

Program Name	B.Sc.	Semester	VI
Course Title	Evolutionary & Developmental Biology (Theory)		
Course Code:	21BSC6C13ZOL	No. of Credits	4
Contact hours	60 Hours	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

CoursePre-requisite(s):

CourseOutcomes(COs): Afterthesuccessfulcompletionofthe course,thestudentwillbeable to:

- Understand that by biological evolution we mean that many of the organisms that inhabit the earth today are different from those that inhabited it in the past.
- Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change.
- Understand how the single cell formed at fertilization forms an embryo and then a full adult organism.
- Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development.
- Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features.
- Understand how a cell behaves in response to an autonomous determinant or an external signal, and the scientific reasoning exhibited in experimental life science.

Contents	60Hrs
Unit-I	16
1. Theories of Organic Evolution: Lamarckism and neo lamarckism, Darwin Wallace theory of natural selection, synthetic theory of evolution. Darwinism (Natural, Sexual and Artificial selection), Modern synthetic theory of evolution, Adaptive radiations: Patterns of evolution (Divergence, Convergence, Parallel, Co-evolution).	8
2. Population Genetics: Microevolution and Macroevolution: allele frequencies, genotype frequencies, Hardy- Weinberg equilibrium and conditions for its maintenance, Forces of evolution: mutation, selection, genetic drift.	8
Unit-II	14
3. Species Concept and Extinction: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric), Mass extinction (Causes, Names of five major extinctions.	7
4. Direct Evidences of Evolution: Relationship among organisms, Morphological and Anatomical evidences, Embryological evidences, Paleontological evidences, Bio-geographical evidences, Biochemical/Physiological evidences, Cytological evidences, Taxonomical evidences and Current evidences. Types of fossils, Incompleteness of fossil record, Dating of fossils, Orgin and evolution of human and horse. Geological Time Scale/ Stratographical Scale.	7
Unit-III	14

<p>5. Developmental Biology: Scope and theories of developmental biology, Gametogenesis, Fertilization: external (amphibians), internal (mammals), Mechanism of fertilization significance of fertilization. monospermy and polyspermy; parthenogenesis, Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo. Environmental regulation of development</p>	14
Unit-IV	16
<p>6. Late Embryonic Development: Structure of mature spermatozoon, Graafian follicle, Estrous cycle and Human menstrual cycle. Ovulation, fertilization, morula, blastocyst, implantation and placentation. Developmental control genes (Homeobox genes) Placenta: Histological and morphological classification of mammalian placenta with examples. Foetal membranes: Development, structure and functions of amnion, chorion, yolk sac and allantoises. Processes of Development of eye, kidney, limb in amphibian.</p>	10
<p>7. Modern trends in human reproduction : In vitro fertilization, cloning, sperm and egg banks, sexually transmitted diseases (AIDS, syphilis and gonorrhoea). Late Developmental Aging: the biology of senescence.</p>	6

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs)/Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Pedagogy:.....

Formative Assessment for Theory	
Assessment Occasion/type	Marks
House Examination/Test	15
Written Assessment/Presentation/Project/Term Papers/Seminars	15
Classroom Performance/Participation	10
Total	40 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

Course Title	Evolutionary & Developmental Biology (Practical)		Practical Credits	2
Course Code	21BSC6C14ZOP		Contact Hours	4 Hours
			Duration of Exam	3 Hours
Formative Assessment	25Marks	Summative Assessment	25Marks	
Practical Content				
1. Study of fossils from models/pictures.				
2. Study of homology and analogy from suitable specimens				
3. Study and verification of Hardy-Weinberg Law by chi-square analysis.				
4. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.				
5. Types of eggs based on quantity and distribution of yolk: Seaurchin, insect, frog, Chick.				
6. Study of adaptive radiations in feet of birds and mouth parts of insects.				
7. Study of aquatic, arboreal and volant adaptations with suitable examples: Shark and Turtle; Chameleon and Loris; Exocoetus, Bat, Pigeon and Draco				
8. Vestigial organs: Vermiform appendix, Wisdom teeth, Coccyx (tail bone), Tonsils, Body hairs, Nipples on males, Nictitating membranes of eye (Any three)				
9. Study of stages of development of Frog: Cleavage stages, Blastula, Gastrula, Neurula stages (whole mount) and various stages of tadpole				
10. Study of permanent slides of Chick embryo -18 hrs, 24 hrs, 36 hrs, 48 hrs (whole mount and T.s of 18hrs and 24 hrs chick embryo)				
11. Evolution of Man and Horse (Charts and models)				
12. Study of Mesozoic Reptiles (Charts or models); Study of adaptive radiations in feet of birds and mouth parts of insects				
13. Any other practical's related to this paper may be added based on the feasibility				

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment Tests

Formative Assessment for Practical	
Assessment Occasion/type	Marks
House Examination/Test	05
Written Assessment/Presentation/Project/Term Papers/Seminars	10
Classroom Performance/Participation	10
Total	25Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

References	
1	Ridley, M (2004) Evolution (3 rd edition) Blackwell Publishing
2	Hall, B.K. and Hallgrimson, B (2008) Evolution (4 th edition) Jones and Barlett Publishers

3	Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
4	Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
5	Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
6	. Developmental Biology: T. Subramaniam, (Reprint), Narosa Publishing House Pvt. Ltd., New Delhi
7	. Developmental biology: Werner A. Müller, Springer Science & Business Media. (2012).
8	Human Embryology and Developmental Biology E-Book: Bruce M. Carlson, Elsevier Health Sciences.
9	Developmental Biology: Michael J. F. Barresi, Scott F. Gilbert, Oxford University Press. (2019).

Program Name	B.Sc.	Semester	VI
Course Title	Environmental Biology, Wildlife Management & Conservations (Theory)		
Course Code:	21BSC6C15ZOL	No. of Credits	4
Contact hours	60 Hours	Duration of SEA/ Exam	2 Hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):	
Course Outcomes (COs): After the successful completion of the course, the student will be able to:	
CO1. Develop an understanding of how animals interact with each other and their natural environment.	
CO2. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.	
CO3. Develop the ability to work collaboratively in team-based projects.	
CO4. Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.	
CO5. Develop an ability to analyze, present and interpret wildlife conservation management information.	
Contents	60Hrs
Unit-I	15
1. Ecology: Introduction to ecology, Definition, ecosystem, types of ecosystem, food chain and food web, trophic levels. Environment: Definition, types of environment, terrestrial, aquatic, desert, grassland and aerial environment. Environmental Biology: Adaptive features of plants and animals to different environment. Ecological factors, weather, climate, ozone layer. Animal relationships with relevant examples.	
Unit-II	15
2. Pollution: Definition, types of pollutants, air, soil, water and thermal pollution, ozone layer depletion, biomagnifications, bioaccumulation and bioremediation. Effects of pollution on plants and animals. 3. Population ecology: Population density, age distribution, population growth rate, age curve, biotic potential, Allele's and Gause principle.	
Unit-III	15
4. Distribution of wildlife in India; Himalayan ranges, the peninsular Indian sub region, deccan plateau, the western ghats, eastern hill chain-Aravali ranges, the Indian desert, tropical rain forest, wild life in Andaman and Nicobar islands. Wildlife threats; hunting over harvesting, habitat destruction due to over population degradation, habitat shrinkage, possibilities of climatic changes and transgenic changes.	
Unit-IV	15

<p>5. Wildlife Management and Conservation: In-situ and ex-situ conservation: Wildlife sanctuaries, National parks, Biosphere reserves, Project Tiger, Project Elephant, Project Lion, Zoological Gardens and Captive breeding. Wildlife Protection Act, 1972, causes and depletion of wildlife, inventory and classification of wetlands and their biotic components, general strategies and issues, concept of home range and territory, animal census, tracing movement and remote sensing and GIS.</p>	
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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs)/Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Pedagogy:.....

Formative Assessment for Theory	
Assessment Occasion/type	Marks
House Examination/Test	15
Written Assessment/Presentation/Project/Term Papers/Seminars	15
Classroom Performance/Participation	10
Total	40 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

Course Title	Environmental Biology, Wildlife Management & Conservation (Practicals)	Practical Credits	2
Course Code	21BSC6C16ZOP	Contact Hours	4 Hours
		Duration of Exam	3 Hours
Formative Assessment	25Marks	Summative Assessment	25Marks
Practical Content			
1. Water quality parameters assessment: Collection of water sample, Dissolved Oxygen (O ₂), Carbon dioxide (CO ₂), Biological Oxygen Demand (BOD) Chemical Oxygen Demand (COD), chlorides and salinity estimation in water, Total hardness.			
2. Analysis of physico-chemical parameters of soil: pH, soil moisture, soil temperature, organic matter in soil.			
3. Analysis of air pollution: Air monitoring for particulate matter			
4. Visit of pond and lakes: Collection and identification of flora and fauna of selected ecosystems. Collection, preservation and estimation of zooplankton.			
5. Demonstration of field equipment's used in wildlife census: Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of cameras and lenses.			
6. Identification wild animals: Wild animal's pugmarks, hoof marks scats, pellet groups, nest, antlers. Demonstration of field techniques for wild flora and fauna.			

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment Tests

Formative Assessment for Practical	
Assessment Occasion/type	Marks
House Examination/Test	05
Written Assessment/Presentation/Project/Term Papers/Seminars	10
Classroom Performance/Participation	10
Total	25Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

References	
1	Colinvaux, P.A. (1993) Ecology (2 nd edition) Wiley, John and Sons, Inc.
2	Krebs, C.J. (2001) Ecology (6 th edition) Benjamin Cummings.

3	Odum, E.P., (2008) Fundamentals of Ecology. Indian Edition. Brooks/Cole. (3 rd Edition) Blackwell Sci.
4	Kendeigh, F.C. (1984) Ecology with Special Reference to Animal and Man. Prentice Hall Inc.
5	Caughley, G., and Sinclair, A.R.E. (1994) Wildlife Ecology and Management. Blackwell Science.
6	Woodroffe, R., Thirgood, S. and Rabinowitz, A. (2005) People and Wildlife, Conflict or Co-existence? Cambridge University.
7	Bookhout, T.A. (1996) Research and Management Techniques for Wildlife and Habitats (5 th edition) The Wildlife Society, Allen Press.
8	Sutherland, W.J. (2000) The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
9	Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008) Problem Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing

Internship for graduate Programme (As Per UGC & AICTE)

Course title	Internship Discipline specific
No of contact hours	90
No credits	2
Method of evaluation	Presentations/Report submission/Activity etc.,

- ❖ Internship shall be Discipline Specific of 90 hours (2 credits) with a duration 4-6 weeks.
- ❖ Internship may be full-time/part-time (full-time during semester holidays and part-time in the academic session)
- ❖ Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
- ❖ The student should submit the final internship report (90 hours of Internship) to the mentor for completion of the internship.
- ❖ The detailed guidelines and formats shall be formulated by the universities separately as prescribed in accordance to UGC and AICTE guidelines.

B.Sc. Semester–VI

INTERNSHIP

Course Title: Internship

Type of Course	Theory / Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
<i>INTERNSHIP</i>	Practical	02	12	90hrs.	3hrs.	50	0	50

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Explore career alternatives prior to graduation and Integrate theory and practice

CO2: Assess interests and abilities in their field of study/ research.

CO3: Develop work habits and attitudes necessary for job success

CO4: Build a record of work experience

CO 5: Identify, write down, and carry out performance objectives related to the job assignment

Expt. No.	<i>Internship:</i> <i>Course Title: Internship-Practical (Code:036 ZOO 091)</i>	90.hrs/sem
1	Small Laboratory Research Projects related to Zoology Or	
2	Field Study Report: Survey of animal biodiversity nearby villages/ ecosystem Or	
3	Survey of animal diseases/human diseases/blood groups etc. Or	
4	Any other work related to this paper may be added based on the feasibility	

Formative Assessment for Practical	
Assessment	Distribution of Marks
Project / Survey / Field Study Report submission	25
Internal assessment marks based on the performance of work	10

Presentation of work	15
Total	50 Marks
<i>Formative Assessment as per guidelines.</i>	

Internship:

A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations for 2 credits. Internships involve working with local industry, local governments (such as panchayats, municipalities) or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.

Note:

1. 1 credit internship is equal to 30hrs on field experience.
2. Internship shall be Discipline Specific of 45-60 hours (2 credits) with duration 1-2 weeks.
3. Internship may be full-time/part-time (full-time during last 1-2 weeks before closure of the semester or weekly 4 hrs in the academic session for 13-14 weeks).
4. College shall decide the suitable method for programme wise but not subject wise.
5. Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
6. The student should submit the final internship report (90 hours of Internship) to the mentor for completion of the internship.
7. Method of evaluation: Presentations/Report submission/Activity etc.