### Detailed course matrix and scheme of evaluation for subject: Life Sciences (3-year B.Sc. course) effective from 2016-17

#### SEMESTER I

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS101T</td>
<td>Biosystematics &amp; Diversity of Plants</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>70</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

#### Practical

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS101P</td>
<td>Biosystematics &amp; Diversity of Plants</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>15</td>
<td>50</td>
</tr>
</tbody>
</table>

#### SEMESTER II

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS201T</td>
<td>Biosystematics &amp; Diversity of Animals</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>70</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

#### Practical

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS201P</td>
<td>Biosystematics &amp; Diversity of Animals</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>15</td>
<td>50</td>
</tr>
</tbody>
</table>

#### SEMESTER III

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS301T</td>
<td>Plant anatomy &amp; physiology</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>70</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

#### Practical

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS301P</td>
<td>Plant anatomy &amp; physiology</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>15</td>
<td>50</td>
</tr>
</tbody>
</table>

*Internal Assessment:*

- Theory (30 marks): Class test – 15 marks; Seminar Report – 05 marks; Seminar Presentation – 05 marks; Attendance – 05 marks
- Practical (15 marks): Class test – 05 marks; Class Record – 05 marks; Attendance – 05 marks
### SEMESTER IV

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS401T</td>
<td>Animal anatomy &amp; physiology</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>70</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>LS401P</td>
<td>Animal anatomy &amp; physiology</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>15</td>
<td>50</td>
</tr>
</tbody>
</table>

### SEMESTER V

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS501T</td>
<td>Cell &amp; Molecular biology</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>70</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>LS502T</td>
<td>Developmental biology</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>70</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>LS501P</td>
<td>Cell &amp; Molecular biology</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>LS502P</td>
<td>Developmental biology</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>15</td>
<td>50</td>
</tr>
</tbody>
</table>

### SEMESTER VI

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>Hrs/week</th>
<th>Total credits</th>
<th>Duration of examination (hrs)</th>
<th>Maximum marks</th>
<th>*Internal Assessment</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS601T</td>
<td>Ecology &amp; Environmental biology</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>70</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>LS602T</td>
<td>Genetics &amp; Evolution</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>70</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>LS601P</td>
<td>Ecology &amp; Environmental biology</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>LS602P</td>
<td>Genetics &amp; Evolution</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>35</td>
<td>15</td>
<td>50</td>
</tr>
</tbody>
</table>
Detailed Course Content
of B.Sc. with Life Sciences
(effective from 2016-17)
Unit 1: Introduction to Biosystematics of Plants 04 hours
Botanical Nomenclature: Principles and a brief account of ICBN & ICNCP.
Botanical literature: Floras, Revisions, Monographs, Indices, Journals. Herbarium – Preparation, maintenance and Importance; Important herbaria of the world.
Botanical garden – a brief account and importance; Important botanical gardens of the world.

Unit 2: Viruses & Bacteria 06 hours
Viruses - General characters, diversity (Morphological and Structural) and classification. Nomenclature of viruses. Morphology, Ultra structure and reproduction of TMV, Cauliflower Mosaic Virus and T4 Phage.
Bacteria - General characters, diversity and classification. Morphology, ultrastrcuture and reproduction of Bacillus and E.coli. Cyanobacteria & Mycoplasma : General characters, diversity and classification.

Unit 3: Non-vascular plants 16 hours
Fungi: Occurrence, general characters, diversity and classification (Ainsworth 1972). Economic importance
Algae: Occurrence, general characters and classification (Fritsch 1945). Economic importance.

Unit 4: Vascular plants 26 hours
Gymnosperms: Occurrence, general characters, diversity and classification (Pilger and Melchior (1954). A brief account of economic importance, origin and evolution of Gymnosperms. Fossil Gymnosperms

Angiosperms: Origin of Angiosperms. Occurrence, general characters, diversity and classification. Salient features and importance of the following families:
Dicots: Magnoliaceae, Nymphaeaceae, Caryophyllaceae, Malvaceae, Euphorbiaceae, Rubiaceae, Scrophulariaceae, Asclepiadaceae, Asteraceae.
Monocots: Alismataceae, Arecaceae, Poaceae, Cyperaceae, Zingberaceae, Liliaceae and Orchidaceae.

Recommended readings:
Non-vascular Plants
Vascular Plants

**Pteridophytes and Gymnosperms :-**

**Angiosperms :-**

******
1. Measurement of dimension of microorganism by Micrometry.
2. Studying Bacteria - Gram staining
3. Identification of Saprolegnia, Pythium, Phytophthora, Albugo, Rhizopus, Aspergillus, Penicillium, Peziza, Puccinia, Tikka and Alternaria.
   Chlorophyceae ; Scenedesmus, Hydrodictyon, Spirogyra, Desmids, Coleochaete, Ulva, Caulerpa.
   Charophyceae: Chara and Nitella.
   Xanthophyceae : Botrydium, Phaeophyceae : Ectocarpus and Sargassum.
   Rhodophyceae: Batrachospermum and Polysiphonia.
5. Study of morphology and anatomy of vegetative and reproductive structures of : Marchantia, Lunularia, Porella, Anthoceros, Sphagnum and Funaria.
6. Field visits to natural vegetations rich in non-vascular plants
   Fossil pteridophytes subjected to the availability of materials / slides.
10. Derivation of a taxon to respective family using Floras.
11. Study of local flora and field visit to various Botanical gardens to study the vegetation.
LS201T BIOSYSTEMATICS AND DIVERSITY OF ANIMALS
52 hours | 4 hours / week | 4 credits

Unit 1: Introduction to Biosystematics of Animals 04 hours
Systematics of Animals: Meaning, Nomenclature, Principles of Classification, Major branches of invertebrates & vertebrates and their relationships. Minor phyla.

Unit 2: Invertebrates 22 hours
Classification, general characters, diversity and economic importance of Phylum Protozoa, Porifera, Coelenterata, Ctenophora, Platyhelminthes, Aschelimenthes, Annelida, Arthropoda, Mollusca and Echinodermata.
Economic importance: Apiculture, Sericulture, Vermiculture, Lac culture.

Unit 3: Vertebrates 20 hours
Origin, systematic position and characteristics of Vertebrates.
Diversity, Salient features and Classification of classes Pisces, Amphibia, Reptilia, Aves and Mammals (up to orders).
External features, Digestive, Respiratory, Circulatory, Excretory, Nervous and Reproductive systems: Shark, Frog, Rabbit.
Economic importance of Vertebrate phyla.

Unit 4: Adaptations & Animal Behaviour 06 hours
Adaptations – Aquatic, Terrestrial, Aerial (Volant). Adaptive radiations in Reptiles & mammals.
Animal Behaviour - Ethogram, Learning, Instincts, Motivation, Cooperation and conflicts, Social organization in Primates.

Recommended readings:

Invertebrates

Vertebrates

**********
Invertebrates:

Identification and classification of

2. Porifera – Leucosolenia, Gemmule, Euspongia (Bath sponge), Euplectella (Venus flower basket), Hyalonema (glass rope sponge).
3. Coelenterata – Obelia, Aurelia, Sea anemone Physalia, Velella, Porpita, Corals – Fungia, Astrea, Gorgonia, Meandrina (Brain coral), Tubifora (Slag horn coral), Penantula (Sea pen).
4. Platyhelminthes-Liver fluke, tape worm, planaria.
5. Aschelminthes- Ascaris, Ancylostoma (Hook worm), Schistosoma (Blood worm) Filarial worm.
8. Mollusca - Sepia, Octopus, chiton, Patella, Dentalium, fresh water mussel, pila globosa (snail), Nautilus, Murex, Xanchus, Cyprea.
10. Demonstration of Dissections –
11. Reproductive, Digestive and Nervous system of male and female Cockroach, Silkmoth.
12. Earth worm – Nervous system (nerve ring) and setae mounting, Rat- Nervous system.

Vertebrates:

1. Identification and classification of vertebrates – Shark, Eel, Tetradon, Macropodus, Ophiocephalus, Narcine, Protopterus, Stegostoma, Salamander, Ichthyophis, Calotes, Mabuya, Phrynosoma, Draco, Varanus, Chamaeleon, Naja naja, Viper, Sphoenodon, Ostrich, Archaeopteryx, Owl, Vampyrurus, Loris, Pangolin, Porcupine.
2. Demonstration of Dissection: Rat nervous, Arterial and venous system, Reproductive system of male and female.
3. Life cycle of Frog.
4. Identification of skulls of chordates.
5. Dentition of chordates

**********
Unit 1: Primary vascular system 13 hours
Organization of primary plant body, apical meristems and primary growth, Primary xylem - composition, Primary phloem - composition, the role of auxins in the development of the primary vascular system.

Cell wall: Structure and development of the cell wall - Structure (light microscopic and ultramicroscopic structure), composition of the cell wall, Cell wall development, role of cytoskeleton in wall development and genetic control of wall development.

Meristem: Definition, classification of meristem, Apical meristems of Shoot and Root apex, relevant theories pertaining to structure and organization of root apex and shoot apex: Shoot Apex: Apical Cell Theory, Tunica Corpus Theory, Zonation Theory.

Root Apex: Histogenic boundries; Quiscent center; Formation of leaf primordial, Transitional tissue regions, The primary peripheral thickening meristem of Monocotyledons.

Unit 2: Secondary vascular system 13 hours
Development of the secondary vascular system of the stem and root. Role of the vascular cambium, the effect of secondary growth on the primary body on leaf and branch traces.


Nodal anatomy: A general account

Anamalous secondary growth: Aristolochia, Boerhaavia, Dracaena.

Periderm: Structure and development, formation of rhytidome, Lenticels

Secretary tissues in plants: Internal secretory structures and External secretory structures.

Ecological adaptations: Xerophytes, Mesophytes, Hydrophytes, Epiphytes, Parasites and Mangroves.

Unit 3: Ascent of Sap 06 hours
Water relation of a plant cell: Water potential, osmotic potential, pressure potential, membrane and their permeability mechanism of water absorption, SPAC concept.

Ascent of sap: Vital and physical forces.

Mineral nutrition: Importance of nutrients, major and minor elements, their deficiency disorders and treatments. Passive and active transport of solutes across the membranes, ion transport in roots, mechanism of translocation, sources and sink concept.

Unit 4: Photosynthesis & Respiration 07 hours
Photosynthesis: General concepts and historical backgrounds, photosynthetic apparatus, mechanism of absorption of light, Absorption spectrum, Emersson’s enhancement effect, two pigment system-PS-I and

Unit 5: Growth & Metabolism 07 hours
Growth hormones: Definition, Kinetics, growth hormones, biosynthesis, transport and physiological effects of Auxins, Cytokinins, Gibberlins, Abscissic acid and ethylene, mechanism of hormone action.

Unit 6: Photobiology 06 hours
Circadian rhythms, photoperiodism, vernalization, phytochromes, biochemical signalling involved in flowering, dormancy, seed germination and senescence.

Recommendations:

Plant Anatomy:

Plant Physiology:

********
LS301P: PLANT ANATOMY & PHYSIOLOGY
3 hours / week | 2 credits

1. Free hand section of Stem: Helianthus (Normal), Cucurbita and Peperomia (Special features).
2. Study of anomalous secondary growth of stem: Boerrhavia, Aristolochia and Draceana.
3. Study of leaf anatomy of Isobilateral (Nerium) and Dorsiventral leaf (Ficus)
5. Study of root anatomy : Aerial root (Ficus), Orchid root.
6. Study of Ecological adaptation – Xerophyte (Nerium), Mesophyte (Hydrophyte (Hydrilla)
7. Wood anatomy-TLS & RLS of Gymnospermous wood (Pinus/Araucaria) & Angiospermous wood(Michelia)
8. Plant Microtechnique - Microtomy, Maceration.
9. Determination of water potentials by following drops methods.
10. Hydroponics study of deficiency symptoms (chlorosis, necrosis)
11. Separation of chlorophylls and carotenoids by Ascending paper chromatography
12. Bioassay of Phyto hormones – Auxins, Cytokinins, Gibberllins, Abssisic acid, Ethylene
13. Determination of lipid activity

*******
LS401T: ANIMAL ANATOMY & PHYSIOLOGY
52 hours | 4 hours / week | 4 credits

Unit 1 05 hours
Integument and derivatives: Structure and functions of skin (Mammals), scales, claws, nails, hairs. feathers and horns.

Unit 2 14 hours
Comparative account of heart (Fish, Frog, Reptile, Bird and Mammals), eyes –compound and camera eye, gills (fish) and lungs (Mammals), skull (rabbit), limbs - fore limbs & hind limbs (mammals).

Unit 3 07 hours
Histophysiology: Liver, Kidney, Spleen, Testis, Ovary, Pituitary, Pancreas.

Unit 4 05 hours
Respiration and Circulation: Types of respiration, Respiratory pigments, transport of O₂ and CO₂, Open and closed circulation, Blood composition and function.

Unit 5 04 hours

Unit 6 03 hours
Excretory patterns in vertebrates: ammonotelism, ureatelism and uricotelism.

Unit 7 07 hours

Unit 7 07 hours
Feeding and digestion: Feeding patterns in vertebrates. Chemical and mechanical digestion, Stimulation of gastro-intestinal secretions, Digestion of carbohydrates, lipids and proteins. Nutritive types, vitamins, minerals, energy requirements, nutrition requirements of different ages. Nutritional disorders.

******

Recommended readings:

******
LS401P ANIMAL ANATOMY & PHYSIOLOGY
3 hrs / week |2 credits

1. Identification and functions of scales (fishes), claws, nails, hairs, horns, feathers, Hoofs and nests.
2. Felid visits to Research institutes, national parks and natural vegetations.
3. Vertebre – Procoelous (Frog), Amphicoelous (Bird), Amphiplateous (Rabbit).
5. Histology sections of Testis, Ovary, Liver, Pancreas, Kidney, Spleen, intestine.
6. Microtomy – Organ fixing, Block making, Sectioning and staining of any one organ (rat)
7. Determination of oxygen consumption and metabolic rate in fish.
8. Rate of protein digestion by trypsin.
9. Acetylcholine activity in tissues
10. Determination of ATPase activity in tissues

******
LS501T: Cell and Molecular Biology
39 hours | 3 hours/week | 3 credits

Unit 1: Techniques in Biology 04 hours
Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

Unit 2: Cell as a unit of Life 02 hours
The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

Unit 3: Cell Organelles 12 hours
Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA.
Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA.
ER, Golgi body & Lysosomes: Structures and roles.
Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis.
Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

Unit 4: Cell Membrane and Cell Wall 04 hours
The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.

Unit 5: Cell Cycle 04 hours
Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

Unit 6: Genetic material 05 hours
DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery’s transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.
DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi-conservative, semi discontinuous RNA priming, Ø (theta) mode of replication, replication of linear, ds-DNA, replicating the 5' end of linear chromosome including replication enzymes.

Unit 7: Transcription (Prokaryotes and Eukaryotes) 04 hours
Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code
Unit 8: Regulation of gene expression

04 hours

Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes.

********

Recommended readings:


*******
LS501P: Cell and Molecular Biology
3 hours/week | 2 credits

**Note:** Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

**Cell Biology**

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. To prepare temporary stained preparation of mitochondria from striated muscle cells/cheek epithelial cells using vital stain Janus green.
7. Study of mitosis and meiosis -temporary mounts and permanent slides (*Allium cepa*, Grass hopper/*Drosophila*)
8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Study of plasmolysis and deplasmolysis on Rhoeo leaf.
11. Measure the cell size (either length or breadth/diameter) by micrometry.
12. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
13. Study DNA packaging by micrographs.
14. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

**Molecular Biology**

1. Isolation of nucleic acids from plant (young leaves, *Allium cepa*) and animal (butterfly or silkworm larva, adult Uzi fly, *Drosophila* larva) by CTAB and SDS-Proteinase K method
2. Isolation of plasmid DNA from bacterial culture using DNA extraction kit
3. Extraction of total RNA from bacterial culture using RNA isolation kit
4. Estimation of DNA content by Diphenylamine(DPA) method
5. Estimation of RNA by Orcinol method
6. Estimation of protein by Bradford method
7. Separation of nucleotide bases by paper chromatography
8. Agarose gel electrophoresis of DNA and RNA
9. Polyacrylamide gel electrophories of proteins

******
Unit 1: Introduction to developmental biology; Early development- Fertilization-types, Types & mechanisms of cleavage. Gastrulation: Cell movement and formation of germ layers in frog & chick and mouse, Concept of cell type determination, competence and differentiation, Creation of specific organs (organogenesis – chick) 5 hours

Unit 2: Organizer concept: Primary organizer, embryonic stem cell, development of vertebrate nervous system (chick) Formation of neural tube, regions of brain. 3 hours

Unit 3: Genetics of pattern formation: Coenorhabditis, Drosophila, Arabidopsis thaliana, Maternal gene and formation of body axes, Homeotic gene function, Imaginal disc development, Axes formation in vertebrate, Hox genes. 6 hours

Unit 4: Post embryonic development:
- Metamorphosis- endocrine control of metamorphosis in amphibian and insects.
- Regeneration – Cellular processes in regeneration, Sources, determination of polarity, regulation of regeneration. 6 hours

Unit 5: Gametogenesis in plants:
Microsporogenesis & male gametophyte: - Anther wall Structure and development- Endothecium, Middle layers, Tapetum, Nuclear behaviour in tapetal cells and Sporogenous tissue; Formation of vegetative and generative cells, Formation of pollen wall – Structure and development and abnormal pollen grains.

Megasporogenesis & female gametophyte: - Structure and development of ovules, Types and parts of ovules. Structure and development of female gametophyte, Types of female gametophytes, Structure of Mature Embryo sac, Embryo sac haustoria. 9 hours

Unit 6: Fertilization and embryogeny: Structure of style and stigma, Pollen germination and pollen tube growth. Path of pollen tube, pollen tube discharge, Double fertilization: triple fusion and syngamy. Central cell as the second gamete of the flowering plant. Structure and types of endosperm, Physiology and cytology of endosperm and functions of endosperm and endosperm haustoria. Classification of Embryogeny, early embryogenesis and mature embryo of Dicotyledons – Capsella bursa pastoris and mature embryo of monocotyledons- Najus lacerata and Grass. 10 hours

Recommended readings:
Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Study of whole mounts of frog and chick- early developmental stages
2. Study of chick development from live eggs (window viewing) & permanent embryo mounting
3. Study of section of chick embryo through selective developmental stages
4. Dissection and mounting of imaginal discs of Drosophila / silk worm
5. Videos showing selective embryonic events like cleavage; gastrulation
7. Micro and mega sporogenesis in higher plants-slides only
8. Pollen germination in-vivo and in-vitro
9. Study of gamete/spores in algae, moss, liverwort, pteridophyte and gymnosperm
10. Embryo development in flowering plant- slides only; dissection of endosperm and embryo
11. Study of apical and lateral meristem, hypertrophy and hyperplasia
12. Mounting of endosperm – Cucumis sp.
13. Mounting of embryo – Cyamopsis / Tridax sp.


Unit 3: Natural resources: Renewable and non-renewable resources, forest resources- use and over exploitation, deforestation, case studies. Timber extraction , mining, dams and their effects on forests and tribal people; Water resources- use and over utilization of surface and ground water, floods, drought, conflicts over water, dams, benefits and problems; Mineral resources- use and exploitation, environmental effects of extraction and use of mineral resources, case studies; Agricultural resources- World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizer- Pesticide problems, water logging and salinity, case studies; Energy resources- growing energy needs, conventional and non-conventional energy resources, use of alternative energy sources, case studies; Land resources- Land as a resource, Land degradation, landslides, soil erosion and desertification.  

Unit 4: Biodiversity and Conservation: Biogeographical classification of India, Biodiversity at Global, National and Local levels, India as a mega diversity nation, Threats to biodiversity, habitat loss, poaching of wildlife, man wildlife conflicts, endangered and endemic species of India, Ex-situ and In-situ conservation of Biodiversity.  


Recommended readings

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Determination of dissolved oxygen in given water sample by Winkler’s method
2. Estimation of Primary Productivity of Lake/ Pond System
3. Sampling techniques for plankton
4. Plotting of survivorship curves from hypothetical life table data
5. Productivity and Biomass estimation of plants
6. To determine minimal quadrat area for sampling in the given simulation sheet
7. To determine soil texture, soil density, bulk density, particle density and pore space
8. To determine water holding capacity and percolation rate of soil
9. To determine COD, BOD, Total solids
10. Determination of hardness of water.
11. Soil analysis: pH, Inorganic and organic contents
13. Principle and function of Sechi disc, Atmometer, Anemometer, Hygrometer, Hair hygrometer, Luxmeter, Rain guage, Soil thermometer, Min-Max thermometer.

*****
Unit 1: Introduction to Genetics
Mendel’s work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Unit 2: Mendelian Genetics and its Extension
Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and codominance, Multiple alleles, lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

Unit 3: Linkage, Crossing Over and Chromosomal Mapping
Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping

Unit 4: Mutations
Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor Mutations.

Unit 5: Sex Determination
Chromosomal mechanisms, dosage compensation

Unit 6: History, theories and evidences of evolution
Major Events in History of Life, Lamarckism, Darwinism, Neo-Darwinism, Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse.

Unit 7: Processes of Evolutionary Change
Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 8: Species Concept, macroevolution and extinction
Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric), Macroevolution and Macroevolutionary principles (example: Darwin's Finches), Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

Recommended readings:
   *****
1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
4. Study of fossil evidences from plaster cast models and pictures.
5. Study of homology and analogy from suitable specimens/ pictures.
6. Charts:
   a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b) Darwin’s Finches with diagrams/ cut outs of beaks of different species.
7. Visit to Natural History Museum and submission of report.