

Centre for Education

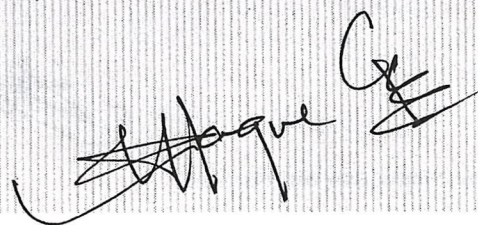
**Syllabus for BSc.BEd. Life Science**

**From 2014 Onwards**

(Compiled on 11.11.14)

**CENTRAL UNIVERSITY OF BIHAR**

**PATNA – 800014**



**BSc BED:- SYLLABUS FOR LIFE SCIENCE (80 Cr.)  
(UNDERGRADUATE PROGRAMMES)**

**From 2014 Onwards**

Animal Science (40 Cr.)		Plant Science (40 Cr.)	
1 <sup>st</sup> Semester	Animal Taxonomy (3Cr) + Practical (1 Cr)	1 <sup>st</sup> Semester	Plant Taxonomy (3 Cr) + Practical (1 Cr)
2 <sup>nd</sup> Semester	Biochemistry & Cell Biology (3Cr) + Practical (1 Cr)	2 <sup>nd</sup> Semester	Genetics & Evolution (3 Cr) + Practical (1 Cr)
3 <sup>rd</sup> Semester	Molecular Biology & Immunology (3Cr) + Practical (1 Cr)	3 <sup>rd</sup> Semester	Ecology & Environmental Biology (3 Cr) + Practical (1 Cr)
4 <sup>th</sup> Semester	Animal Biodiversity (3Cr) + Practical (1 Cr)	4 <sup>th</sup> Semester	Plant Biodiversity (3 Cr) + Practical (1 Cr)
5 <sup>th</sup> Semester	Animal Behaviour & Applied Animal Science (4 Cr) + Practical (2 Cr)	5 <sup>th</sup> Semester	Plant Pathology & Applied Plant Science (4 Cr) + Practical (2 Cr)
6 <sup>th</sup> Semester	Animal Physiology (4Cr) + Practical (2 Cr)	6 <sup>th</sup> Semester	Plant Physiology and Plant development biology (4 Cr) + Practical (2 Cr)
7 <sup>th</sup> Semester	Developmental Biology & Endocrinology (4Cr) + Practical (2 Cr)	7 <sup>th</sup> Semester	Microbiology (4Cr) + Practical (2 Cr)
8 <sup>th</sup> Semester	Animal Biotechnology (4 Cr) + Project Work (2 Cr)	8 <sup>th</sup> Semester	Plant Biotechnology (4 Cr) + Project Work (2 Cr)

## From 2014 Onwards

### Semester: I

#### Animal Science

##### Animal Taxonomy (3Cr. + 1Cr.)

<b>Unit-I</b>	<b>Introduction</b> <ul style="list-style-type: none"><li>• Systematics and classification it's importance and application in biology.</li><li>• Body symmetry- Bilateral and radial, Body cavities-acoelomates, pseudo coelomates, coelomates, Body opening- Protostomes and Deuterostomes.</li></ul>
<b>Unit-II</b>	Species concept and Animal identification– Zoological nomenclature <ul style="list-style-type: none"><li>• Form and hierarchy of classification</li><li>• Species concepts: species category, different species concepts, subspecies</li><li>• Theories of biological classification:</li><li>• Taxonomic collection and preservation</li><li>• Curation</li><li>• Process of identification</li></ul>
<b>Unit-III</b>	Modern concept in taxonomy. Trends in biosystematics - Molecular Taxonomy: Genetic polymorphism, electrophoretic variations, amino acid sequencing for variety of proteins, DNA-DNA hybridization and DNA Bar-coding. <ul style="list-style-type: none"><li>• Numerical taxonomy: Logical Steps of Numerical taxonomy, Principle and advantages of Numerical taxonomy.</li><li>• Chemotaxonomy: Introduction, principle/concept and importance of chemotaxonomy.</li><li>• Cytotaxonomy: Introduction, principle/concept of chemotaxonomy. Advantage and disadvantage of cytotaxonomy. Karyotyping.</li></ul>
<b>Unit-IV</b>	<b>Species richness</b> <ul style="list-style-type: none"><li>• Diversity indices: Shannon - Weiner, Simpson Index</li><li>• Dominance Index.</li><li>• Similarity and Dissimilarity Indices</li></ul>

### **Tentative List of Practicals (1 Cr)**

1. Identification and taxonomic division of any two animals from respective phylum from available slides/specimen
  - Protozoa, Porifera, Platyhelminthes, Aschelminthes, Annelida
2. To visit Sanjay Gandhi Javik Udayan Patna and study classification of animals available there.
3. Development of relationship among different animals by RAPD profile.
4. Identification of certain locally available fishes on the basis of their morphological characters.
5. Zoological survey of some common animals.

### **Suggested Readings\*:**

1. **Dalela & Sharma:** Animal Taxonomy and Museology (1976, Jai PrakashNath).
2. **Kapoor:** Theory and Practicals of Animal Taxonomy (1988, Oxford & IBH).
3. **Simpson:** Principles of Animal Taxonomy (1962, Oxford).
4. **Roymahoney:** Laboratory Techniques in Zoology (1966, Butterworths).

## **Plant Science**

### **Plant Taxonomy (3Cr. + 1Cr.)**

<b>Unit-I</b>	<b>Introduction</b> Difference in Systematics and Taxonomy, Systematics – Concept, structural, Biochemical and Molecular systematics, Principles and Procedures of plant systematic, Sources of data for plant systematics.
<b>Unit-II</b>	<b>Systems of Classification</b> Classification based on morphology, Reproductive, Natural System and Phylogenetic System.
<b>Unit-III</b>	<b>Principles and Methods of Taxonomy</b> Taxonomic characters other than morphology: Characters from anatomy, embryology, palynology, chromosomes, secondary metabolites, proteins, nucleic acids in taxonomy. Numerical methods in taxonomy
<b>Unit-IV</b>	<b>Cladistics</b> Introduction – advantages and problems; classical taxonomy as base for molecular systematics; systematic and phylogenetic classifications – use and utility. The choice of molecules in systematics – Nucleic acids, proteins and amino acids. Cladograms and trees; characters: apomorphic and plesiomorphic characters,

	homologous vs. analogous; Phylogenetic Trees - monophylatic, polyphylatic and paraphylatic; rooted and unrooted. Phylogenetic – algorithmic (UPGMA and Neighbour joining) and tree-searching (Parsimony, Maximum Likelihood and Bayesian).
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### **Tentative List of Practicals (1 Cr)**

1. Study the habit, growth, plants morphology, flowering behaviour of Algae, Bryophyta, Pteridophyta, Gymnosperm and Angiosperm in detail.
2. Comparative study of monocot, dicot primitive and advanced characters.
3. Collection of specimen from the field and preparation of herbarium
4. Anatomical study of monocot and dicot stem.
5. Study of permanent slides: L.S. of Angiosperm, L.S. of ovule, L.S. of endosperm, L.S. of dicot embryo, L.S. of monocot embryo, L.S. of young anther, T.S. of mature anther, T.S. of Dicot stem, T.S. of Monocot stem, T.S. of Dicot root, T.S. of Monocot root

### **Suggested Readings\*:**

1. Third Edition; Plant Systematics: An Integrated Approach by Gurucharan Singh.
2. Mauseth, J.D. Botany: An Introduction to plant Biology. Jones and Barlett publishers

## **Semester: II**

### **Animal Science**

#### **Biochemistry and Cell Biology (3Cr. + 1Cr.)**

<b>Unit I</b>	<b>Chemical and Thermodynamic Foundations for Biochemistry</b> <ul style="list-style-type: none"><li>• Various types of bonds, Water, acids, bases, and buffers</li><li>• Laws of thermodynamics, Enzyme kinetics</li></ul>
<b>Unit II</b>	<b>Carbohydrates, Lipids &amp; Proteins</b> <ul style="list-style-type: none"><li>• Classification, structure &amp; function of lipids, Lipid Metabolism</li><li>• Classification, structure, function &amp; biological importance of carbohydrates, Carbohydrate Metabolism</li><li>• Amino Acids, peptide bond &amp; structural organization of proteins, Amino acid Metabolism</li></ul>
<b>Unit III</b>	<b>Structural organization of cell &amp; Dynamic cellular processes</b> <ul style="list-style-type: none"><li>• Ultrastructure of cell, Membrane composition, characteristics and Dynamics, protein targeting, vesicle trafficking, cytoskeleton, cell-cell interactions in tissues</li></ul>
<b>Unit IV</b>	<b>Cell cycle &amp; Cell death</b> <ul style="list-style-type: none"><li>• Cell cycle phases &amp; checkpoints</li><li>• Cytokinesis, Cancer, aging &amp; Apoptosis</li></ul>

#### **Tentative List of Practicals (1 Cr)**

1. Preparation of buffer & determination of pH
2. TLC separation of Amino acids /sugars
3. Use of microscopes`
4. Squash & smear techniques to prepare slides
5. Mitosis and the Cell Cycle in Onion Root-Tip Cells

#### **Suggested Readings\*:**

1. Harper's Illustrated Biochemistry by Robert K. Murray
2. Biochemistry by Donald Voet
3. Lehninger Principles of Biochemistry by Albert L. Lehninger
4. Molecular Biology of the Cell by Bruce Albertset al

# Plant Science

## Genetics and Evolution (3Cr. + 1Cr.)

<b>Unit I</b>	<b>Origin and Evolution of Life</b> <ul style="list-style-type: none"><li>• Origin of life and life forms</li><li>• Concepts and Theories of organic evolution: theories of Lamark, Darwin and De Vries</li><li>• Evidences of organic evolution: anatomical, paleontological and embryological</li><li>• Adaptations: Curssorial, aquatic, terrestrial, fossorial and volant</li></ul>
<b>Unit II</b>	<b>Mendelism, Chromosome Theory and Inheritance</b> <ul style="list-style-type: none"><li>• Mendel's experiments with inheritance and principles</li><li>• Chromosome Theory of Inheritance: experimental evidence linking the inheritance of genes to chromosomes, nondisjunction as a proof of the theory, the chromosomal basis of Mendel's principles of heredity</li><li>• Chromosome structure and Variations in number: aneuploidy and polyploidy</li><li>• Rearrangement of chromosome structure: Deletion, Duplication, Inversion, Translocation, Position Effect</li><li>• Sex-linked inheritance and sex determination</li></ul>
<b>Unit III</b>	<b>Post Mendelion concepts</b> <ul style="list-style-type: none"><li>• Deviation from Mendel's principles, allelic variations: types of dominance, multiple alleles, allelic series</li><li>• Genetic Interactions: types of epistasis</li><li>• Penetrance (complete &amp; incomplete), Expressivity</li><li>• Pleiotropy</li></ul>
<b>Unit IV</b>	<b>Linkage &amp; Recombination</b> <ul style="list-style-type: none"><li>• Kinds of linkage, linkage groups</li><li>• Basis of recombination: Crossing over, mechanism of meiotic crossing over, calculation of genetic distance on the basis of crossing over</li><li>• Recombination mapping base on two-point and three-point test cross</li></ul>

### **Tentative List of Practicals (1 Cr)**

1. Demonstration of Model Organisms and their significance in Genetic studies.  
Virus – TMV (Tobacco leaves)  
Bacteria – *E. coli* (slide)  
*Neurospora* and Yeast (slides)  
*Paramecium* (slides)  
*Coenorhabdites elegans*  
*Drosophila melanogaster* – Life Cycle
2. Staining of genetic material: RNA & DNA with Methyl green and Pyronin
3. Observation of crossing over in meiotic stages in permanent slide
4. Pedigree analysis

### **Suggested Readings\*:**

1. Principles of Genetics: D.P. Snustad and M.J. Simmons
2. Principles of Genetics: Gardner, Snustad and Simmons
3. An Introduction to Genetic Analysis: Anthony JF Griffiths, Jeffrey H Miller, David T Suzuki, Richard C Lewontin, and William M Gelbart



## **Semester: III**

### **Animal Science**

#### **Molecular Biology & Immunology (3Cr. + 1Cr.)**

<b>Unit I</b>	<b>Nucleic acid metabolism</b> Structure of Nucleic acid (DNA & RNA), Different forms of DNA & RNA, DNA as genetic material, DNA Replication in prokaryotes & Eukaryotes, The Central Dogma, Transcription in prokaryotes & Eukaryotes, Translation in prokaryotes & Eukaryotes
<b>Unit II</b>	<b>DNA cloning</b> Genomic DNA cloning and cDNA cloning, Restriction endonuclease and cloning vector, Screening of cloned DNA
<b>Unit III</b>	<b>Overview of Immune System</b> Historical perspective of Immunology, Innate and Adaptive immunity, Active and Passive Immunity Antigens: Properties of antigens, Adjuvants and Haptens. Cells and Organs of the Immune System: Haematopoiesis, Cells of the immune system, Organs of the Immune system: Primary and Secondary lymphoid organs, Lymphatic system, vaccines, autoimmunity
<b>Unit IV</b>	<b>Immunoglobulins and Major Histocompatibility Complex</b> Basic structure, classes and function of Immunoglobulin, Polyclonal sera, Monoclonal antibodies Structure and functions of major histocompatibility complex.

#### **Tentative List of Practicals (1 Cr)**

1. Making DNA model
2. Isolation of genomic DNA
3. DNA agarose gel electrophoresis
4. Demonstration and display of lymphoid organs.
5. Viability and cell counting of peritoneal macrophages using trypan blue.

#### **List of readings:**

1. Principles of Biochemistry by Lehninger
2. Genomes by TA Brown
3. Molecular Cell Biology by Harvey Lodish
4. Cell and Molecular Biology (6<sup>th</sup> edition) Gerald Karp
5. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
6. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI edition. Roitt's Essential Immunology, Blackwell Publishing

# Plant Science

## Ecology and Environmental Biology (3Cr. + 1Cr.)

<b>Unit I</b>	<b>Basic concepts in an Ecosystem</b> Definition; Components of ecosystem; Abiotic components: Light, Temperature, Pressure, Water, Wind, Soil; Biotic components: Species diversity, Species dominance; Intraspecific interactions; Interspecific interactions: Neutralism, Commensalisms, Mutualism, Parasitism, Predation. Energy flow in an ecosystem: Primary production, Secondary production; Food chain: Grazing food chain, Detritus food chain; Food web; Ecological indicators, Wild life conservation.
<b>Unit II</b>	<b>Habitats, Development and Population Ecology</b> Habitats in the ecosystem: Fresh water, marine, estuarine, terrestrial and deserts. Concept of Niche, Ecological pyramids; limiting factors, laws and combined concept of limiting factors, Development and evolution of the ecosystem. Ecotone and edge effect, Ecades, ecotypes. Population dynamics, Communities, Species interaction.
<b>Unit III</b>	<b>Biodiversity and Applied Ecology</b> Biodiversity: Origin, speciation and extinction and ecological role of biodiversity. Types of biodiversity, alpha, beta, and gamma diversity. Rare and endangered species: IUCN, Red Data Book. Causes of Biodiversity loss. Conservation of biodiversity: Conservation theory, conservation practices, protected areas and protected species. Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.
<b>Unit IV</b>	<b>Environment and Pollution Studies</b> The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Air Pollution : Sources ( Stationary and Mobile Sources ), Effects : Effects of air pollution on human health, Vegetation, Animals; Long term effects on the planet : Green house effects, Ozone layer depletion, Acid rain, Global warming Photochemical smog; Control measures of air pollution; Air quality standards, Water Pollution : Quality of sewage : Physical properties,

	<p>Chemical properties, Biological characteristics; Sources of water pollution: Domestic, Industrial and Biological.</p> <p>Soil pollution: Industrial wastes, Urban wastes, Radioactive wastes, Agricultural practices, Chemical and metallic pollutants, Detrimental effects of soil pollution : Effects of Industrial pollutants, Effects of urban waste products, Effects of radioactive pollutants, Effects of modern agro technology, Effects of pesticides.</p> <p>Noise pollution: Sources, intensity, biological effects.</p>
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### **Tentative List of Practicals (1 Cr)**

1. Analysis of soil/pond biota
2. Determination of dissolved oxygen and pH of different water samples
3. Community structure of grass land
4. Moisture content of soil sample.
5. Record book and viva voce

### **Suggested Readings\*:**

1. Miller, G.T. Jr. (2004) Environmental Science Working with the Earth, Thomson Brooks/Cole Publ. (International Students Edition).
2. Miller, G.T. Jr. & Spoolman, S. E. (2010) Environmental Science, Cengage Learning.
3. Singh, J. S., Singh, S.P. & Gupta, S.R. (2007) Ecology, Environment & Resource Conservation, Anamaya Publishers, New Delhi.
4. Rajagopalan, R. (2005) Environmental Studies from Crisis to Cure, Oxford University Press, New Delhi
5. Rangarajan, M. (ed.) (2007) Environmental issues in India Reader, Dorling Kindersley, Delhi.
6. Marten, G. (2001) Human Ecology Basic Concepts for Sustainable Development, Earthscan Publications, UK.
7. Botkin, D. B. & Keller, E. A. (2002) Environmental Science: earth as a living planet, John Wiley & sons, New York.
8. Smith, T. M. & Smith, R.L. (2008) Elements of Ecology, Pearson, New Delhi.

## Semester: IV

### Animal Science

#### Animal Biodiversity (3Cr. + 1Cr.)

<b>Unit I</b>	<b>Acoelomates &amp; Pseudocoelomate</b> <ul style="list-style-type: none"><li>• <b>Protozoa:</b> Salient features of Phylum, Classification up to order, General characters of Genus followed by species.</li><li>• <b>Porifera:</b> Salient features of Phylum, Classification up to order, General characters of Genus followed by species.</li><li>• <b>Cnidaria:</b> Salient features of Phylum, Classification up to order, General characters of Genus followed by species.</li><li>• <b>Platyhelminthes and Nemathelminthes:</b> Salient features of Phylum, Classification up to order, General characters of Genus followed by species.</li></ul>
<b>Unit II</b>	<b>Coelomates</b> <ul style="list-style-type: none"><li>• <b>Annelida</b> – Salient features of Phylum, Classification up to order, General characters of Genus followed by species.</li><li>• <b>Arthropoda-</b> Salient features of Phylum, Classification up to order, General characters of Genus followed by species.</li><li>• <b>Mollusca</b> – Salient features of Phylum, Classification up to order, General characters of Genus followed by species.</li><li>• <b>Echinodermata:</b> Salient features of Phylum, Classification up to order, General characters of Genus followed by species, larval forms in Echinodermata.</li></ul>
<b>Unit-III</b>	<b>Chordata I</b> <p>Protochordates-General characters and classification of the following i.e. Hemichordates, Urochordates, and Cephalochordates up to sub-classes with examples</p>
<b>Unit-IV</b>	<b>Chordata II</b> <ul style="list-style-type: none"><li>• <b>Pisces:</b> General characters, and classification up to sub classes.</li><li>• <b>Amphibia:</b> General characters, Origin of amphibian.</li><li>• <b>Reptilia:</b> General characters, Evolution of land vertebrates, Extinct reptiles, Poisonous and non-poisonous snakes.</li><li>• <b>Aves:</b> General characters, Origin, aerial adaptations and flightless birds.</li><li>• <b>Mammalia:</b> General characters, Origin, Distribution, Habitat and adaptations including aerial &amp; aquatic.</li></ul>

#### Tentative List of Practicals (1 Cr)

1. Fixation of fresh water protozoans.
2. Study of animal by using power point/slide/specimen (Classification of animals) and their Salient features.

- Protozoa : Paramoecium ,Euglena, Amoeba, Plasmodium vivax
  - Porifera: Sycon, Leucosolenia, Hyalonema, Euplectella, Spongilla
  - Coelenterata : Obelia, Aurelia, Tubipora, Fungia, Adamsia
  - Platyhelminthes : Planaria, Fasciola, Taenia
  - Aschelminthes : Ascaris, Drancunculus, Ancylostoma, Wuchereria
  - Annelida : Aphrodite, Nereis, Chaetopteurs, Tubifix, Hirudinaria
3. Demonstration- Digestive and nervous system of cockroach
  4. Study of following specimen/organism
    - Balanoglossus, Amphioxus Lamprey, Chimaera, Lung Fish, salamander, Ambystoma, Alytes, Hyla, Chameleon, Tortoise, poisonous and non-poisonous snakes, any three common birds (crow, duck, owl) Duck-billed Platypus, squirrel, bat, rat.

### **Suggested Readings\*:**

1. **Marshall & Williams:** Textbook of Zoology, Vol. I (Parker &Haswell, 7th ed.1972, Macmillan)
2. **Miller & Harley:** Zoology (6th ed. 2005, W.C. Brown)
3. **Nigam:** Biology of Non-chordates (1997, S Chand)
4. **Nigam:** Biology of Chordates (1997, S Chand)
5. **Marshall & Williams:** Textbook of Zoology, Vol.II (Parker &Haswell, 2005, Macmillan)
6. **Parker &Haswell:** Text Book of Zoology, Vol. II (2005, Macmillan)
7. **Purves et al:** Life-the Science of Biology, (7th ed. 2004, Sinauer)

## Plant Science

### Plant Biodiversity (3Cr. + 1Cr.)

<b>Unit I</b>	<b>Algae</b> General characteristics; Ecology and distribution (with reference to distribution in Indian peninsula); Range of thallus organization and reproduction; Basic criteria used in algae classification (Fritsch, 1945); Important classes in relation to Applied Phycology listed below Cyanophyceae- Nostoc ; Chlorophyceae- Chlamydomonas, Volvox, Chlorella; Bacillariophyceae-Diatoms; Phaeophyceae- Fucus and Kelps; Rhodophyceae- Porphyra and Gracilaria
<b>Unit II</b>	<b>Fungi</b> General characteristics, distribution, classification in relation to Aspergillus, Pythium, Puccinia and Fusarium.
<b>Unit III</b>	<b>Non Vascular Plants</b> <b>Bryophytes:</b> Classification, characteristic features of different groups; Adaptations to land habit; Study of Vegetative and reproductive structures (including anatomical details) in Marchantia and Funaria. Evolution of tissue structure and vascular system.  <b>Vascular plants without Seeds</b> <b>Pteridophytes:</b> Classification, characteristic features of different groups; Study of vegetative and reproductive structures (including anatomical details) in Selaginella (with concept of heterospory and seed habit), Equisetum & Pteris; Apogamy and Apospory.
<b>Unit IV</b>	<b>Vascular plants with seeds</b>  <b>Gymnosperms:</b> Classification, characteristic features of different groups; Study of vegetative and reproductive structures (including anatomical details) in Cycas & Pinus  <b>Angiosperms:</b> Different types of tissue; their organization into root, stem and leaf (monocot and dicot). Concept of stele and its evolution. Structure of flower, types of inflorescence; Special reference to Bentham & Hooker's system of classification and its application with reference to identification of Solanaceae, Brassicaceae, Asteraceae and Poaceae.

## **Tentative List of Practicals (1 Cr)**

1. Study of blue green algae, green algae, lichen.
2. Marchantia: Morphology of thallus (vegetative and with gemma cup), W.M. rhizoids, gemmae, V.S. thallus through gemma cup, Morphology of male & female thallus, Permanent slide showing L.S. sporophyte. Funaria: Morphology, W.M. rhizoids, leaf, operculum, peristome teeth and spores, Permanent slides showing antheridial and archegonial heads, L.S. capsule, protonema.
3. Selaginella: Morphology, W.M. leaf with ligule, W.M. strobilus, W.M. mega- and microsporangia, W.M. spores, Permanent slides showing T.S. stem and L.S. strobilus. Equisetum: Morphology, T.S. stem through internode, L.S. & T.S. strobilus, W.M. sporangiophore, W.M. spores (wet & dry). Pteris: Morphology, T.S. rachis, V.S. sporophyll, W.M. sporangia, W.M. spores, Permanent slides showing fern prothallus.
4. Cycas: Morphology ( coralloid roots, bulbil, leaf), T.S. rachis, V.S. leaflet Male cone, V.S. microsporophyll, Megasporephyll, Permanent slides showing T.S. coralloid root and L.S. Ovule. Pinus: Morphology (long and dwarf shoots), Male cone, L.S. male cone, W.M. microsporophyll & microspores, Permanent slide showing T.S. stem, V.S. needle.
5. Study of floral characters of the following families for their identification according to Bentham & Hooker's system of classification:
  - Solanaceae: Solanum / Withania
  - Brassicaceae: Brassica / Alyssum
  - Asteraceae: Calendula / Helianthus
  - Poaceae: Triticum / Avena

## **Suggested Readings\*:**

1. Sharma, OP (2002) Textbook of Thallophytes, Tata McGraw Hill Publishing Co. New Delhi.
2. Fritsch F.E. 1935, 45 (Vol. I & II) The structure and reproduction of the Algae. Vikas Publishing House Ltd. Delhi
3. Raven P.H. et al. (2006) Biology 7th edition. Tata McGraw Hill Publishers, ND
4. Singh, G. (2004) Plant Systematics: Theory and Practice 2nd edition. Oxford & IBH Publishing Co. Delhi.
5. Mauseth, J. D. (2003) Botany, An Introduction to Plant Biology 3rd edition. Jones and Barlett Publishers.
6. Raven, P. H. et al. (2005) Biology of Plants 7th edition. W.H. Freeman and Co

## Semester: V

### Animal Science

#### **Animal Behaviour & Applied Animal Science (4Cr. + 2Cr.)**

<b>Unit I</b>	<b>Animal Behaviors</b> <ul style="list-style-type: none"><li>• Introduction to Ethology, Behavior of individual animals: food findings, predators; prey defense; orientation and migration; navigation and homing; Animal relationships; communications; aggregation; courtship; parental behavior; coloration; breeding systems; Migration of fishes &amp; birds.</li><li>• Biorhythms, learning and memory, insect societies, vertebrate societies, association between species, culture in animals.</li></ul>
<b>Unit II</b>	<b>Parasitology:</b> Structure, life cycle, pathogenicity, and control of the following parasites- Entamoeba, Leishmania, Plasmodium, Wuchereria, Ascaris, Taenia
<b>Unit III</b>	<b>Animal culture</b> Pearl-culture, Prawn-culture, Sericulture, Apiculture, Lac-culture and Pisciculture.
<b>Unit IV</b>	<b>Applied Animal Science</b> <ul style="list-style-type: none"><li>• An introduction to applied zoology with reference to human welfare Pharmaceuticals from animals. Sea Food: Value addition and export.</li><li>• Animal Waste Recycling-Biogas and its production; types of biogas plants. Slaughter house wastes and their utilization. Fish by-products; fish meal: methods of processing and uses.</li></ul>

#### **Tentative List of Practicals (1 Cr)**

1. Locomotory behaviour of *Caenorhabditis elegans* after exposure of different chemicals
2. Effect of light intensity on the rate of *Caenorhabditis elegans* locomotion
3. Study of individual and social behavioral patterns of a troop of monkey
4. Comparison of slides of liver cirrhosis and normal liver
5. Study of permanent slides and specimen of available parasite and its vector.



### Suggested Readings\*:

1. **Campbell, N.A. and Reece, J.B.:** Biology, Ninth edition Pearson Benjamin Cummings, San Francisco.
2. **Arora, D.R. and Arora B.(2001)** Medical Parasitology. II edition. CBS Publications and Distributers.
3. **Drickamer&Vessey :** Animal Behaviour – concepts, processes and methods (2nd ed. 1986,Wadsworth,)
4. **Goodenough et al.:** Perspectives on Animal Behaviour (1993, Wiley)
5. **Manning & Dawkins:** An Introduction to Animal Behaviour (5th ed. 1998, Cambridge).

## Plant Science

### **Plant Pathology & Applied Plant Science (4 Cr. + 2 Cr.)**

<b>Unit-I</b>	<b>History and Principles of Plant Pathology:</b> Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. Host parasite interaction, recognition concept and infection, defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors.
<b>Unit-II</b>	<b>Physiological and Molecular Plant Pathology:</b> Molecular mechanisms of pathogenesis: recognition phenomenon, penetration, invasion, primary disease determinant. Enzymes and toxins in relation to plant disease. Mechanisms of resistance. Phytoalexins. PR proteins. Antiviral proteins. SAR. HR and active oxygen radicals. Management of pathogens through satellite, antisense - RNA. Ribozymes, coat protein, hypovirulence cross protection/useful genes and promoter technology.
<b>Unit-III</b>	<b>Fungal, Bacterial, and Viral Diseases of Crop Plants:</b> Diseases of cereals, oilseeds, pulses, fruits, vegetables, plantation, fiber, spices and ornamental crops with special reference to etiology, disease cycle, perpetuation, epidemiology and management.
<b>Unit-IV</b>	<b>Plant domestication, utility &amp; exploitation:</b> History of plant domestication. Origin of the world's crop plants. Human influences on plants and ecosystems. Plants as sources for food, fodder, fibres, spices, beverages, drugs, narcotics, insecticides, timber, gums, resins and dyes. Latex, cellulose Starch and their products. Aromatic plants and Perfumery. Importance of Energy plantation. Botanical Gardens and Herbaria.

### **Tentative List of Practicals (2 Cr)**

1. Study of disease symptoms on virus, bacteria, fungi and nematodes infected plants and disorders
2. Field surveys; collection and preservation of diseased specimens, identification of diseases based on symptoms
3. Collection, preservation and identification specimens of tree diseases.
4. Study the biotic stress on plants and disorders
5. Collection and preparation of herbarium of economic plants

### **Suggested Readings\*:**

1. Fundamentals of Plant Pathology by N.G. Ravichandra (2013)
2. Plant Pathology Paperback by Agrios (2006)
3. Introduction to Principles of Plant Pathology 4ed R S Singh (2009)
4. Plant pathology by George N. Agrios (2009)
5. Textbook of Economic Botany Paperback – V. Verma (2009)
6. Economic Botany: A Textbook of Useful Plants and Plant Products: By Albert F. Hill
7. Economic Botany in the Tropics Paperback – Kochhar S L (2012)

## Semester: VI

### Animal Science

#### Animal Physiology (4 Cr. + 2 Cr.)

<b>Unit I</b>	<b>General Introduction</b> Definition and scope of physiology. Physico-chemical laws governing physiological processes; pH, electrolytes, diffusion, osmosis, active transport, Body fluids and compartments, Homeostasis.
<b>Unit II</b>	<b>Locomotion and Nervous Integration</b> <b>Locomotion:</b> Types of muscles, physical properties and ultrastructural organization of skeletal muscle fibres, muscle contraction. <b>Nervous System:</b> Parts of the Nervous System, The Peripheral Nervous System, The Central Nervous System, Neurotransmitters, Propagation of nerve impulse through nerve fibres, synaptic and neuromuscular junctions (origin, nature and mechanism). <b>Sensory Physiology:</b> General organizations of different sense organs, vision, hearing, taste, smell and pain.
<b>Unit III</b>	<b>Thermoregulation:</b> Control Temperature regulations- The influence of temperature on the growth and function of body organs. Modes of heat transfer, survival of poikilotherms in cold and hot environment. Mechanism of thermoregulation in homeotherms. <b>Excretion:</b> The significance of excretion and osmoregulation, Nitrogenous excretion and osmoregulation in representative animals- the effect of environment on osmoregulation. Structure of mammalian nephron, physiology of urine formation, osmoregulators and osmoconformers. Physiology of excretion a) urea cycle, Nitrogenous wastes- Ammonia, urea, uric acid, creatinine. <b>Digestion:</b> Physiology of digestion of Carbohydrates, Proteins, fats, role of Vitamins and Minerals, deficiency disorders, Hormonal control of digestion, Nervous Control of digestion. <b>Circulatory and Cardiac activity:</b> Physical characteristics of blood-cells and plasma; Coagulation, blood groups. The heart-properties of cardiac muscle; cardiac cycle, electrocardiogram (ECG), control of cardiac activity. <b>Respiration:</b> Breathing and gas exchange, gas transport, Hb and O <sub>2</sub> , dissociation, chloride shift, cellular respiration, biological oxidation, energy transfer, hydrogen transfer, carbohydrate, fat and protein metabolism, BMR.

<b>Unit IV</b>	<b>Reproduction:</b> Breeding patterns, oestrous and menstrual cycle, human male and female reproductive physiology, implantation, gestation, lactation, birth control.
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### **Tentative List of Practicals (2 Cr)**

1. Blood group determination
2. Counting of red blood cells using haemocytometer
3. Counting of white blood cells
4. Recording of blood pressure using a sphygmomanometer
5. Staining of neurons/glia
6. Observation of mammalian slides for oesophagus, liver, spleen, lung and kidney

### **List of Readings:**

1. **Guyton and Hall** textbook of medical physiology by Hall, John E. and Guyton, Arthur C. Published by : Elsevier (Philadelphia), 2011.
2. **Gangong's** review of medical physiology by Barrett, Kim E. Publication: Tata McGraw Hill, 2012.
3. **Eckert** Animal Physiology: Mechanisms and Adaptations, Fifth Edition, by David Randall, Warren Burgren, and Kathleen French., WH Freeman

## **Plant Science**

### **Plant Physiology and Plant development biology (4 Cr. + 2 Cr.)**

<b>UNIT – I</b>	<ul style="list-style-type: none"> <li>• Plant - water relationship: Colligative properties of water, free energy concept. Water uptake, conduction, transpiration, mechanism and its regulation by environmental variables.</li> <li>• Mineral nutrition: Macro, and micronutrients, their role, deficiency and toxicity symptoms.</li> </ul>
<b>UNIT – II</b>	<ul style="list-style-type: none"> <li>• Photosynthesis: photosynthetic pigments, O<sub>2</sub> evolution, CO<sub>2</sub> fixation - C<sub>3</sub>-C<sub>4</sub> and CAM plants, photorespiration.</li> <li>• Respiration: aerobic and anaerobic respiration, glycolysis, krebs' cycle, electron transport, pentose phosphate pathway</li> <li>• Nitrogen metabolism: atmospheric nitrogen fixation, nitrogen cycle, nitrogen assimilation.</li> </ul>
<b>UNIT – III</b>	<ul style="list-style-type: none"> <li>• Growth: Concept of growth general aspects of phytohormones, auxins, cytokine, gibberellins, and ethylene: action and their application; photoperiodism and vernalization, abscission and senescence</li> <li>• Germination, Seed dormancy, Plant movements.</li> </ul>
<b>UNIT – IV</b>	<ul style="list-style-type: none"> <li>• Structure of a Microsporangium, Structure of a pollen grain</li> <li>• Development of male gametophyte (Microgametogenesis)</li> </ul>

	<ul style="list-style-type: none"> <li>• Types of ovule, Development of female gametophyte (Megagametogenesis)– Monosporic (Polygonum), Bisporic (Allium) and Tetrasporic (Adoxa)</li> <li>• Double fertilization and its significance</li> <li>• Development and maturation of seed (Post fertilization changes)</li> <li>• Endosperm and its types</li> <li>• Development of dicotyledonous embryo (Crucifer type). Apomixis, Parthenocarpy and polyembryony</li> </ul>
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### **Tentative List of Practicals (2 Cr)**

1. Measuring stomatal frequency in plant leaves.
2. Measuring Total chlorophyll concentrations in plant tissues
3. Separation of different plant pigment through paper chromatography
4. Study the effect of light and dark on monocot/dicot plant growth
5. Pollen viability test by I<sub>2</sub>-KI solutions under microscope
6. Measure seed germination percentage and rate

### **Suggested Readings\*:**

1. **Hopkins, W.G. and Huner, N.P.A.** 2004. Introduction to Plant Physiology. Third Edition. John Wiley, UK.
2. **Taiz, L. and Zeiger, E.** (Eds.) 2006. Plant Physiology. Fourth Edition. Sinauer Associates Inc. Publishers, USA.
3. **Srivastava, L.M.** 2002. Plant Growth and Development: Hormones and Environment. Academic Press, USA.

*\*\*Please refer to latest editions available.*

## **Semester: VII**

### **Animal Science**

#### **Developmental Biology & Endocrinology (4Cr. + 2 Cr.)**

<b>Unit I</b>	<b>Developmental Biology</b> Definition and scope of embryology and developmental biology. Germplasm: chemical nature and preservation. Gametogenesis. Structure of gametes. Process of fertilization and egg activation with special emphasis on chemical basis.
<b>Unit-II</b>	<b>Structural and Functional aspects of development</b> Extra-embryonic membranes, structure and function. Placenta: structure and types. Energy nutrients in eggs and embryos. Embryonic and post-embryonic growth; Cleavage: types and patterns. Blastulation; Fate maps, Gastrulation, Tubulation. organogenesis with special reference to three germinal layers.
<b>Unit III</b>	<b>Endocrinology</b> Endocrine glands, concept of endocrine regulation of physiological process. Hormones: classification – proteins, steroid and derived hormones. Regulation of hormonal secretion-feed back control, secretory mechanism, Role of hypothalamus. Mechanism of hormone action-protein and steroid.
<b>Unit IV</b>	<b>Histology and functions of endocrine glands</b> Adenohypophysis and neurohypophysis, Hypothalamus, Thyroid gland and Parathyroid gland, Endocrine pancreas; Adrenal cortex and medulla; Gonads: Endocrine testis and endocrine ovary.

#### **Tentative List of Practicals (2 Cr)**

1. Study of different types of eggs
2. Observation of rat/frog sperm and ova
3. Study of frog developmental stages by using permanent slides
4. General study of endocrine glands in rat
5. Examination of sections of Pituitary, Adrenal, Thyroid, Parathyroid

#### **Suggested Readings\*:**

1. **Gilbert, S.F.** 2000. Developmental Biology. Ninth edition. INC Publishers, USA.
2. **Wolpert, L.** 2001. Principles of Development. Second Edition. Oxford Univ. Press, UK.
3. **A.C. Guyton** Textbook of Medical Physiology W.B. Saunders, Philadelphia, 1981
4. **Campbell, N.A. and Reece, J.B.:** Biology, Ninth edition Pearson Benjamin Cummings, San Francisco.
5. **William S.Hoar-** General and Comparative Physiology, prentice hall of India ltd.
6. **Wood E.W.** Principle of Animal physiology
7. **Nagbhushnum R.,Sarojini R., Kodarkar M.S.** –Animal Physiology

8. **Moeye K.**-Animal Physiology, Cambridge low prize edition.
9. **Dantzler, W.H.** Comparative Physiology (Handbook of Physiology): Vol. 1, 2, (ed.) Oxford University Press, New York, USA
10. **R. Eckert.** Animal Physiology: Mechanisms and Adaptation. W.H.
11. **Mohan Arora** – animal physiology , Himalaya publication
12. **A.K. Berry.** –animal physiology

## **Plant Science**

### **Microbiology (4 Cr. + 2 Cr.)**

<b>Unit-I</b>	History and Scope of Microbiology, Microbial taxonomy (numerical and molecular), Culture media and their types. Pure Culture Techniques-Serial dilution methods, spread plate, pour plate, streak plate technique. Classical and molecular methods of microbial identification, and characterization. Bergey's manual and Bacterial classification.
<b>Unit –II</b>	Ultrastructure and distinctive features of Virus, Bacteria and Archaeobacteria. Plant and animal Viral Genome replication. Control of viral diseases; Genetics of Bacteria: Gene transfer by conjugation, transduction and transformation.
<b>Unit-III</b>	Nutritional requirements of micro-organisms, Mode of nutrition, phototrophy, mixotrophy, saprophytic, symbiotic (nitrogen fixation, mycorrhiza). Auxotrophs&Prototrophs. Microbial growth and population kinetics, methodology for measuring growth and growth regulation. Physical and chemical control of microbes: general characteristic and mode of action.
<b>Unit-IV</b>	Basic concepts, action of pathogens, human pathogenic viruses and bacteria, Bacterial agents of disease. Life cycle of some important pathogens like- Hepatitis, Tuberculosis, AIDS, Ebola, Bird flu, and Swine flu.

### **Tentative List of Practicals (2 Cr)**

1. Sampling and quantification of microorganisms in air, soil and water.
2. Isolation of bacteria by Streak plate, spread plate and pour plate techniques
3. Serial dilution of natural sample and plating
4. Gram staining of bacteria
5. Observation of morphology - shape and arrangement of cells
6. Growth curve studies of microbes

**Suggested Readings\*:**

1. Microbiology (2009) Prescott, Harley and Klein
2. Biology of Micro-organism: Madigan, Martinko and Parker
3. Fundamentals of Microbiology (2009) Alcano
4. Foundations in Microbiology (2008) Talaro K. and Talaro A.
5. Microbiology: Concept and Applications (1993) Pleczar M. J.,  
Chan E. C. S. and Krieg N. R.
6. Principles of Microbiology (2007) Atlas, R. M.
7. Bergey's Manual of Systematic Bacteriology (2012) (2nd ed.)  
Gornity, G. M.



## **Semester: VIII**

### **Animal Science**

#### **Animal Biotechnology (4 Cr. + 2 Cr.)**

<b>Unit-I</b>	<b>Laboratory requirements for animal cell culture :</b> Laminar flow, Sterilizer, Incubator; CO2 incubator, Refrigerators and freezers, Centrifuge, Inverted stage microscope, Liquid nitrogen freezers, Slow cooling system for cell freezing, Water bath, Autoclaves and hot air oven, Pipette washers, sterilization of different materials used in animal cell culture, Aseptic concepts.
<b>Unit-II</b>	<b>Media and reagents</b> Types of cell culture media, Ingredients of media, Physiochemical properties, CO2 and bicarbonates, Buffering, Oxygen, Osmolarity, Temperature, Surface tension and foaming, Balance salt solutions, Antibiotics, growth supplements, Fetal bovine serum; Serum free media, Trypsin solution, Selection of medium and serum, Preparation and sterilization of cell culture media, serum and other reagents.
<b>Unit-III</b>	<b>Different types of cell cultures</b> History of animal cell culture, Different tissue culture techniques, primary culture and Secondary culture, Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture. Cryopreservation, Common cell culture contaminant.
<b>Unit-IV</b>	<b>Gene transfer technology in animals</b> Transfection techniques, Production of transgenic animals and molecular pharming. Animal cloning: Techniques, relevance and ethical issues.

#### **Project (2 credits)**

#### **Suggested Readings\*:**

1. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000.
3. Ed. Martin Clynes, Animal Cell Culture Techniques, Springer, 1998.
4. B.Hafez, E.S.E Hafez, Reproduction in Farm Animals, 7th Edition, Wiley- Blackwell, 2000.
5. Louis-Marie Houdebine, Transgenic Animals: Generation and Use, 1st Edition, CRC Press, 1997.
6. Elements of Biotechnology by P.K. Gupta, Meerut publication.

## Plant Science

### Plant Biotechnology (4Cr. + 2 Cr.)

<b>Unit-I</b>	<ul style="list-style-type: none"><li>• <b>Plant tissue culture:</b> Techniques of plant tissue culture. Concept of cellular totipotency. Media composition and sterilization techniques, Plant micropropagation and regeneration; Somatic embryogenesis; Embryo rescue; Haploid plant production; Protoplast culture; Somatic hybridization; Artificial Seeds; Germplasm conservation</li></ul>
<b>Unit-II</b>	<ul style="list-style-type: none"><li>• <b>Plant secondary metabolites:</b> Plant Cell culture, Control mechanisms and manipulation of alkaloids and industrial enzymes, Plant derived biodegradable plastics, Edible vaccines.</li></ul>
<b>Unit-III</b>	<ul style="list-style-type: none"><li>• <b>Plant transformation technology</b> – Basis of tumor formation; Features of Ti and Ri plasmids; Methods and Mechanisms of DNA transfer to plant cell; Co-integrate vector and Binary vectors. Chloroplast transformation; Transgene stability and gene silencing. Application of plant transformation for productivity and performance- Insect resistance, Fungal diseases resistance, Bacterial diseases resistance, Herbicide Resistance, Drought and salt resistance.</li></ul>
<b>Unit-IV</b>	<ul style="list-style-type: none"><li>• <b>Molecular markers in plant genome analysis:</b> Introduction and principle of Molecular marker. Types of molecular markers and its application: RAPD, SCAR, RFLP, AFLP, SSR, STS etc.</li></ul>

### Project (2 credits)

### Suggested Readings\*:

1. Plant Tissue Culture by MK Razdan and SS Bhojwani (2009) Elsevier
2. Plant Physiology by L Taiz and E Zeiger 4th Edition (2010) Sinauer Associates Inc, Publishers
3. Experiment in Microbiology, Plant pathology and Tissue culture by K.R. Aneja, WishwaPrakashan
4. Genetic Transformation of Plants, Edited by Jackson, J.F.; Linskens, H.F., Springer 2009
5. Plant Biotechnology and Transgenic Plants, Edited by Kirsi-Marja Oksman-Caldentey, Wolfgang Barz Marcel Dekker
6. Molecular Biology and Biotechnology of Plant Organelles - Chloroplasts and Mitochondria: Daniell, Ph.D., Henry; Chase, Christine D. (2004).