disease and Marek's disease in fowl. Aetiology, pathogenesis and control measures of foot and mouth disease, mastitis and milk fever	06
II	Human diseases Pathogenesis and preventive measures for tuberculosis, and AIDS. Zoonotic diseases: a brief introduction about zoonosis, rabies and plague Aetiology and pathogenesis of leptospirosis	08
III	Common pathological processes Retrogressive changes: Definition, Introduction Cloudy swelling. Degeneration - fatty degeneration, mucoid degeneration and amyloid degeneration. Necrosis: Definition, Nuclear and cytoplasm changes during necrosis of cell. Types of necrosis. Gangrene: Definition and causes. Types of gangrene - dry, moist and gas gangrene	10
IV	Pathological disturbances and disorders: A brief introduction about types of pathological disturbances. Causes and effects of Ischaemia, Haemorrhage and embolism. Disturbances in Mineral Metabolism	06

Learning Resources- References

Sr. No.	References
1.	A text book of Pathology, 2009, 15th Rev Edn., Dey N. C. and Dey T. K. Sinha Debashish, New central book agency, Kolkata.
2.	General pathology and pathology of systems, 2008, 6th Edn., Bhende Y. M. and Deodhar S.G.; Popular Prakashan Ltd., India.
3.	Robins Basic Pathology, 2012, 9th Edn., Vinay Kumar, Abul K. Abbas, Jon C. Aster, Saunders, Philadelphia.
4.	Textbook of Pathology, 2014, 7th Edition, Harsh Mohan, Jaypee Brothers Medical Publishers (P) Ltd.
5.	Essentials in Haematology & Clinical Pathology, 2012, 1st Edition, Ramadas Nayak, Sharada Rai, Astha Gupta.
6.	Concise Book On Medical Laboratory Technology, 2005 reprint, 1st Edn., C. R. Maiti, New Central Book Agency (p) Ltd, Kolkata, India
7.	Wiley: Diseases of poultry, 13th edition - David E. Swayne.
8.	Pathological basis of veterinary diseases, 5th edition, Editor - James Zachary Mc Gavin.
9.	Wiley: Fish diseases - diagnosis and treatment, Edward James, 2nd edition.
10.	https://www.google.com/search?q=superior+cervical+ganglia&client=firefox-b-d&tbm=isch&source=iu&ictx=1&fir=cmPURCdvDgKOSM%252CjD6Ck-FSPSVt1M%252C_&vet=1&usg=AI4_-kRB2KV506amMw1P9cft-tuFuNEZw&sa=X&ved=2ahUKEwjAsv291vjuAhUnwTgGHVa_DJcQ9QF6BAGJEAE&biw=1536&bih=750#imgsrc=xekovO542FHafM
11.	FSPSVt1M%252C_&vet=1&usg=AI4_-kRB2KV506amMw1P9cft-
12.	tuFuNEZw&sa=X&ved=2ahUKEwjAsv291vjuAhUnwTgGHVa_DJcQ9QF6BAGJEAE&biw=1536&bih=750#imgsrc=xekovO542FHafM

	ZOO-355-Forensic Zoology Elective-Theory	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe the concepts of forensic entomology, its medicolegal importance and rigor mortis. Explain the life cycle of insects of forensic importance and use of insects to determine post-mortem interval.	1
CO2	Discuss the factors stimulating rigor mortis and post-mortem damages caused by predators and also the role of aquatic insects in forensic investigation.	2
CO3	Apply the knowledge of forensic entomology in detection of poisoning cases and investigation.	3
CO4	Explain and analyse the data obtained at crime scene to find out causes death and also to determine time interval between the death and the onset of post-mortem changes.	4
CO5	Discriminate the features of somatic, molecular and brain death and review its medicolegal aspects.	5
CO6	Compile the data of some crime cases and aquatic and terrestrial ecosystem and write the forensic report.	6

**ZOO-355 - Forensic Zoology
(Elective Course)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to Forensic Science Definition, Scope, History and Development of Forensic Science, Concept of Forensic Entomology, Scope and Medico legal aspects of Forensic Entomology Somatic and Molecular Death, Brain Death and it's medico legal aspects	08
II	Determination of Post-Mortem Interval Rigor Mortis and conditions stimulating Rigor Mortis, Post-Mortem damage by predators, use of insects in determination of Post-Mortem interval	06
III	Insects of Forensic Importance Life Cycle patterns of Calliphoridae and Sarcophillidae insects (Any 1 examples each). Use of insects in determination in displacement of body, detection of poisoning cases by use of insects.	06
IV	Role of Aquatic Insects in Forensic Investigation Introduction, Decomposition in Aquatic Ecosystems Freshwater Ecosystems: First Stage - Submerged Fresh, Second Stage - Early Floating, Third Stage - Floating Decay, Fourth Stage - Bloated Deterioration, Fifth Stage - Floating Remains, Sixth Stage - Sunken Remains, Marine Ecosystems.	10

Learning Resources- References

Sr. No.	References
1.	Forensic Entomology edited by Jayson Byrd and James Castner.
2.	Crime Scene Intelligence, an experiment in Forensic Entomology by Albert Cruz.
3.	Text Book of Forensic Medicine and Toxicology: Principles and Practice by Krishnan Vij.

4.	DNA in Forensic Science: Theory, Techniques and Applications (1st edition), by James Robertson.
5.	Handbook of Forensic Science, US Department of Justice, Federal Bureau of Investigation.
6.	DNA evidence and Forensic Science by David Newton.
7.	Forensic Science: Modern Methods of solving Crime by Max M. Houck.
8.	Forensic Art and Illustration by Karen T. Taylor.

	ZOO-356 -Biostatistics Elective-Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe statistical data representation and interpretation methods	1
CO2	Explain collection, presentation of statistical data and various methods of presenting data	2
CO3	Illustrate descriptive statistical methods like Mean, Median and Mode, measures of dispersion and Probability	3
CO4	Classify various statistical methods and interpretation	4
CO5	Review Concepts used in Testing of Hypothesis	5
CO6	Application of statistical methods and prepare a report on given statistical data and its analysis	6

**ZOO-356 - Biostatistics
(Elective Course)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introductory Biostatistics, Data Representation, and Interpretation Importance of Statistics in Biology, Samples and Population A. Types of data, Random sampling (SRSWR and SRSWOR), Attributes and Variables, Collection and presentation of data, tabulation, Diagrammatic representation (Simple bar diagram, sub-divided bar diagram and pie diagram). Graphical representation (Histogram and frequency polygon)	06
II	Descriptive Statistics and Probability A. Measures of central tendency–Mean, median, mode. B. Measures of dispersion–Range, Standard deviation, and Variance C. Concept of Probability – classical definition, discrete and continuous random variable, concept of density and mass function.	08
III	Testing of Hypothesis A. The concepts of null hypothesis, alternative hypothesis, significance level, type I and type II errors, p-value, one tailed and two tailed tests, degrees of freedom. B. Equality of two population means - t-test, paired t-test. C. χ^2 (chi square) test –test for goodness of fit, independence of attributes (2X2 contingency table)	08

IV	Hands on: 1. Diagrammatic and graphical representation of data in R. 2. Descriptive Statistics using R 3. t – tests using R 4. χ^2 (Chi square) tests using R	08
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Learning Resources- References

Sr. No.	References
1.	Fundamentals of Statistics, Goon, Gupta and Dasgupta World Press Kolkata
2.	Statistical methods, Gupta S. P. Sultan Chand & Sons Publisher, New Delhi
3.	Fundamentals of Biostatistics. 3 rd Ed. Irfan Ali Khan and Atiya Khanum, Ukaaz, Publications, Hyderabad
4.	Fundamentals of Biostatistics, 5 th Ed. Bernard Rosner Duxbury Thomson
5.	Statistical methods, Gupta S.P. Sultan Chand & Sons Publisher, New Delhi
6.	Statistical methods in biology, 3 rd Ed. Norman T.J. Bailey Cambridge University Press

	ZOO-357 - Insect Pest Management Elective-Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Define the Insect Pest	1
CO2	Outline the classification of insects up to orders. <i>Explain</i> life cycles in various insects. <i>Distinguish</i> mouthparts in different insect. Compare the food and feeding of various insects. <i>Summarize</i> various types of larvae in insects	2
CO3	<i>Explain</i> the insect pest of cereals and pulses, vegetables, stored grains, and fruit plants.	3
CO4	<i>Classify</i> insecticides on the basis of their chemical nature <i>Distinguish the insecticide on the basis of</i> mode of entry and mode of action. <i>Write an</i> application of power and hand operated pest control equipment	4
CO5	<i>Compile the knowledge of</i> integrated Pest Management. <i>Review the</i> Methods and process of IPM. <i>Illustrate</i> PM practices in India	5
CO6	Define the Insect Pest	6

**ZOO-357 - Insect Pest Management
(Elective Course- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to Insect Pest Food and feeding Life cycle and larvae of insect pests	08
II	Insect Pests Insect pest of cereals and pulses, vegetables, stored grains and fruit plants (Nature of damage, diagnostic features, life history and control measures)	10
III	Biological Control of Insect Pests using pathogens, parasites and predators. Classification of insecticides on the basis of their chemical nature, mode of entry and mode of action, Natural Insecticides. Applications of power and hand operated pest control equipment	08
IV	Integrated Pest Management – processes and practices.	04

Learning Resources- References

Sr. No.	References
1.	Insect Biology - A Textbook of Entomology, H. E. Evans, 1984. (Addison-Wesley Publ. Co.).
2.	General Entomology, M. S. Mani, 1982, (Oxford & IBH Publ. Co.)
3.	Insects, M. S. Mani, 1995. (National Book Trust, India).
4.	Destructive and Useful Insects, C. L., Metcalf & W. P. Flint, 1962. (Tata McGraw-Hill Publ. Co. Ltd.)
5.	Agricultural Pests of India and South-East Asia by A. S. Atwal.
6.	Taxonomy - A Text and Reference Book by Kapoor V. C., 1983, John Wiley & Sons, New York.

7.	Theory and Practice in Animal Taxonomy by Black welder R. E., 1967, Oxford & IBH, New Delhi.
8.	Principles and Procedures of Plant Protection by Chattopadhyay S. B. 1985, Oxford & IBH, New Delhi.
9.	Insecticides: Toxicology and Uses by Gupta H. C., 1999, Agrotech Publ., Udaipur.
10.	Integrated Pest Management - Concepts and Approaches, Dhaliwal G. S. & Arora R., 2003, Kalyani Publ., New Delhi,
11.	Essentials of Agricultural Entomology, Dhaliwal G. S., Singh R. & Chillar B. S., 2006. Kalyani Publications, New Delhi

	ZOO-361-Zoology Practical-8	
	Major-Practical	
	Number of Credits: 02	
	No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe continuous variation with the help of given sampled data and animals with continuous and discontinuous distribution.,	1
CO2	Explain types of DNA.	2
CO3	Classify different types of fossils.,Classify DNA and RNA	3
CO4	Analyse normal constituents of urine, haemin-crystals and hemoglobin in blood.	4
CO5	Compare morphological similarities and differences between man and ape.	5
CO6	Create evolutionary relationship using molecular data and DNA paper model.	6

ZOO-361 - Zoology Practical-8
(Major Course-Practical)

Practical No.	Title and Contents
1	Preparation of DNA paper model. (E)
2	Study of types of DNA. (D)
3	Temporary mounting of Barr body. (E)
4	Detection of DNA and RNA by Methyl Green Pyronin staining. (E)
5	Isolation of DNA by Isoamyl alcohol and Chloroform method (E)
6	Sampling of human height, weight and BMI for continuous variation (E)
7	Explore evolutionary relationship using molecular data. (E)
8	Study of continuous and discontinuous type of distribution with two examples with the help of specimens / charts / photos. (D)
9	Study of morphological similarities and differences between man and ape. (D)
10	Study of types of fossils with the help of specimens / charts / photos. (D)
11	Estimation of haemoglobin using Sahli's haemoglobin meter. (E)
12	Preparation of haemin crystals. (E)
13	Urine Analysis: Physical and chemical: Colour appearance, odour, urea, pH (E)

	ZOO-362 - Zoology Practical-9	
	Major-Practical	
	Number of Credits: 02	
	No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Define different stages of estrous cycle.	1
CO2	Discuss different structural adaptation	2
CO3	Demonstrate evidences from evolution.	3
CO4	Classify different zoogeographical realms. and distribution of animals in respective zoogeographical realms on the world map.	4
CO5	Determine bleeding time, clotting time, blood pressure and DNA by diphenylamine method.	5
CO6	Prepare slide of polytene chromosome from suitable material.	6

ZOO-362-Zoology Practical-9
(Major Course - Practical)

Practical No.	Title and Contents
1	Study of structural adaptations: (D) (a) Terrestrial adaptations. (b) Aquatic adaptations. (c) Aerial adaptation.
2	Study of evidences of evolution - embryological, paleontological, connecting links, comparative anatomy. (D)
3	To record Zoogeographical distribution of animals to respective zoogeographical realms on the world map. (E)
4	Prepare and submit a study report on adaptations of any three animal species. (P)
5	Estimation of DNA by Diphenylamine method. (E)
6	To study the principle of Agarose Gel Electrophoresis (D)
7	Study of effect of colchicine on mitosis. (E)
8	Mounting of polytene chromosome from chironomous larvae. (E)
9	Determination of bleeding and clotting time (E)
10	Urine Analysis: Physical and chemical: Color appearance, odor, urea, pH (E)
11	Measurement of Blood Pressure (E)
12	Effect of isotonic, hypotonic and hypertonic solution on RBCs. (E)
13	Study of oestrous cycles in rat with the help of permanent slides (D)

	ZOO-382 - Zoology Practical-10 Vocational Skill Course-Practical	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe the good laboratory practices employed in biological laboratories.	1
CO2	Articulate usage of various instruments used in biological laboratories	2
CO3	Calculate various statistical tests to interpret data	3
CO4	Analyze basic methods for culturing micro-organisms	4
CO5	Standardize chemical preparations required in biological laboratory	5
CO6	Compose methods used in molecular biology and interpret results.	6

**ZOO-382 - Zoology Practical-10
(Vocational Skill Course-Practical)**

Practical No.	Title and Contents
1	Good Laboratory practices and basic design of biology laboratory / Signs and symbols in laboratory (D)
2	Preservation of specimens (wet and dry) (D)
3	Preparation and Standardization of chemicals/solutions/ buffers in laboratory (E)
4	Use of common equipment's in laboratory /micropipettes (E)
5	Use of Autoclave and Laminar Air flow (D)
6	Streaking methods using agar plates (quadrant, T, continuous and radiant streak)(E)
7	Antibiotic sensitivity test by using suitable microbial culture (E)
8	Testing of cell viability by using dye exclusion test (E)
9	Agarose gel electrophoresis (D)
10	Data representation using MS Excel (E)
11	Measures of central tendency (mean, mode and median) and concept of probability using suitable examples.(E)
12	Measures of dispersion- standard deviation using suitable examples.(E)
13	Testing of hypothesis using Chi square test with suitable examples.(E)
14	Testing of hypothesis using Student 't test' with suitable examples.(E)

	ZOO-371-Bee Keeping Minor-Theory	
	Number of Credits: 02 No. of Hours:30	
	Course Outcomes (COs) On completion of the course, the students will be able to:	Bloom's cognitive level
CO1	Describe the concepts of apiculture, importance of beekeeping, traditional and modern beekeeping methods. Explain the role of Khadi Gramodyog and Village Development Corporation in development and spread of apiculture in India.	1
CO2	Discuss the medical properties of honey and its application in various fields, its nutrients and composition.	2
CO3	Apply the knowledge of bee keeping in establishment and maintenance of bee colonies and for the use of various equipment to obtain bee products like honey, bee wax, royal jelly etc. Demonstrate the technique of handling the bees and processing of honey.	3
CO4	Explain the social organization and division of labour in the honeybees. Compare the indigenous and exotic species of honeybees and differentiate queen, workers and drone bees.	4
CO5	Appraise the importance of propagation of bee flora and its role in the agricultural crop pollination. Evaluate the impact of pesticides on honeybees.	5
CO6	Design the calendar for management of bee colonies. Prepare the proposal for financial assistance from banks for starting a beekeeping project.	6

**ZOO-371 - Bee Keeping
(Minor-Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to Apiculture History of beekeeping, Scope and importance of beekeeping, Beekeeping in the world and in India. Traditional beekeeping, Modern beekeeping. Role of Khadi Gramodyog and Village development Corporation in apiculture development in India.	04
II	Biology of Honeybee Indigenous and exotic species, Life cycle of honey bee, Morphology and Anatomy of Bees, Communication in Bees, Social organization in honeybees– Queen, drone, worker.	06
III	Honey - its properties and application in various fields Medicinal properties of Honey, application in various fields, other valuable by-products of honeybees, Value added honey products. Properties of honey products, Nutrients and composition of honey, Acid content and flavor effects. Types of value added honey products.	04
IV	Indigenous methods and modern methods of apiculture, Merits and Demerits	04
V	Honeybee Plants and Floral Calendar Bee flora - importance propagation - congenial conditions for starting up apiculture. Migratory Beekeeping - designing floral Calendar Improved Agricultural practices - crop pollination - Pesticides impact on Honey bees.	05

VI	Honey Processing and Economics of Beekeeping Honey extraction & handling – Quality control standards – Honey testing kit, Processing of honey. Other valuable by products of honey bees, Bee venom, propolis & Royal jelly extraction, Economics of beekeeping.	04
VII	Funding agencies, Feasibility report of apiculture (bank) , Steps involved in starting a beekeeping project/ Entrepreneurship/ Start-Ups, Marketing of honey and honey products	03

Learning Resources- References

Sr. No.	References
1.	Prospective in Indian Apiculture - R.C. Mishra
2.	Rearing queen bees in India - M.C. Suryanarayana et. al.
3.	Beekeeping in India - G. K. Ghosh
4.	Technology and value addition of Honey - Dr. D. M. Wakhle and K. D. Kamble.
5.	ABC & XYZ of Bee culture - A. I. Root
6.	Indian Bee Journal - All India Beekeeping Association
7.	Asian Bee Journal
8.	Modern Text Book of Invertebrate Zoology, R.L.Kotpal
9.	Invertebrate Zoology, P. S. Dhami and G. S. Dhami
10.	A comprehensive Guide to Bees and Bee Keeping, D. P. Abrol
11.	Essentials of Bee Keeping and Pollination, A.S.Atwal
12.	Honey Bees and Their Management, R.C.Misra
13.	https://www.perfectbee.com/beekeeping-articles/a-new-beekeepers-journal/educational-resources-for-new-beekeepers
14.	https://msme.gov.in/sites/default/files/Beekeeping.pdf
15.	https://www.cabdirect.org/cabdirect/abstract/19900228408
16.	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0263281
17.	https://iyanolaapiculture.org/training/
18.	https://www.beeculture.com/approved-website-resources/

T.Y. B.Sc. Semester VI		
	ZOO-395 – On Job Training	
	Number of Credits: 04	