

BSC ZOOLOGY

OUTCOMES AND OUTCOME BASED EDUCATION (OBE)

Outcomes are what the students are expected to be able to do at the end of a unit of learning. The unit of learning is three year formal program.

An Outcome:

- Should unambiguously state what the student should be able to do/perform.
- What the students do or perform are observable and assessable?
- Students should be able to understand what it means (comprehensible).
- Should be able to provide guidance to students in planning their learning.

Outcome Based Education (OBE) was introduced by William Spady in early 1990s for American school system and eventually adapted by higher education systems. This is an approach to education in which decisions about the curriculum and instructions are driven by the exit learning outcomes that the students should display at the end of a programme or a course. OBE establish the conditions and opportunities within the system that enable and encourage all students to achieve those essential outcomes. A system based on outcomes gives top priority for learning, accomplishments and results.

Advantages of OBE

- Relevance*: Outcome based education promotes fitness for practice and education for capability.
- Discourse*: The process of identification of the outcomes within an institution promotes discussion of fundamental questions.
- Clarity*: An explicit statement of what the educational process aims to achieve clarifies the curriculum for both students and teachers, and provides a focus for teaching and learning.
- Provision of a Framework*: OBE provides a robust framework for integration of the curriculum.
- Accountability*: By providing an explicit statement of what the curriculum is setting out to achieve, OBE emphasizes accountability.
- Self Directed Learning*: If students are clear about what they are trying to achieve, they can take more responsibility for their own learning. OBE thus promotes a student-centered approach to learning and teaching.
- Flexibility*: OBE does not specify educational strategies or teaching methods.

- *Guide for Assessment*: The outcomes provide the framework for student examinations.
- *Facilitates Curriculum Evaluation*: The outcomes provide benchmarks against which the curriculum can be judged.

Three levels of Outcomes:

- **Programme Outcomes (POs)**
- **Programme Specific Outcomes (PSOs)**
- **Course Outcomes (COs)**

Programme Outcomes (POs) indicate the generic knowledge, skills and attitudes that every student graduating from a UG programme should attain. While every course of the programme can address only a subset of POs, all the core courses together should be able to address all the POs.

1. Programme Outcomes (POs) for General Undergraduate Programme:

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Problem Solving: Understand and solve the problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired from humanities/sciences/mathematics/social sciences.

PO3. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO6. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

2. Programme Specific Outcomes (PSOs):

PSOs are specific to a programme and are to be attained at the time of graduation from the programme. They are to be identified by a committee with representation from all stakeholders.

B.Sc. Zoology Programme

PSO1: Understand the biological diversity and grades of complexity of various animal forms through their systematic classification and process of organic evolution.

PSO2: Understand the roles of plants, animals and microbes in the sustainability of the environment and their interaction among themselves and deterioration of the environment due to anthropogenic activities.

PSO3: Understand the concepts and principles of biochemistry, immunology, physiology, ethology, endocrinology, developmental biology, cell biology, genetics, molecular biology and microbiology and develop technical skills in biotechnology, bioinformatics and biostatistics.

PSO4: Perform laboratory procedures as per standard protocols in the areas of animal diversity, systematics, cell biology, genetics, biochemistry, molecular biology, microbiology, physiology, immunology, developmental biology, environmental biology, ethology, evolution and science methodology.

Course Outcomes

CORE COURSES

Semester I Course Category: Core Course I Paper name: ANIMAL DIVERSITY: NON-CHORDATA PART- I Code: ZOL1B01T	
Course Outcomes	
CO1	Describe the principles of classification and nomenclature.
CO2	Explain the five kingdom classification of living organisms.
CO3	Understand the concepts of classification of animals.
CO4	Explain the classification with examples and characteristic features of kingdom Protista and describe the morphology and structural organization of Paramecium
CO5	Describe the characteristic features of subkingdom Mesozoa
CO6	Explain the classification of phylum Porifera and elucidate the salient features of each class
CO7	Describe the characteristic features of phylum Cnidaria and Ctenophora, illustrate the classification of phylum Cnidaria down to classes and explain the structural organization of Obelia
CO8	Explain the salient features of phylum Platyhelminthes and illustrate its classification down to classes.

CO9	Explain the characteristic features and classification of super-phylum Aschelminthes and phylum Nematoda
CO10	Elucidate the characters of Pseudocoelomate minor phyla Rotifera and Gastrotricha
Semester II Course Category: Core Course II Paper name: ANIMAL DIVERSITY: NON-CHORDATA PART – II Code: ZOL2B02T	
Course Outcomes	
CO1	Explain the classification with examples and characteristic features of phylum Annelida and describe the morphology and structural organization of Nearthes
CO2	Describe the distribution, peculiarities and affinities of phylum Onychophora
CO3	Explain the classification of phylum Arthropoda; elucidate the salient features of each class and describe the morphology and structural organization of Penaeus
CO4	Describe the characteristic features of phylum Mollusca, illustrate its classification down to classes and explain the structural organization of Pila globosa
CO5	Explain the salient features of phylum Echinodermata and illustrate its classification down to classes
CO6	Understand the salient features and affinities of phylum Hemichordata
CO7	Elucidate the characters of coelomate minor phyla Phoronida, Ectoprocta and Echiura
Semester III Course Category: Core Course III Paper name: ANIMAL DIVERSITY: CHORDATA PART - I Code: ZOL3B03T	
Course Outcomes	
CO1	Explain the characteristics of chordates and outline classification of the phylum Chordata
CO2	Describe the salient features and affinities of subphylum Urochordata and its classification down to classes; elucidate the morphology and structural organization of Ascidia
CO3	Explain the salient features and affinities of subphylum Cephalochordata with reference to Branchiostoma
CO4	Describe the salient features of subphylum Vertebrata, illustrate its classification down to classes and elucidate the characteristics of division Agnatha
CO5	Enumerate the salient features of superclass Pisces and illustrate its classification down to orders and the morphology and structural organization of Mugil cephalus

CO6	Describe the salient features and affinities of class Amphibia and its classification up to orders; explain the morphology and organ systems of <i>Hoplobatrachus tigerinus</i>
CO7	Elucidate the characteristic features of the class Reptilia and its classification down to orders; describe the morphology and organ systems of <i>Calotes versicolor</i>
Semester IV Course Category: Core Course IV Paper name: ANIMAL DIVERSITY: CHORDATA PART-II Code: ZOL4B04T	
Course Outcomes	
CO1	Describe the classification of class Aves down to orders, salient features of each order with suitable examples
CO2	Describe the external characters and functional systems of <i>Columba livia</i>
CO3	Enumerate the salient features and classification of class Mammalia down to orders with suitable examples
CO4	Elucidate the external characters and functional systems of <i>Oryctolagus cuniculus</i>
CO5	Compare the circulatory, excretory and nervous systems of vertebrates
Semester IV Course Category: Core Course IV Paper name: ANIMAL DIVERSITY: CHORDATA PART-II Code: ZOL4B04T	
Course Outcomes	
CO1	Describe the classification of class Aves down to orders, salient features of each order with suitable examples
CO2	Describe the external characters and functional systems of <i>Columba livia</i>
CO3	Enumerate the salient features and classification of class Mammalia down to orders with suitable examples
CO4	Elucidate the external characters and functional systems of <i>Oryctolagus cuniculus</i>
CO5	Compare the circulatory, excretory and nervous systems of vertebrates
Semester I to IV Course Category: Core Course Paper name: PRACTICAL – I: ANIMAL DIVERSITY Code: ZOL4B05P	
Course Outcomes	
CO1	Identify and describe specified protists and acoelomate & pseudocoelomate nonchordates and perform the culture of selected protists; understand the histological features of coelenterate, platyhelminth and nematode.
CO2	Identify and describe specified coelomate non-chordates and the transverse sections of annelids; Perform mounting of the specified organs of selected nonchordates

CO3	Identify and describe specified chordates and specified bones of chordates; Prepare key for identification of venomous snakes; Perform mounting and dissection of specified organ systems of chordates.
CO4	Identify and describe selected vertebrates and specified bones of vertebrates.
Semester V Course Category: Core Course V Paper name: CELL BIOLOGY AND GENETICS Code: ZOL5B06T	
Course Outcomes	
CO1	Understand the principles and applications of various types of light microscopes, electron, Scanning-tunnelling and Atomic force microscope and illustrate the histological and histochemical processing of tissues
CO2	Explain the basic structure of a eukaryotic cell and the structure and functions of plasma membrane, mitochondria, lysosome, cytoskeletal elements and interphase nucleus
CO3	Illustrate the nucleosome organization of chromatin and higher order structures; structure of chromosomes and giant chromosomes
CO4	Enumerate eukaryotic cell cycle and cell division by amitosis, mitosis and meiosis
CO5	Explain the causes of transformation, characteristics of transformed cells and the role of protooncogenes and tumor suppressor genes in malignant transformation; mechanism and significance of apoptosis
CO6	Enumerate allelic and non-allelic gene interactions; supplementary, complementary, polymeric, duplicate and modifying genes and polygenic inheritance
CO7	Illustrate multiple allelism and solve problems related to blood group inheritance
CO8	Explain characteristics of linkage groups and linkage map; crossing over and calculation of recombination frequency; sex-linked, sex-influenced and sex-limited characters; sex differentiation and disorders of sexual development
CO9	Describe the mechanisms of sex determination including chromosomal, genic, haploid-diploid mechanisms; the hormonal and environmental influence on sex determination and gynandromorphism
CO10	Explain mutagenesis, mutagens and chromosomal and gene mutations
CO11	Enumerate the classification and grouping of human chromosomes; numerical and mutational human autosomal and sex chromosomal anomalies; polygenic human traits and genetic counseling
Semester V Course Category: Core Course VI Paper name: BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY Code: ZOL5B07T	
Course Outcomes	
CO1	Illustrate the steps in genetic engineering and animal cell culture

CO2	Explain transfection methods, transgenic animals and ethical issues of transgenic animals
CO3	Enumerate the applications of biotechnology
CO4	Understand the biological diversity of microbial forms and the various techniques for handling microbes in the laboratory
CO5	Enumerate the basic structure and life cycle of bacteria and virus
CO6	Understand the industrial and medical importance of microorganisms
CO7	Describe different types of immunity and the cells and organs of the immune system
CO8	Explain antigen, antibody, immunity and major histocompatibility complex
CO9	Enumerate autoimmune and immunodeficiency diseases and immunology of tumor and organ transplantation
Semester V Course Category: Core Course VII Paper name: BIOCHEMISTRY AND MOLECULAR BIOLOGY Code: ZOL5B08T	
Course Outcomes	
CO1	Understand the elements of biological importance and the non-covalent interactions that stabilize biomolecules
CO2	Describe the classification, types, structure, reactions and biological roles of carbohydrates, and diabetes Type I and II
CO3	Enumerate the properties and classification of amino acids and their standard abbreviations; hierarchical levels of protein structure, classification, separation, purification and sequencing of proteins
CO4	Explain the classification and functions of lipids and fatty acids; chemistry and structure of nucleic acids and sequencing of DNA
CO5	Understand the classification, nomenclature and properties of enzymes; enzyme action, co-enzymes, cofactors, isozymes, ribozymes and allosteric enzymes
CO6	Explain glycolysis, Krebs cycle, glycogenesis, glycogenolysis, gluconeogenesis, HMP pathway; amino acid and fatty acid oxidation and oxidative phosphorylation
CO7	Describe the mechanism of DNA duplication and the role of enzymes
CO8	Understand the concept of gene and gene expression; genetic code and wobble hypothesis
CO9	Explain the mechanism of transcription and post-transcriptional modification of hnRNA
CO10	Enumerate the processes of translation and post-translational modification and targeting of peptides
CO11	Describe the regulation of trp operon, C-value, repetitive DNA, satellite DNA, selfish DNA, overlapping genes, pseudogenes, cryptic genes, transposons and retrotransposons
CO12	Explain the structure and life cycle of bacteriophages and the gene transfer mechanisms in bacteria

Semester V Course Category: Core Course VIII Paper name: METHODOLOGY IN SCIENCE, BIOSTATISTICS AND BIOINFORMATICS Code: ZOL5B09T	
Course Outcomes	
CO1	Explain science, its importance, disciplines and the major steps in formulating a hypothesis, various hypothesis models, theory, law and importance of animal models, simulations and virtual testing
CO2	Illustrate the principles and procedures in designing experiments and elaborate the requirements for carrying out experiments
CO3	Describe the ethical concerns in practicing science
CO4	Understand the Scope and role of statistics; methods and procedures of sampling; Construction of tables, charts and graphs
CO5	Calculate central tendency and measures of dispersion and application of its knowledge on hypothesis testing as well as in problem solving
CO6	Enumerate major biological databases and database search engines
CO7	Perform DNA and protein sequence analysis, including sequence alignment and sequence similarity search using BLAST, FASTA, CLUSTAL W and CLUSTAL X
CO8	Understand molecular phylogenetics and tools and methods for construction of phylogenetic trees
CO9	Explain genome sequencing technologies, functional genomics, proteomic technologies and molecular docking and drug design
Semester V Course Category: Core Course Paper name: PRACTICAL – II Code: ZOL6B15P	
Course Outcomes	
CO1	Perform experiments in cell biology and genetics including demonstration of Barr body in buccal epithelial cells of man, polytene chromosome in the salivary glands of D. melanogaster larva, mitotic division in onion root tip cells, micrometry of microscopic objects, prepare whole mounts of microscopic objects, and calculate mitotic and metaphase index from slides.
CO2	Enumerate the inheritance of major human genetic traits, pedigree chart, normal and abnormal human karyotypes, phenotypic differences of male and female Drosophila and solve problems on Monohybrid, dihybrid crosses, blood groups and sex-linked inheritance.
CO3	Understand electrophoresis, PCR, Northern blotting, Southern blotting and Western blotting, DNA sequencing and fingerprinting and isolation of genomic DNA.
CO4	Perform gram staining and preparation of culture media for bacteria and demonstrate bacterial motility by standard laboratory protocols.
CO5	Understand the detection of human blood groups and organs of immune system

CO6	Perform standard biochemical tests for the detection of reducing and nonreducing sugars, polysaccharides, proteins and lipids.
CO7	Understand the staining of mitochondria, tissue homogenization and isolation of nuclei, effect of colchicines on cell division, extraction of DNA and polyacrylamide and agarose gel electrophoresis
CO8	Solve basic problems in biostatistics and Bioinformatics
Semester VI Course Category: Core Course IX Paper name: PHYSIOLOGY AND ENDOCRINOLOGY Code: ZOL6B10T	
Course Outcomes	
CO1	Describe the regulation of digestion in man, nutrition in pregnancy and infancy, nutritional disorders, balanced diet, starvation, fasting and obesity.
CO2	Understand the mechanism of transport and exchange of respiratory gases and its neurophysiological control and physiological problems in diving mammals, newborn and aged individuals.
CO3	Describe functions, composition, coagulation, transfusion, agglutination and clinical analysis of blood, haemoglobinopathies, types of heart and common cardio-vascular problems.
CO4	Understand the osmoregulatory mechanisms in animals; excretion and its hormonal control and common renal disorders in man.
CO5	Explain the ultrastructure of skeletal muscles and biochemical events and energetics of muscle contraction.
CO6	Understand the different types of nerve cells, glial cells and nerve fibres, and the mechanism of nerve impulse transmission
CO7	Understand the types, physiology and significance of bioluminescence, and the structure and functions of electric organs.
CO8	Describe invertebrate neuro-endocrine organs and hormones, vertebrate endocrine glands, their hormones and functions
CO9	Understand the concept of neurosecretion and the mode of action of peptide and steroid hormones.
Semester VI Course Category: Core Course X Paper name: REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY Code: ZOL6B11T	
Course Outcomes	
CO1	Explain the reproductive strategies in invertebrates and vertebrates and structural and functional features of human reproductive system.
CO2	Describe process of fertilization, pregnancy, gestation, placentation, parturition and lactation in humans.
CO3	Explain the scope of reproductive technologies in infertility management; prenatal diagnostic techniques and methods of fertility control.
CO4	Understand the phases and theories of development, and classification of eggs

CO5	Enumerate the types of cleavage, arrangement of blastomeres, germ layers and their derivatives, cell lineage in Planocera and different types of blastula.
CO6	Illustrate the early developmental process of egg in Amphioxus, frog, chick and man
CO7	Explain the basics of cell differentiation and its genetic control, stem cells and applications of stem cell technology
CO8	Describe parthenogenesis, types, and significance
CO9	Explain fate map construction, Spemann's constriction experiments on amphibian embryos, organizers in development, embryonic induction, gradient experiments in sea urchin eggs, cloning experiments in sheep and teratogenesis

Semester VI
Course Category: Core Course XI
Paper name: ENVIRONMENTAL AND CONSERVATION BIOLOGY
Code: ZOL6B12T

Course Outcomes

CO1	Explain the structure of ecosystem and its functioning through energy flow and nutrient cycling.
CO2	Enumerate biogeochemical cycles and understand the concept of limiting factors
CO3	Describe the ecology of population, community and habitat as a self regulating system
CO4	Understand various types of population interactions and appraise the co-evolution
CO5	Comprehend the diverse environmental and sustainability challenges ranging from local to global and the establishment of perfect harmony between economic development, social issues and environmental conservation
CO6	Enumerate the several tools and techniques employed for studies on populations, communities and ecosystems.
CO7	Understand the threats to biodiversity, and strategies adapted for the conservation of diversity of organisms.
CO8	Describe the various international strategies for conserving biodiversity
CO9	Describe the toxic chemicals, their toxicity levels and the health hazards caused by them

Semester VI
Course Category: Core Course XII
Paper name: ETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY
Code: ZOL6B13T

Course Outcomes

CO1	Describe the patterns and mechanisms of animal behaviour
CO2	Illustrate biological rhythms and the chemical basis of communication
CO3	Identify major evolutionary transitions over time, and explain the tools and evidences that support current hypotheses of the history of life on earth

CO4	Describe the evidences for evolution and its required corollaries
CO5	Explain the various theories of evolution
CO6	Describe the mechanisms by which evolution occurs
CO7	Recognize the significance of reproductive isolation in reducing gene flow between populations, biological and morphological species concepts and distinguish between prezygotic and postzygotic barriers to reproduction
CO8	Review the events in human evolution
CO9	Explain ecological and historical foundations for understanding the distribution and abundance of species, and their changes over time and comprehend the basic principles of biogeography as a discipline

Semester VI
Course Category: Core Course
Paper name: PRACTICAL – III
Code: ZOL6B16P

Course Outcomes

CO1	Perform standard laboratory experiments for the estimation of Hb, presence of hCG/abnormal constituents in urine, detection of blood pressure, bleeding and clotting time and identification of formed elements in blood
CO2	Identify selected stages in the development of frog and chick and chosen larval forms of invertebrates and vertebrates
CO3	Carry out experiments of laboratory standards to estimate water quality parameters including, dissolved Oxygen, Carbon dioxide, hardness and pH; determination of adulteration of selected food items and identify marine planktons and soil organisms
CO4	Demonstrate the behavioural response of earthworm/dipteran larva to selected stimuli
CO5	Describe homologous , analogous and vestigial organs, connecting links, adaptive radiation and evolution of man
CO6	Illustrate zoogeographical realms, Wallace line, Weber line, Wallacea and the distribution of Peripatus, lung fishes, Sphenodon, monotremes and marsupials
CO7	Identify the normal and selected abnormal human karyotypes and inheritance of chosen traits from pedigree charts/describe ornamental and other culture fishes/ describe chosen beneficial and harmful insects

ELECTIVE COURSES

Semester VI
Course Category: Elective Course I
Paper name: AQUACULTURE, ANIMAL HUSBANDRY AND POULTRY SCIENCE
Code: ZOL6B14(E)02T

Course Outcomes	
CO1	Explain aquaculture and the process of prawn, mussel and pearl culture
CO2	Illustrate the methodology of pisciculture and understand common culture fishes and ornamental fishes
CO3	Identify major fishing crafts and gear and enumerate fish utilization and preservation
CO4	Enumerate the poultry rearing techniques and understand major breeds of fowl
CO5	Understand the major breeds of cattle, cattle feeds and diseases of cattle
CO6	Illustrate the steps in dairy processing and identify the role of dairy development in rural economy
<u>OPEN COURSES</u>	
Semester V Course Category: Open Course I Paper name: REPRODUCTIVE HEALTH AND SEX EDUCATION Code: ZOL5D01T	
Course Outcomes	
CO1	Understand the reproductive health, and importance of sex education for teen and youth.
CO2	Explain the chromosomal mechanism of sex determination and sex chromosomal anomalies.
CO3	Describe the structural and functional features of human reproductive system, fertilization, implantation, pregnancy, gestation, placenta, parturition and lactation.
CO4	Explain the scope of reproductive technologies in infertility management and the assisted reproductive techniques.
CO5	Understand the different methods of prenatal diagnosis and associated ethical issues
CO6	Describe the different methods of fertility control.
CO7	Understand the symptoms, mode of transmission, diagnosis and treatment of different sexually transmitted diseases and their socio economic dimensions.
CO8	Describe sexual orientation, sexual abuse and myths
CO9	Understand the ethical aspects of sex