

**Sacred Heart College (Autonomous)**

**Department of Zoology**

**Master of Science [Zoology]**

**Course plan**

**Academic Year: 2015 – 16**

**Semester II**

**COURSE PLAN**  
**Ecology- Principles and Practices**

**Credits:3**

**54 hours**

**COURSE OBJECTIVES**

- To provide an understanding on the basic theories and principles of ecology
- To help study various disciplines in ecology
- To learn current environmental issues based on ecological principles
- To gain critical understanding on human influence on environment

**Basic Reference**

Odum, E.P. and Barrett, G. W. 2005. Fundamentals of Ecology. Thomson Asia Pvt. Ltd., Singapore  
Primack, R.B. 1998. Essentials of Conservation Biology. Sinauer Associates.

Faculty I

<b>Sessio ns</b>	<b>Topic</b>	<b>Method</b>	<b>Remarks</b>
1	<b>Module I. Ecology and Environment</b> Physical Environment- biotic and abiotic interactions.	Lecture	
2	Concept of Homeostasis	Lecture with interaction	
3	Concepts of habitats- host as habitat,	Lecture	
4	Niche, niche width and overlap	Lecture and interaction	
5	Fundamental and realized niche	Lecture	
6	Resource partitioning, character displacement	Lecture	
7	Module V. Resource Ecology Natural Resources: Soil-soil formation	Lecture	
8	Physical and chemical properties of soil.	Lecture	
9	Significance of soil fertility.	Lecture	
10	Mineral resources with reference to India	Lecture	
11	Impact of mining on environment;	Lecture	

12	Forest resources- deforestation, forest scenario of India.	Lecture and interaction	
13	Aquatic resources - Freshwater and water scarcity, water conservation measures - case studies from India	Lecture	

14	Wetlands and its importance, international initiatives for wetland conservation - Ramsar sites.	„	
15	Sand mining and its impacts. Wetland reclamation- causes and consequences.	Lecture	
16	Depletion of resources and impacts on quality of life.	Lecture and interaction	
17	Energy Resources- solar, fossil fuels, hydro, tidal, wind, geothermal and nuclear. Energy use pattern in different parts of the world	Lecture	
18	Recent issues in energy production and utilization; Energy audit, Green technology and sustainable development.	„	

#### Faculty II

Session s	Topic	Method	Remarks
	<b>Module I. Ecology and Environment</b>		
1	Cybernetic nature of ecosystem	ICT Enabled (ppt & images, video clippings); discussion	
2	Cybernetic nature of ecosystem contd...	ICT Enabled (ppt & images, video clippings); discussion	
3	stability through feedback control and through redundancy of components; Resistance and resilience stability	ICT Enabled (ppt & images, video clippings); discussion	
4	Gaia hypothesis	ICT Enabled (ppt & images, video clippings); discussion	
5	CIA I	1 Hr.	

	<b>Module II. Ecosystem - Structure and Function</b>		
6	Pathways in ecosystem	ICT Enabled (ppt & images, video clippings); discussion	
7	Energy in the environment-Laws of thermodynamics,	ICT Enabled (ppt & images, video clippings); discussion	
8	Laws of thermodynamics contd...	ICT Enabled (ppt & images, video clippings); discussion	

9	Energy flow in the ecosystem	ICT Enabled (ppt & images, video clippings); discussion	
10	Primary productivity	ICT Enabled (ppt & images, video clippings); discussion	
11	Primary productivity contd..	ICT Enabled (ppt & images, video clippings); discussion	
12	Biomass and productivity measurement. Contd...	ICT Enabled (ppt & images, video clippings); discussion	
13	Biomass and productivity measurement. Contd...	ICT Enabled (ppt & images, video clippings); discussion	
14	CIA II	2 Hrs	
15	Discussion on CIA II; Pathways in ecosystem	ICT Enabled (ppt & images, video clippings); discussion	
16	Biogeochemical cycles- patterns and types (CNP).	ICT Enabled (ppt & images, video clippings); discussion	
17	Biogeochemical cycles- patterns and types (CNP). Contd.. Tropical versus Temperate Ecology	ICT Enabled (ppt & images, video clippings); discussion	
18	Revision & Evaluation of the course	ICT Enabled (ppt & images, video clippings); discussion	

### Faculty III

Sessions	Topic	Method	Remarks
	<b>Module III. Population Ecology</b>		
1	Population group properties, density and indices of relative abundance	ICT Enabled ppt, images, video clippings	
2	Concept of rate. Natality and mortality	ICT Enabled ppt, images, video clippings	
3	Population age structure, Growth forms and concept of carrying capacity	ICT Enabled ppt, images, video clippings	
4	Population fluctuations, density dependent and density independent controls	ICT Enabled ppt, images, video clippings	
5	Life history strategies, r & k selection	ICT Enabled ppt, images, video clippings	
6	Population structure	ICT Enabled ppt, images, video clippings	
7	Aggregation, Allee's principle, isolation, dispersal and territoriality.	ICT Enabled ppt, images, video clippings	
8	Population interactions- types, positive and negative	ICT Enabled ppt, images, video clippings	
9	<b>I CIA</b>	1 hr Descriptive test	
10	Population interactions- interspecific and intraspecific interactions	ICT Enabled ppt, images, video clippings	

11	Ecological and evolutionary effects of competition	ICT Enabled ppt, images, video clippings	
12	Concept of metapopulation. Levin's model of metapopulation	ICT Enabled ppt, images, video clippings	

13	Comparison of Metapopulation and Logistic population model	ICT Enabled ppt, images, video clippings	
14	Metapopulation structure.	ICT Enabled ppt, images, video clippings	
	<b>Module IV. Community Ecology</b>		
15	Concept of community - community structure and attributes, ecotone and edge effect	ICT Enabled ppt, images, video clippings	
16	Development and evolution of the ecosystem, concept of climax	ICT Enabled ppt, images, video clippings	
17	Guild and its functioning in the community.	ICT Enabled ppt, images, video clippings	
	<b>II CIA</b>		
18	Revision & Evaluation of the course		

### ASSIGNMENTS

	<b>Date of submission/completion</b>	<b>Topic of Assignment &amp; Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)</b>
1	Session 10	Individual assignments

### Additional Reading List

1. Abbasi, S.A. and Ramasami, E.V.1998. Biotechnological Methods of Pollution Control. Oxford University Press, Hyderabad.
2. Benton, A.H. and Werner, W.E. 1976. FieldBiology and Ecology. Tata McGraw Hill, New Delhi.  
Boitani, L and T.K.Fuller.2000.Research Techniques in Animal Ecology. Columbia University Press, USA
3. Daniel,C.D. 2010.Environmental Science.(8thedn).Jones and Bartlett Publishers.
4. Mani,M.S. Ecology and Biogeography in india.1974. Dr.W. Junk, The Hague.
5. Misra, S P and Pandey S. N.2009. Essential Environmental Studies. Ane BooksPvt. Ltd.
6. Odum, E P .1996.Fundamentals of Ecology. W.B Saunders College Publishing, Philadelphia.
7. Peter, H.R., Berg, L.R., and Hassenzahl, D.M. 2008. Environment. (5thedn.).John Wiley Publishers.  
Pianka, E. R. 1981. Competition and Niche Theory in "Theoretical Ecology". (2ndedn.).In: May, R.M. (Ed.). Blackwell, London.
8. Rana,S.V.S. 2009.Essentials of Ecology and Environmental Science.(4thedn.). PHI learning Pvt. Ltd., New Delhi
9. Simons, I.G. 1981. Ecology of Natural Resources. Edwin-Arnold Ltd., London.
10. Tietenberg, T.2004. Environmental and Natural Resource Economics.(6thedn.). Pearson, New Delhi.  
Tyler, M. G. 2007. Living in the Environment. (15thedn). Thomson Brooks/cole, NewYork.

## COURSE PLAN GENETICS AND BIO INFORMATICS

### **COURSE OBJECTIVES:**

To give an in-depth understanding on the principles and mechanisms of inheritance

- To help study the fine structure and molecular aspects of genetic material
- To provide an opportunity to learn the importance of inheritance in Man
- To expose the learners to the emerging field of bioinformatics and equip them to take up

### **Basic Reference:**

Brooker , 1999. Genetics: Analysis and Principles. Addison- Wesley, NY.

David Allis and Thomas Jenuwein, 2007.Epigenetics.Cold Spring Harbor Laboratory Press.

Hartl, D.L. 2000.A Primer of Population Genetics.Suinaer Associate, Inc, Massachusetts.

Gardner. J.E.,Simmons, J.M and D.P.Snustad.2007. Principles of Genetics (8<sup>th</sup>edn). John Wiley,India.

Gilbert, S.F. 2006.Developmental Biology (9<sup>th</sup> edn).Sinauer Associates, Inc., Publishers, Masachusetts.

Griffiths et al., 2002. Modern Genetic Analysis.W.H. Freeman, NY, USA.

Hartl, L.D., and E.W. Jones.2009.Genetics:Analysis of Genes and Genomes (7<sup>th</sup>edn). Jones & Bartlett Pub.,Inc. MA,USA.

Herskowiz I.H, 1977. Principles of Genetics .Collier Macmillan.

Lewin B, 2008 .Genes (9<sup>th</sup>edn). Jones and Barlett Publishers Inc.

Klug, W.S. and Michael R. Cummings, 2009.Concept of Genetics.Pearson Education.Inc.

Russel,J,P., 2010. Genetics.Pearson International Edn.

Snustard,P and M. J. Simmons, 2010. Principles of Genetics. John Wiley and Sons

Strickberger, M.W.1968.Genetics. Macmillan Publishing Co.

Watson et al., 2004. Molecular Biology of Gene (5<sup>th</sup>edn.). Pearson Education Inc

<b>Session</b>	<b>Topic</b>	<b>Method</b>	<b>Remarks</b>
1	Extension of Mendel's principles	Lecture and animation videos	
2	Allelic variation and gene function- incomplete dominance and codominance	Lecture and animation videos	
3	Gene action-from genotype to phenotype	Lecture and animation videos	
4	Penetrance and expressivity, gene interaction epistasis	Lecture and animation videos	
5	Pleiotropy, genomic imprinting, phenocopy	Lecture and animation videos	
6	Genome size and C-value Paradox	Lecture and animation videos	
7	Structure of eukaryotic chromosome, nucleosome model	Lecture and animation videos	
8	Chromosome Condensation - euchromatin and heterochromatin	Lecture and animation videos	
9	Repetitive nucleotide sequences in eukaryotic genomes	Lecture and animation videos	
10	Kinetics of renaturation: Cot and Cot curve	Lecture and animation videos	
11	Unique and repetitive sequences. Mini and micro	Lecture and	
	Satellites.	animation videos	

12	Molecular structure of centromere and telomere. Polytene chromosomes and Lampbrush chromosomes. Chromosome banding techniques.	Lecture and animation videos	
13	Evolution of the concept of gene function and structure. The definition of gene	Lecture and animation videos	
14	The standard genetic code, Redundancy and Wobble	Lecture and animation videos	
15	DNA Structure- alternate forms of the Double Helix	Lecture and animation videos	
16	Gene synthesis (in vitro Synthesis) – works of Khorana and Kornberg. Modern findings on the nature of gene	Lecture and animation videos	
17	Interrupted genes In eukaryotes, exons and introns-R loops, significance of introns. Genes-within-genes (overlapping genes)	Lecture and animation videos	
18	Bacteriophage $\phi$ X174. Transposable elements in Bacteria –IS elements, composite transposons, Tn3 elements, medical significance	Lecture and animation videos	
19	Transposable elements in Eukaryotes-P elements	Lecture and animation videos	
20	Retrotransposons, significance of transposons	Lecture and animation	

		videos	
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21	Chromosome theory of heredity, Linkage and recombination of genes in a chromosome	Lecture and animation videos	
22	Crossing over as the physical basis of recombination, Stern's Experiment	Lecture and animation videos	
23	Molecular mechanisms of recombination (Holliday model), Gene conversion	Lecture and animation videos	
24	Recombination mapping with two-point and three – point test cross in <i>Drosophila</i>	Lecture and animation videos	
25	Coincidence and Interference	Lecture and animation videos	
26	Genetic mapping by tetrad analysis in <i>Neurospora</i>	Lecture and animation videos	
27	Mitotic recombination. Genetic recombination in Phage, rII locus	Lecture and animation videos	
28	Complementation test, deletion mapping, conjugation mapping	Lecture and animation videos	
29	Mapping by interrupted mating	Lecture and animation videos	
30	Mapping with molecular markers and mapping using somatic cell	Lecture and animation videos	
31	Molecular basis of gene mutation	Lecture and animation	

		videos	
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32	Mutant types- lethal, conditional	Lecture and animation videos	
33	Loss of function, gain of function, germinal verses somatic mutants	Lecture and animation videos	
34	Induced mutation, The Ames test for mutagen/carcinogen detection.	Lecture and animation videos	
35	DNA damage and repair mechanisms	Lecture and animation videos	
36	The Meselson-Stahl experiment	Lecture and animation videos	
37	Semi conservative replication of DNA in chromosomes	Lecture and animation videos	
38	Theta replication	Lecture and animation videos	
39	Rolling-circle replication	Lecture and animation videos	
40	Molecular mechanisms of eukaryotic replication	Lecture and animation videos	
41	Assignment on any research paper in Genetics		
42	Karyotype, pedigree analysis	ICT (ppt & images, video clippings) and discussion	
43	Lod score for linkage testing	ICT (ppt & images, video clippings) and discussion	

44	Genetic analysis of complex traits - complex pattern of inheritance,	ICT (ppt & images, video clippings) and discussion	
45	Threshold traits; human genome and mapping.	ICT (ppt & images, video clippings) and discussion	
	<b>Module VIII. Extra Chromosomal Inheritance</b>		
46	Inheritance of mitochondrial and chloroplast genes	ICT (ppt & images, video clippings) and discussion	
47	Maternal inheritance	ICT (ppt & images, video clippings) and discussion	
	<b>Module IX. Epigenetics</b>		
48	Epigenetics - from phenomenon to field, a brief history of epigenetics - overview and concepts	ICT (ppt & images, video clippings) and discussion	
49	Chromatin modifications and their mechanism of action	ICT (ppt & images, video clippings) and discussion	
50	Concept of 'histone-code' hypothesis	ICT (ppt & images, video clippings) and discussion	
51	Epigenetics in <i>Saccharomyces cerevisiae</i>	ICT (ppt & images, video clippings) and discussion	
	I CIA	1 Hr	
52	Position effect variegation, heterochromatin formation and gene silencing in <b>Drosophila</b>	ICT (ppt & images, video clippings) and discussion	
	<b>Module X. Quantitative and Population Genetics</b>		
53	Polygenic inheritance, analysis of quantitative traits	ICT (ppt & images, video clippings) and	
		discussion	
54	Quantitative traits and natural selection	ICT (ppt & images, video clippings) and discussion	

55	Estimation of heritability, QTL mapping	ICT (ppt & images, video clippings) and discussion	
56	Genotype-environment interactions	ICT (ppt & images, video clippings) and discussion	
57	Molecular analysis of quantitative traits	ICT (ppt & images, video clippings) and discussion	
58	Phenotypic plasticity	ICT (ppt & images, video clippings) and discussion	
	II CIA		
59	Revision and Evaluation		
60	Introduction- Biological databases	Lecture with PowerPoint	
61	Primary databases - Nucleotide sequence databases: GenBank, EMBL, DDBJ	Lecture with PowerPoint	
62	Protein sequence databases: SWISSPROT, PIR	Lecture with PowerPoint	
63	Structure databases: PDB, NDB	Lecture with PowerPoint	
64	Secondary databases: PROSITE, Pfam, CATH	Lecture with PowerPoint	
65	Composite databases: OWL Literature database: PubMed; Database searching – Entrez	Lecture with PowerPoint	
66	Database sequence submission – BankIt.	Lecture with PowerPoint	
67	Types of sequence alignment	Lecture with PowerPoint	
68	Methods of sequence alignment	Lecture with PowerPoint	
69	Scoring schemes, gaps and gap penalties	Lecture with PowerPoint	
70	Construction of phylogenetic trees using BIOEDIT	Lecture with PowerPoint	

71	Construction of phylogenetic trees using PHYLIP	Lecture with PowerPoint	
72	Evaluation of phylogenetic trees	Lecture with PowerPoint	
73	Structural genomics	Lecture with PowerPoint	
74	Functional genomics	Lecture with PowerPoint	
75	Comparative genomics-Data mining in proteomics	Lecture with PowerPoint	
76	Microarrays	Lecture with PowerPoint	
77	Introduction-metabolomics	Lecture with PowerPoint	
78	Gene network, Synthetic biology.	Lecture with PowerPoint	

## DEVELOPMENTAL BIOLOGY

**72 Hours (4 hrs/week)**

**Credit – 4**

### Objectives:

- To introduce the concepts and process in developmental biology
- To help students understand and appreciate the genetic mechanisms and the unfolding of the same during development
- To expose the learner to the new developments in embryology and its relevance to Man

### Course Out comes

- Students understand the concepts and processes in development of an organism
- students understand and appreciate the genetic mechanisms during development
- students become aware of the new developments in embryology

**No. of Course Teachers -3**

Sessions	Topic	Method	Remarks
	<b>Module 1 Early development at molecular level</b>		
1.	Introduction	Discussion to test the pre- requisite	
2.	Molecular biology of gametogenesis	Lecture and PPT	
3.	Germ plasm and determination of	ICT Enabled (PPT)	

	primordial germ cells		
4.	Germ cell determination – in nematodes, insects, mammals	ICT Enabled (PPT)	
5.	Germ cell migration in insects, mammals	Discussions from Text –Gilbert	
6.	Primordial germ cells into functional gametes	PPT	
7.	Biochemicals involved in maintaining species – specificity	Lecture and PPT	
8.	Electrical and biochemical mechanisms to ensure monospermy	Lecture and PPT	
	CIA - I	1 hr; descriptive answers only	
9.	Biochemistry of egg activation	Lecture and PPT	
10.	Control mechanism in cleavage	Lecture and ppt	

11.	Blastulation - significance of mid-blastula transition	Lecture and PPT	
12.	Molecular basis of gastrulation	Discussion and teaching	
13.	Revision		
	<b>Module II. Axis and Pattern Formation – vertebrate model</b>		
14.	Anterior posterior axis	Lecture and PPT	
15.	Dorsal ventral axis	Lecture and PPT	
16.	Left right axis	Lecture and PPT	
17.	Spemann's constriction experiments	Lecture and PPT	
18.	Transplantation experiments	Lecture and PPT	
19.	Embryonic induction, competence – Spemann organizer	Lecture and PPT	

20.	Nieuwkoop centre and mesodermal signaling	Lecture and PPT	
21.	Inducer molecules associated with organizer such as paracrine factors (FGF factors, Hedgehog proteins)	lecture	
22.	Wnt proteins, TGF – $\beta$ factors, BMP proteins	Lecture	
23.	Justacrine factors, transcription factors	Lecture	
24.	Role of these molecules in development. Left-right axis formation	Lecture and PPT	
25.	Significance of axis formation in embryonic patterning	Lecture and PPT	
26.	Revision		
	<b>CIA- I</b>	<b>1Hr.</b>	
	<b>Module III. Axis and Pattern Formation – invertebrate models</b>		
27.	Early development and axis specification in <i>caenorhabditis elegans</i> .	Lecture and PPT	
28.	Early development of <i>drosophila</i> .	Lecture and PPT	
29.	Molecular mechanism of anterior-posterior patterning in <i>drosophila</i> - introduction	Lecture and PPT	
30.	Maternal effect genes	Lecture and PPT	
31.	Zygotic genes,	Lecture and PPT	
32.	Gap genes	Lecture and PPT	
33.	Pair rule genes, segment polarity genes	Lecture and PPT	
34.	Homeotic selector genes, realisator genes	Lecture and PPT	

35.	Dorsal-ventral patterning in <i>drosophila</i>	Lecture and PPT	
36.	Left right patterning in <i>drosophila</i>	Lecture and PPT	
37.	Revision		

	<b>Module IV. Postembryonic Development</b>		
38.	Metamorphosis- Introduction	Lecture and PPT	
39.	Morphological changes associated with Amphibian metamorphosis	Lecture and PPT	
40.	growth of new structures, cell death and remodelling during metamorphosis.	Lecture and PPT	
41.	Hormonal regulation of amphibian metamorphosis.	Lecture and PPT	
42.	Insect metamorphosis – role of imaginal discs	Lecture and PPT	
43.	Hormonal control of insect metamorphosis.	Lecture and PPT	
44.	Regeneration -Introduction	Lecture	
45.	stem cell mediated, epimorphosis,	Lecture and PPT	
46.	morpholaxis, and compensatory.	Lecture and PPT	
47.	Mechanism of epimorphic regeneration in Salamander leg	Lecture and PPT	
48.	Morpholactic regeneration in Hydra,	Lecture and PPT	
49.	Compensatory regeneration in mammalian liver	Lecture and PPT	
50.	Lens regeneration in amphibia	Lecture and PPT	
51.	Revision		
	<b>Module 5 Teratogenesis</b>		
52.	Malformations and disruptions	Seminar	
53.	Gene – phene relationship	Seminar	
54.	Alcohol, retinoic acid as teratogens	Seminar	
55.	CIA- II	2 hrs	
56.	Drugs and chemicals, heavy metals as	Seminar	

	teratogens		
57.	Pathogens and environmental oestrogens as teratogens	Seminar	
58.	Revision		
	<b>CIA- II</b>	<b>2 hrs</b>	



	<b>Module VI. Applied aspects of Developmental Biology</b>		
59.	Human Infertility – types and causes	Lecture and PPT	
60.	<i>In vitro</i> fertilization	Lecture and PPT	
61.	Other assisted reproductive technologies (ART).	Lecture and PPT	
62.	Cloning experiments- (Amphibians, Mammals and Human)	Lecture and PPT	
63.	Ethical issues.	Lecture and PPT	
64.	Revision		
	<b>Module VII. Stem cells</b>		
65.	Definition, Pluripotent, multipotent stem cells, embryonic stem cells & adult stem cells	Lecture and PPT	
66.	Types of embryonic stem cells	Lecture and PPT	
67.	Stem cells and therapeutic cloning	Lecture and PPT	
68.	Stem cells and regenerative medicine,	Lecture and PPT	
69.	Transgenic stem cells	Lecture and PPT	
70.	Stem cell banks	Lecture and PPT	
71.	Ethical issues associated with stem cell experiment	Lecture and PPT	
72.	Revision		

### **Additional Reading List**

Balinsky, B.I.2004. An Introduction to Embryology.

.B.SaundersCo.,Philadelphia. Berril, N.J. 1979. Developmental Biology.Tata McGraw-Hill Pub.Co.Ltd.,New Delhi.

Gilbert, S.F. 2006. Developmental Biology (9thedn).Sinauer Associates Inc., Publishers, Masachusettes, USA Hopper, A.F. and Hart ,N.H.1985. Foundations of Animal Development.Oxford University Press, Oxford.

