Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune 5

Detailed Syllabus

For M. Sc. Botany

(2019-20 Course)

(with effect from 2019-20)

Semester I (Part 1)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-1	19ScBotP101	Cryptogamic Botany I Algae (1.25 Credits) Fungi (1.25 Credits) Lichens (0.5 Credits)	4	4	50	50	100
CCT-2	19ScBotP102	Cell Biology and Evolution Cell Biology (3 Credits) Evolution (1 Credit)	4	4			
DSET-1	19ScBotP103	Plant Metabolism	4	4			
DSET-1	19ScBotP104	Botanical Techniques	4	4			
CCP-1	19ScBotP105	Practical based on 19ScBotP101	4	4			
CCP-2	19ScBotP106	Practical based on 19ScBotP102	4	4			
	Total			20			

Semester II (Part 1)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-1	19ScBotP201	Cryptogamic Botany II Pteridophytes Gymnosperms Paleobotany	4	4	50	50	100
CCT-2	19ScBotP202	Biochemistry	4	4			
DSET-1	19ScBotP203	Genetics and Plant Breeding Genetics Plant Breeding	4	4			
DSET-1	19ScBotP204	Molecular Biology	4	4			
CCP-1	19ScBotP205	Practical based on 19ScBotP201	4	4			
CCP-2	19ScBotP206	Practical based on 19ScBotP202	4	4			
	Total			20			

*Field visit for 19**Sc**BotP201 and submission of 5 forms each of Pteridophytes and Gymnopserms.*

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Modern College of Arts, Science and Commerce, (Autonomous)

Shivajinagar, Pune – 5

First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP101

Course Name: Cryptogamic Botany I-Algae, Fungi, Lichens and Bryophytes

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Student should have basic knowledge of Algae, Fungi and lichens

Course Objectives:

- To study general characteristics of each group
- To learn evolutionary relationship among taxa within each group
- To gain expertise in the field work

Course Outcome:

On completion of the course, student will be able to–

- Identify and classify lower cryptogams

Course Content

Chapter 1	**Systematics and taxonomy of algae**	**2Lectures**
	1.1 Concept of algal systematics 1.2 Position of algae and fungi in five Kingdom System 1.3 Economic importance of algae 1.4 Algal biofertilizers 1.5 Mass cultivation of sea weeds	
Chapter 2	**Classification of Algae**	**4Lectures**
	2.1 Outline of classification of algae 2.2 Role of pigment constitution and reserve food in algae	
Chapter 3	**Recent studies in phycology**	**3Lectures**

	3.1 Recent algological studies in India. 3.2 Modes of perennation in algae. 3.3 Origin and evolution of sex and thallus in the algae 3.4 Fossil algae	
Chapter 4	**Cyanophyta (Blue Green Algae)**	**3Lectures**
	4.1 Distinguishing characters. 4.2 Thallus organization, cell structure, heterocyst and its significance. 4.3 Structure and reproduction in Chrococcales, Nostocales, and Stigonematales.	
Chapter 5	**Chlorophyta (Green Algae)**	**3Lectures**
	5.1 Distinguishing characters. 5.2 Origin of green algae 5.3 Range of thallus organization in Chlorophyta 5.4 Reproduction – asexual and sexual, Life cycle pattern in unicellular, filamentous and multicellular green algae.	
Chapter 6	**Charophyta**	**3Lectures**
	6.1 Distinguishing characters, comparative study of thallus structure in *Chara* and *Nitella* 6.2 Reproduction and Life cycle pattern	
Chapter 7	**Phaeophyta (Brown algae)**	**3Lectures**
	7.1 Distinguishing characters. 7.2 Comparative study of thallus morphology, anatomical peculiarities, reproduction and life cycle patterns.	
Chapter 8	**Rhodoophyta:(Red algae)**	**3Lectures**
	8.1 Distinguishing characters. 8.2 Comparative study of thallus morphology, anatomical peculiarities, reproduction and life cycle patterns.	
Chapter 9	**Diatoms**	**2Lectures**
	9.1 Xanthophyta 9.2 Bacillariophyta 9.3 Chrysophyta	
Chapter 10	**Lichens**	**4Lectures**
	10.1 History of Lichenology 10.2 Types and classification of lichens, nature of association 10.3 Morphology and anatomy of lichen thallus, reproduction	

	10.4 Economical and ecological importance	
Chapter 11	**Fungi**	**4Lectures**
	11.1 Outline of classification of fungi 11.2 Recent studies of fungi in India 11.3 Distinguishing characters 11.4 Thallus: unicellular and multicellular filamentous, nutrition, cell structure, hyphal modifications in fungi, phylogeny of fungi 11.5 Economic importance	
Chapter 12	**Myxomycotina and Mastigomycotina**	**3Lectures**
	12.1 Myxomycotina: Distinguishing characters, comparative study of structure of thallus and reproductive bodies, life cycle pattern 12.2 Mastigomycotina: Distinguishing characters, comparative study and Evolution of thallus structure and reproduction (asexual and sexual), Life cycle pattern in Chytridiomycetes and Oomycetes	
Chapter 13	**Zygomycotina**	**2Lectures**
	13.1 Zygomycotina - Distinguishing characters, thallus structure, heterothallism and sexual reproduction 13.2 Evolution of asexual reproduction 13.3 Life cycle pattern	
Chapter 14	**Ascomycotina**	**3Lectures**
	14.1 Distinguishing characters. 14.2 Comparative study of thallus structure, evolution of sexuality, 14.3 Concept of hamathecium and centrum, fructifications. 14.4 Life cycle pattern in Hemiascomycetes and Euascomycetes	
Chapter 15	**Basidiomycotina**	**3 Lectures**
	15.1 Distinguishing characters. 15.2 Thallus structure, types and structure of basidia and basidiocarps. 15.3 life cycle pattern in Teliomycetes, Hymenomycetes and Gasteromycetes	
Chapter 16	**Deuteromycotina**	**2Lectures**
	16.1 Distinguishing characters 16.2 Thallus structure, fructifications, types of conidia, conidial ontogeny 16.3 Life cycle patterns	

Chapter 18	**Bryophytes**	**2Lectures**
	17.1 Outline of Classification of Bryophyte. 17.2 Contributions of any three Bryologists from India	
Chapter 19	**Hepaticopsida**	**3Lectures**
	19.1 Distribution 19.2 Distinguishing Characters 19.3 Morphology and anatomy of gametophyte and sporophytes of liverworts, Takaiales, Jungermanniales, Marchantiales, Sphaerocarpales	
Chapter 20	**Anthocerotopsida**	**3Lectures**
	20.1 Distribution. 20.2 Distinguishing Characters 20.3 Morphology and anatomy of gametophyte and sporophyte in Anthocerotales, Biological importance of *Anthoceros* sporophyte	
Chapter 21	**Bryopsida/Musci**	**4Lectures**
	21.1 Distribution 21.2 Distinguishing Characters 21.3 Morphology and anatomy of gametophyte and sporophytes of Sphangnales, Funariales, Polytrichales, ,Eubryales.	
Chapter 22	**Discussion/guidance of experiential learning through field work**	**1Lectures**

References:

1. **Brodie J. and Lewis J. (2007).** (Ed.) Unravelling the algae: the past, present and future of algal systematics. CRC press, New York,
2. **Bellinger E.G. and Sigee D.C. (2010).** Freshwater algae: Identification and use asbioindicators, Willey-Blackwell, UK.
3. **Cole K.M. and Sheath R.G. (1990).** Biology of the red algae. Cambridge UniversityPress.USA.
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14. **Alexopolous C.J., Minms C.W. and Blackwell M. (1999).** (4th edn) IntroductoryMycology. Willey, New York, Alford R.A.
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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP102

Course Name: Cell Biology and Evolution

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- A student should know basic concept of cell.

Course Objectives:

- To study ultrastructure of cell organelles and functions
- To learn basic metabolism of cell
- To understand advanced trends of cell biology

Course Outcome:

On completion of the course, student will be able to

- understand the structure and functions of cell organelles
- understand the metabolism of cell organelles
- Grasp the current trends in cell Biology

Course Content

Chapter 1	**Cell Wall**	**3Lecture**
	1.1 Biogenesis, ultra-structure and functions 1.2 Growth- primary and secondary cell wall.	
Chapter 2	**Cell membranes**	**4 Lecture**
	2.1 Molecular organization, fluid mosaic model, membrane protein diffusion 2.2 Electrical properties of membranes transport across membranes, facilitated diffusion, carrier and channel proteins, transporters, active transport, transport of ions and solutes	
Chapter 3	**Cell Organelles-I**	**8Lecture**
	3.1 Endoplasmic reticulum: Ultra structure of ER, Role in synthesis and transport of secretary proteins **3.2 Golgi complex:** Ultra structure of golgi complex, Role in sorting, storage and secretion	

	3.3 Lysosomes: Ultra structure of lysosomes, membrane integrity and role **3.4 Glyoxysomes and Peroxisomes:** Structure and functions Ultra structure of Chloroplast and Mitochondria. Molecular organization and biogenesis of chloroplast and mitochondrial membrane	
Chapter 4	**Cell organelles-II**	**7 Lecture**
	4.1 Nucleus: Structure, Organization and regulation of nuclear pore complex, Transport across nuclear membrane **4.2 Ribosome:** Structure, assembly and dissociation of subunits, function **4.3 Vacuoles:** biogenesis, transporters, Mechanism of sorting and regulation of intracellular transport, Role as storage organelle, Transport across vacuolar membrane	
Chapter 5	**Cytoskeleton and Signal Transduction**	**8 Lecture**
	5.1 Cytoskeleton: Composition and organization of microtubules, microfilaments, signaling and intracellular traffic, Role in motility, flagella- Structure and organization, Intermediate filaments. **5.2 Plasmodesmata:** Structure and role in movement of molecules, virus transport **5.3 Signal Transduction:** Types of receptors, G-proteins and G-protein coupled receptors **5.4 Signaling mechanisms:** Phospholipid signaling, Ca^{2+}, Calmodulin cascade, Diversity in protein kinases and phosphatases, secondary messengers, regulation of signaling pathways Specific signaling mechanisms with suitable examples- Biotic and abiotic stress, ABA induced stomatal closure, Stomatal guard cell signaling 5.4.1 Nuclear- organelle signaling during plastid development 5.4.2Receptor Serine/ Threonine kinase, Ethylene mediated two component system	
Chapter 6	**Cell Cycle**	**8 Lecture**
	6.1 Phases of cell cycle, functional importance of each phase, Molecular events during cell cycle, 6.2 Regulation of cell cycle, Cyclins and protein kinases, MPF (Maturation promoting factor), 6.3 Methods to study cell cycle- labeled mitotic curve, flow cytometry, use of mutants.	
Chapter 7	**Cell aging and cell senescence**	**7 Lecture**
	7.1 Programmed cell death:molecular aspects, regulation of cell death, PCD in response to stress 7.2 Apoptosis: Role of different genes, cell organelles during apoptosis, genetic control of apoptosis	
Chapter 8	**Origin of Life**	**3 Lecture**
	8.1 Emergence of evolutionary thought: Steps and preview of	

	evolution, Lamarkism 8.2 Darwinism- concepts of variation, adaption, struggle for fitness and natural selection; Neuo Darwinism, Spontaneity of mutations 8.3 The evolutionary synthesis	
Chapter 9	**Theories of Evolution**	**4 Lecture**
	9.1 Origin of cells and unicellular evolution: Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers 9.2 Concepts of Oparin and Halden, Miller Experiment (1953), The first cell, evolution of prokaryote, origin of eukaryotic cells, evolution of unicellular eukaryotes, anaerobic metabolism 9.3 Photosynthesis and aerobic metabolism, RNA world theory	
Chapter 10	**Molecular Evolution**	**3Lecture**
	10.1 Concepts of natural evolution, molecular clocks, molecular tools in phylogeny 10.2 Protein and nucleotide sequence analysis, origin of new genes and proteins, gene duplication and divergence	
Chapter 11	**The mechanism of evolution**	**4 Lecture**
	11.1Population genetics: Types of population's gene pool, gene frequency, 11.2 Hardy-Weinberg law, Concepts natural selection, Changes in gene frequency through, migration and random genetic drift. Adaptive radiation and modification, isolation mechanism. Speciation-allopatric sympatric, and parapetric, convergent evolution and co-evolution	
Chapter 12	**Discussion/guidance of experiential learning through field work.**	**1 Lecture**

References:

1. **Alberts B., Bray D., Lewis J., Raff M., Roberts K., Watson J.D. (1989).** Molecular Biology of the Cell. 2nd Edn. Garlan Publ. Inc. New York.
2. **Karp G. (1999).** Cell and Molecular Biology- Concept and Expts. John Wiley and ScneIne., USA.
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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP103
Course Name: Plant Metabiolism

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite:

- A student should have a basic knowledge ofPlant Physiology.

Course Objectives:

- To understand the interaction between the environment and plant growth
- To study the metabolic and physiological processes in plants

Course Outcome:

On completion of the course, student will be able to–

- understandinterrelationship between plant metabolism and development
- understand several major areas of active investigation in contemporary plant biology

Course Content

Chapter 1	**Introduction to metabolism and energy**	**3 Lectures**
	1.1 The flow of energy in living system 1.2 The laws of thermodynamics and concepts of free energy 1.3 ATP: The energy currency of cell. 1.4 The natures of metabolism	
Chapter 2	**Solute transport**	**3Lectures**
	2.1Transport of ions across membranes 2.2 Membrane transport processes and proteins 2.3 Ion transport in roots	
Chapter 3	**Photosynthesis**	**9 Lectures**

	3.1 Chloroplast and photosynthetic pigments system 3.2 Concept of photosynthetic unit 3.3 Hill reaction 3.4 Oxygenic and anoxygenic photosynthesis 3.5 Stages of photosynthesis 3.6 Photorespiration 3.7 C_3 and C_4pathways 3.8 CAM pathway	
Chapter 4	**Sensory photobiology**	**3Lectures**
	4.1 Plant responses to light and gravity, mechanical stimuli, water and temperature. 4.2 Role of PGRsinsensory system.	
Chapter 5	**Plant water relations**	**4Lectures**
	5.1 Soil water and its absorption by roots 5.2 Transport of water 5.3 Water movement from the leaves to the atmosphere 5.4 An overview of the soil–plant–atmosphere continuum	
Chapter 6	**Respiration**	**8Lctures**
	6.1Glycolysis 6.2 Fermentation 6.3 Aerobic respiration 6.4 Shuttle system 6.5 Electron transport chain and oxidative phosphorylation 6.6 Respiratory quotient and respiratory substrate 6.7 Glyoxylate cycle 6.8 Pentose phosphate pathway	
Chapter 7	**Stress physiology**	**5Lectures**
	7.1 Response of plant to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses 7.2 Mechanism of resistance to biotic stress and tolerance to abiotic stress 7.3 Physiological process affected by drought 7.4 Mechanism of drought tolerance	
Chapter 8	**Plant growth regulators**	**7Lectures**
	8.1Classification 8.2 Site of synthesis 8.3 Biosynthetic pathways of PGRs and	

	their metabolism 8.4 Influence of auxins, gibberellins, cytokinins, ethylene and abscisic acid on plant growth and development 8.5 Introduction to Brassinosteroids, Triacontanol, Phenols Polyamines, and Jasmonates 8.6 Concept of death hormone	
Chapter 9	**Seed germination flowering &fruit ripening**	**3Lectures**
	9.1 Metabolic changes during seed germination 9.2 Seed viability and seed dormancy 9.3 Means to overcome seed dormancy 9.4 Initiation of flowering	
Chapter 10	**Secondary metabolites and plant defense**	**4Lectures**
	10.1 Secondary metabolites-structure and synthesis 10.2Induced plant defenses against insect and herbivores 10.3Plant defenses against pathogens	
Chapter 11	**Post-harvesttechnology of fruits**	**4 Lectures**
	11.1 Physiological changes during ripening 11.2Artificial v/s natural ripening of fruits 11.3Fruit preservation 11.4Role of ethylene in post-harvest technology 11.5Cold chain 11.6Centralised packing operations	
Chapter 12	**Equipmentused in plant metabolism study**	**5Lectures**
	Working and Principle of: 12.1Grain moisture meter (Capacitance meter) 12.2Turbidity meter (PAR meter) 12.3Chlorophyll fluorometer 12.4Lux meter 12.5Infrared pyrometer 12.6Infrared gas analyzer (IRGA) 12.7Leaf area meter 12.8Portable pigment analyzer	
Chapter 13	**Discussion/guidance on experiential learning through field work**.	**2 Lectures**

References:

1. Noble P.S. (2009). Physicochemical and Environmental Plant Physiology, 4rth edition, Academic Press, San Diego , USA
2. Salisbury F.B. and Ross C.W. (2009). Plant Physiology, 4rth edition, Australia Cengage Learning.
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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP104

Course Name: Botanical Techniques

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- A student should have basic knowledge of equipment's

Course Objectives:

- To study principles and application of equipment's used in life science

Course Outcome:

On completion of the course, student will be able to:

- Know the principles and application of equipment's

Course Content

Chapter 1	**Microscopy**	**8Lecture**
	1.1 Image formation (properties of light), Lens- refraction, dispersion of light, objects, images, image quality, magnification concept, resolution 1.2 Light microscopy, Confocal microscopy, Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy (SEM and TEM), Flow cytometry	
Chapter 2	**Microtomy,Histochemical and Cytochemical techniques**	**7 Lecture**
	2.1 Dissection, maceration, squash, peeling and whole mount-pretreatment andprocedures 2.2 Serial sectioning, double or multiple staining, Lesser assisted Microtomy 2.3 Localization of specific Compounds/reactions/ activities in tissues and cells	
Chapter 3	**Chromatography techniques**	**8 Lecture**
	3.1 Introduction, concept of partition coefficient, Paper, TLC, Column, Gel filtration 3.2 Affinity, Ion exchange, HPLC 3.3 Gas chromatography (Principle, method and applications of each)	
Chapter 4	**Electrophoretic techniques**	**7 Lecture**

	4.1 History, Principles, Agarose gel electrophoresis, Pulsed Field Gel Electrophoresis, Polyacrylamide Gel Electrophoresis (PAGE/ Native) 4.2 Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis (SDS-PAGE/ Denaturing), 4.3 Isoelectric focusing, 2Dimensional Gel Electrophoresis (2-D method)	
Chapter 5	**Spectroscopic techniques**	**9 Lecture**
	5.1 General principles, Beer and Lambert's Law, Molar extinction coefficient, Spectrophotometer (working and application) 5.2 UV-Visible spectroscopy, Nuclear Magnetic 5.3 Resonance (NMR) spectroscopy, 5.4 X-ray crystallography, Spectro-flurometry 5.5AAS, MS, IR Spectroscopy	
Chapter 6	**Radioactive techniques**	**6 Lecture**
	6.1 Radioisotopes used in biology and their properties 6.2 Units of radioactivity, Interaction of radioactivity with matter, 6.3Detection and measurement of radioactivity, Autoradiography 6.4Safe handling of radio isotopes, Non-Radio labeled techniques	
Chapter 7	**Centrifugation techniques**	**4 Lecture**
	7.1 Principles, Rotors, Factors affecting centrifugation, Ultra-centrifugation, 7.2 Density Gradient Centrifugation, High speed centrifuges	
Chapter 8	**Electrochemical techniques**	**3 Lecture**
	8.1Electrical conductivity 8.2pH meter, 8.3Oxygen electrode	
Chapter 9	**Immunological techniques**	**4 Lecture**
	9.1 Principles, Antigen–antibody interaction, 9.2 Immuno diffusion, Immuno precipitation, 9.3Radio-immuno assay, Rocket immumo-electrophoresis, ELISA	
Chapter 10	**Molecular biology techniques**	**4 Lecture**
	10.1 DNA sequencing techniques- Sanger's method, 10.2 Maxam- Gilbert's mehod, Automated DNA sequences, Pyrosequencing, 10.3 Sequencing of proteins, PCR, 10.4 DNA microarray	
Chapter 11	**Discussion/guidance of experiential learning through field work.**	**1 Lecture**

References:

1. **P. Gunadegaram**(1995). Laboratory Manual in Microbiology. New AgeInternational (P) Ltd.
2. **Srivistava M.L.** (2008). Bioanylatical Techniques. Narosa Publishing House (P)Ltd.
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11. **Egerton R.F.** Physical Principle of Electron Microscopy: an Introduction to TEM, SEM and AEM.
12. **Bisen P.S. Mathur S.** (2006). Life Science in Tools and Techniques. CBSPublishers, Delhi.
13. **Marimuthu R.** (2008). Microscopy and Microtechnique. MJP Publishers,Chennai.
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15. **Prasad and Prasad** (1984). Outline of Microtechnique. Emkay Publications,Delhi.
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17. **Annie and Arumugam**(2000). Biochemistry and Biophysics, Saras Publishing,Tamilnadu.
18. **Sass John E.** (1984). Botanical Microtechniques. Tata McGraw-Hill PublishingCompany Ltd.
19. **Pal and Ghaskadabi**(2009). Fundamentals of Molecular Biology.OxfordPublishing Co.

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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP105
Course Name: Practical

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Practicals based on Cryptogamic Botany I (Algae, Fungi, Lichens and Bryophytes)

Algae(24 Practicals)

1. Morphological observations, documentation (description and illustrations) andclassification according to Fritsch with reasons of taxa belonging to (At least oneexample from each order):

- Chlorophyta- Any eight forms, Charophyta - Any two forms 3P
- Phaeophyta - Any five forms 1P
- Rhodophyta - Any five forms 1P
- Cyanophyta- Any five forms 1P
- Minor Groups - Any three forms 1P

Note: Collection tour to any marine/oceanic habitat to collect algae is compulsory

Fungi

1. Preparation of cotton blue, Lactophenol and culture medium - PDA 1P
2. Study of Lichens -Any three forms 1P
3. Study of representative genera belonging to following subdivisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth et al. (1973) (At least one example from each class):

- Myxomycotinaand Deuteromycotina-Any three forms 1P
- Mastigomycotinaand Zygomycotina- Any five forms 1P
- Ascomycotina - Any five forms 2P
- Basidiomycotina- Any five forms 2P

Note: Collection tour to any forest to observe, collect fungi and lichens and submission of ten specimens and excursions report is compulsory.

Bryophytes

Morphological, anatomical and reproductive studies of Bryophytes:

1.Hepaticopsida*: Asterella, Plagiochasma, Marchantia, Targionia, Cyathodium, Fossombronia,* Pallavicinia, *Riccardia* and *Metzeria, Porella* and *Fruillania* (Any six forms) 5P

2. Anthocerotopsida: *Anthoceros* and *Notothylus.* 1P

3. Musci: *Sphagnum, Funaria, Polytrichum, Pogonatum, Bryum* (Any four forms) 2P

Note: Excursion report on studies of Bryophytes from Western Ghat is compulsory. Submission of any five photographs of Bryophytes form each

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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP106

Course Name: Practical

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

(24Practicals)

Practicals based on Cell Biology and Evolution

1. Isolation of Chloroplasts to study: 4P
   - Hill reaction to measure intactness
   - Chlorophyll estimation

2. Isolation of mitochondria for: 2P
   - Estimation of succinic dehydrogenase activity

3. Estimation of acid phosphatase activity. 2P
4. Study of Electron Micrographs of cell organelles. 2P
5. Isolation of protoplasts and viability staining to determine % viability. 2P
6. Cytochemical / Histochemical studies of special cell types: guard cells, senescent cells, bundle sheath cells, meristematic cells, laticiferous cells, glandular cells, pollen grains. 4P
7. Study of induced cell senescence in leaf discs. 2P
8. Isolation of lysosomal fraction and estimation of acid phosphatase activity. 2P
8. Study of different plant fossils with respect to evolution- 2P
   - Impression
   - Compression
   - Petrification
   - Coal ball

9. Geological Time Scale 2P

Progressive Education Society's

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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP201

Course Name: Cryptogamic Botany II-Pteridophytes, Gymnosperms and Paleobotany

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- Student should have basic knowledge of classification of Bryophytes and Pteridophytes

Course Objectives:

- To study general characteristics of each group with one example each
- To learn evolutionary relationship between the taxa
- To be expertise in field work

Course Outcome:

On completion of the course, student will be able to–

- Identify and classify the biological specimens in nature
- Collect, preserve and have his own start up

Course Content

Chapter 1	**Pteridophytes**	**5Lectures**
	1.1 Distinguishing characters. Apospory, Apogamy, parthenogenesis, Telome theory, Stelar and soral Evolution 1.2 Gametophytes in Pteridophytes- homosporous and heterosporous	
Chapter 2	**Classification of Pteridophytes**	**5 Lectures**
	2.1 Outline of Classification of pteridophytes. 2.2 Economic importance of pteridophytes.	
Chapter 3	**Psilopsida**	**5Lectures**
	3.1 Distribution 3.2 Distinguishing characters 3.3 Comparative study of sporophyte and gametophyte of *Psilotum* and *Tmesipteris*	
Chapter 4	**Lycopsida**	**5Lectures**

	4.1 Distribution 4.2 Distinguishing characters 4.3 Affinities, comparative study of sporophyte and gametophyte of Lycopodiales, Selaginellales, Isoetales, Life cycle patterns	
Chapter 5	**Sphenopsida**	**5Lectures**
	5.1 Distribution 5.2 Distinguishing characters 5.3 Comparative study of sporophyte and gametophyte, Life cycle Pattern Equisetales	
Chapter 6	**Pteropsida/Filicophyta**	**5Lectures**
	6.1 Distribution 6.2 Distinguishing Characters 6.3 Comparative study of sporophyte and gametophyte of order OphioglossalesOsmundales ,Filicales ,Marsileales ,Salviniales	
Chapter 7	**Classification Gymnospermns**	**10Lectures**
	7.1 Outline classification of Spermatophyta. 7.2 Gymnosperm classification as per Sahni (1920), Chamberlain (1934), Raizda and Sahni (1960), Sporne (1965) and Bierhorst (1971) 7.3 Distribution of gymnosperms- Worldwide and in India, Economic aspects of gymnosperms	
Chapter 8	**General characters**	**5Lectures**
	8.1 Affinities, morphology of sporophytes and gametophytes of living gymnosperm orders 8.1.1 Cycadales 8.1.2Ginkgoales 8.1.3 Coniferals 8.1.4Gnetales, Ephedrales and Welwitschiales	
Chapter 9	**Paleobotany- Fossil Pteridophytes**	**7Lectures**
	9.1 Psilopsida :- *Rhynia* 9.2 Lycopsida :- *Lepidodendron, Lepidophyllum, Stigmaria, Lepidostrobus, Lepidocarpon, Sigillaria.* 9.3 Sphenopsida :- *Calamites, Annularia, Calamostach, Cheirostrobus.*	
Chapter 10	**Paleobotany- Fossil Gymnosperms**	**7Lectures**
	10.1Cycadeoidales: General characters, structure of *Cycadeoidea* and *Williamsonia* 10.2 Pentoxylales: General characters, Pentoxylon, structure of secondary wood, male and female strobili, and contribution of Birbal	

	Sahni 10.3Cordaitales:General characters, structure of *Cordaites*and *Cordaitanthus*	
Chapter 12	**Discussion/guidance of experiential learning through field work**	**1 Lectures**

References:

1. **Bhatnagar S.P and MoitraAlok 1996**. Gymnosperms. New Age International Pvt. Ltd. Publishers, New Delhi, 470 pp.
2. **Biswas C and Johari B.M 2004.** The Gymnosperms Narosa Publishing House, New Delhi. 497 pp.
3. **Sporne K.R 1965.** The Morphology of Gymnosperms London, pp. 216.
4. **Bierhorst D.W. 1971.** Morphology of Vascular Plants. New York and London.
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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP202

Course Name: Molecular Biology

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite Courses:

- A student should have a basic knowledge of molecularbiology

Course Objectives:

- To study the theoretical concepts and experimental techniques of molecular biology.
- To learnmechanism of prokaryotic and eukaryotic mechanisms of storage, retrieval and manipulation of genetic information.

Course Outcome:

On completion of the course, student will be able to–

- Understand molecular biology of prokaryotic and eukaryotic organisms.
- Understand the mechanisms and need of regulation of gene expression

Course Content

Chapter 1	**Structure and properties of nucleic acids**	**6 Lectures**
	1.1 Chemical and physical structures of nucleic acids 1.2 Spectroscopic and thermal properties of nucleic acids. (e.g. Buoyant density, melting temperature, effect of acid and alkali, UV absorption, hypo and hyperchromicity) 1.3 Dissociation and reassociation kinetics of DNA 1.4 C-value paradox 1.5 Cot curves, Cot ½ values and their significance 1.6 Unique, moderately repetitive and highly repetitive DNA 1.7 Forms of DNA. (A, B, C, Z) 1.8 RNA as a genetic material	
Chapter 2	**Organisation of genetic material**	**2Lectures**

	2.1 Packaging of genome in viruses and bacteria 2.2 Organelle genome organization 2.3 Structure of chromatin, nucleosome packaging, histone modification, chromosome organisation	
Chapter 3	**DNA replication**	**4Lectures**
	3.1 Mechanism of prokaryotic and eukaryotic DNA replication, replication apparatus 3.2 Origins of replication, priming and DNA polymerases 3.3 Models for mechanism of replication for circular DNA: Rolling circle and theta (Ø) models 3.4 Fidelity of replication 3.5 Extrachromosomal replications, DNA modification and DNA restriction	
Chapter 4	**DNA damage and repair**	**3Lectures**
	4.1 Types of DNA damage 4.2 Enzymes involving in repairing of DNA damages 4.3 Type of DNA repair 4.4 Photoactivation, excision repair, recombination repair and mismatch repair systems, SOS repair	
Chapter 5	**Gene structure**	**5Lectures**
	5.1Structure and organization of prokaryotic and eukaryotic genes 5.2Structure and role of promoters, exons, introns, terminators and enhancers.	
Chapter 6	**Transcription**	**5Lectures**
	6.1 RNA polymerases and their role 6.2 Transcription apparatus 6.3 Transcription in prokaryotes and eukaryotes- Initiation, elongation and termination	
Chapter 7	**Processing of RNA**	**5 Lectures**
	7.1 Processing of tRNA, rRNA, RNA editing, capping, methylation, polyadenation and splicing 7.2 Ribonucleoproteins 7.3 Structure of mRNA- RNA transcript, RNA damage and RNA repair	
Chapter 8	**Protein synthesis**	**6Lectures**

	8.1 Structure of mRNA, rRNA, tRNA and ribosomal assembly 8.2 Mechanism of protein synthesis in prokaryotes and eukaryotes: initiation, elongation and termination 8.3 Translational and post translational control	
Chapter 9	**Post translational modifications of proteins**	**6Lectures**
	9.1 Targeting of organelle proteins 9.2 Protein folding and processing 9.3 Chaperones and chaperonins	
Chapter 10	**Regulation of gene expression**	**3Lectures**
	10.1Operon concept (Lac, Tryptophan, Arabinose) 10.2Positive and negative regulation of prokaryotic genes 10.3Role ofeukaryotic transcription factors	
Chapter 11	**Techniques used in molecular biology**	**8Lectures**
	11.1RT Polymerase Chain Reaction 11.2Blotting techniques 11.3Mass-spectrometry	
Chapter 12	**Promotor characterization**	**5Lectures**
	12.1Promotor analysis through reporter genes 12.2Electrophoretic mobility shift assay 12.3DNA foot-printing	
Chapter 13	**Discussion/guidance of experiential learning through field work.**	**2Lectures**

References:

1.Buchanan B.B, Gruissem W. and Jones R.L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologistsm Maryland, USA.
2. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) (1997). Plant Metabolism (Second Edition) Longman, Essex, England.
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5. Leninger A.C. (1987). Principles of Biochemistry, CBS Publishers and Distributers (Indian Reprint)

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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP203
Course Name: Genetics and Plant Breeding

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite:

- A student should have a basic knowledge of genetics and plant breeding.

Course Objectives:

- To study the mechanism of inheritance
- To understand the concept, methodology and applications of plant improvement

Course Outcome:

On completion of the course, student will be able to–

- Work in seed industry as Technician and Assistant Plant Breeder

Course Content

Chapter 1	**Principles of mendelian inheritance and interaction of genes**	**6Lectures**
	Introduction to genetics 1.1 Early concepts of inheritance 1.2 Mendel's Laws - Dominance, Segregation, Independent assortment, Chi Square test and probability 1.3 Interaction of genes- Complementary, epistasis, inhibitory, polymeric and additive 1.4 Chromosomal theory of inheritance 1.5 Concept of gene, allele, multiple allele, pseudo allele- complementation tests	
Chapter 2	**Cytoplasmic inheritance:**	**3Lectures**
	2.1 Mitochondrial and chloroplast genomes 2.2 Inheritance of chloroplast genes (*Mirabilis jalapa* and *Zea mays*) 2.3 Inheritance of mitochondria genes (Petite yeasts, cytoplasmic male	

	sterility in plants) 2.4 Interaction between nuclear and cytoplasmic genes 2.5 Maternal effect in inheritance (*Limnaea peregra*)	
Chapter 3	**Quantitative inheritance and Inheritance of complex traits**	**4Lectures**
	3.1 Quantitative traits, Continuous variation 3.2 Inheritance of quantitative traits, (Polygenic traits) - corolla length in *Nicotiana*, cob length in *Zea mays* 3.3 Introduction to complex traits 3.4 Heritability and its measurement 3.5 Marker assisted selection	
Chapter 4	**Population genetics**	**2Lectures**
	4.1 Hardy Weinberg's Law 4.2 Factors affecting gene and gene frequencies	
Chapter 5	**Recombination, linkage and mapping in eukaryotes**	**11Lectures**
	5.1 Linkage and crossing over 5.2 Recombination: homologous and non-homologous, Inducing transposition site specific recombination 5.3 Genetic markers 5.4 Linkage maps, lod score for linkage testing, mapping by 3-point test cross 5.5 Mapping by tetrad analysis in *Yeast* (unordered) and *Neurospora* (ordered)	
Chapter 6	**Mutation**	**4 Lectures**
	6.1 Mutation- causes and detection 6.2 Types of Mutation- lethal, conditional, biochemical, loss and gain of function 6.3 Germinal v/s somatic mutants 6.4 Insertional mutagenesis 6.5 Point mutagenesis	
Chapter7	**Microbial genetics**	**3Lectures**
	7.1 Methods of genetransfers- transformation, conjugation and transduction in bacteria and genetic recombination 7.2 Mapping of bacterial genome by interrupted mating 7.3 Mutant phenotypes	
Chapter 8	**Phage genetics**	**3Lectures**

	8.1 Lytic and lysogenic cycles in phages 8.2 Genetic recombination- general and specialized transduction, site specific recombination in phage 8.3 Mapping the bacteriophage genome 8.4 Fine structure analysis of rII gene in T4 bacteriophage 8.5 Phage mutants	
Chapter 9	**Karyotype**	**2Lectures**
	9.1 Structure and organization of chromosome, Concept of karyotype and idiogram 9.2 Chromosome banding 9.3 Preparation of chromosome for karyotype analysis 9.4 Karyotype evolution 9.5 Role of karyotype in identificationof plant species	
Chapter 10	**Numerical alterations of chromosomes**	**4 Lectures**
	10.1Concept of polyploidy 10.2Classification of polyoploidy, cytological and genetical method of identification of autopolyploids and allopolyploids 10.3Classification, method of production, identification and meiotic behavior of aneuploids (Monosomics, Nullisomics and trisomics)	
Chapter 11	**Structural alterations of chromosomes**	**3 Lectures**
	11.1 Deletion, duplication, inversion, translocation, complex translocation heterozygotes 11.2Robertsonian 11.3 BA translocations	
Chapter 12	**Plant breeding**	**1Lectures**
	12.1Pre and post mendelian development 12.2Objectives of plant breeding 12.3Plant breeding in India 12.4Patterns of evolution in cultivated crops	
Chapter 13	**Plant genetic resources**	**2Lectures**
	13.1 Centers of origin, distribution and areas of diversity 13.2 Importance of genetic diversity in crop improvementand erosion of genetic diversity 13.3Importance of genetic diversity in	

	conservation and regulation.	
Chapter 14	**Reproductive systems, population structure and breeding strategies**	**2Lectures**
	14.1 Sexual reproduction (Cross and self-pollination) 14.2Asexual reproduction 14.3Pollination control mechanisms and implications of reproductive system on population structures 14.4 Genetic structure of populations	
Chapter 15	**Selection methods**	**4 Lectures**
	15.1 Selection methods in self-pollinated crops 15.2 Selection methods in cross pollinated crops 15.3Selection methods in asexually propagated crops	
Chapter 16	**Hybridization**	**3Lectures**
	16.1Hybridization and its role 16.2Inter-varietal and wide/distant crosses 16.3Principles of combination breeding and its application	
Chapter 17	**Induced mutations in crop plants**	**1Lectures**
	17. 1 Physical and chemical mutagens used for induction of mutations, chimeras 17.2 General method of induction of mutations in crop plants 17.3Role of induced mutations 17.4 Induction of polyploidy in crop plants 17.5 Role of polyploidy in plant breeding	
Chapter 18	**Discussion/guidance of experiential learning through field work.**	**2Lectures**

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1. Albert B. Bray, D Lewis, J Raff, M. Robert, K. and Walter 1989, MolecularBiology of the Cell (Second Edition) Garland Publishing Inc, New York.
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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP204
Course Name: Biochemistry

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisite:

- A student should have basicknowledge of structure of atoms, molecules, and their functions, and various life processes

Course Objectives:

- To study the molecular composition of living cells, the organization of biological molecules within the cell, and the structure and function of these biological molecules.
- To learnthe synthesis of proteins, lipids, nucleic acids, and carbohydrates and their role in metabolic pathways

Course Outcome:

On completion of the course, student will be able to:

- Understand the behavior of biological macromolecules
- Understand enzymes and cellular dynamics

Course Content

Chapter 1	**Water and buffers**	**3 Lectures**
	1.1 Structure and properties of water 1.2 Water as biological solvent 1.3 Ionization of water, acids and bases, pH, buffers	
Chapter 2	**Bioenergetics**	**3Lectures**
	2.1 Structure of atoms, molecules and chemical bonds 2.2 Principles of thermodynamics 2.3 Concept of free energy, changes in free energy during chemical reactions, entropy and enthalpy 2.4 Redox potentials 2.5 Dissociation and associations constants 2.6 Activation energy andbinding energy	

Chapter 3	**Enzymology**	**5 Lectures**
	3.1 Classification and properties of enzymes, units of enzyme activity, factors affecting enzyme activity 3.2 Enzyme Kinetics- substrate concentration and rate, Michaelis – Menton equation 3.3 Competitive, uncompetitive and non-competitive inhibitors 3.4 Covalent and allosteric regulation. coenzymes, isoenzymes and co-factor	
Chapter 4	**Carbohydrates**	**4Lectures**
	4.1 General classification, structure, general properties and functions of polysaccharides and complex carbohydrates 4.2 Synthesis and breakdown of carbohydrates (starch, glycogen and pectin)	
Chapter 5	**Amino acids and proteins**	**8Lectures**
	5.1 General classification of amino acids and proteins 5.2 Structure, synthesis and properties of amino acids 5.3 Proteins – Peptide synthesis: chemical and Merrifield synthesis. Primary (peptide conformation, N- and C- terminal, peptide cleavage), Secondary (α-helix, beta sheets, and random coil,), tertiary and quaternary structures of proteins 5.4 Ramachandran plot	
Chapter 6	**Metabolism of nucleic acids**	**7Lectures**
	6.1 Structure and function of nucleotides. 6.2 Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA, RNA, Purines, Pyrimidines, their biosynthesis and metabolism	
Chapter 7	**Nitrogen metabolism**	**3Lectures**
	7.1 Importance of nitrogen in biological systems, nitrogen cycle 7.2 Nitrogen fixation; symbiotic and non-symbiotic, nitrogenase complex, energetics and regulation 7.3 Formation of root nodules in legumes 7.4 Assimilation of nitrate and ammonium ion	
Chapter 8	**Secondary metabolites**	**5Lectures**

	8.1 General classification of major pathways 8.2 Phenolics (Lignins, tannins) Flavonoids, terpenoids (steroids), Alkaloids, pigments (Carotenoids, Anthocynins)	
Chapter 9	**Lipid metabolism**	**7 Lectures**
	9.1 Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins, proteolipids, phosphatidopeptides and lipopolysaccharides	
Chapter 10	**Radioactivity**	**5 Lectures**
	10.1 Radioactivity measuring techniques and correction factors 10.2Application of isotopes in biochemical analysis, isotope dilution techniques and autoradiography 10.3Radioisotopes in biochemistry and medicine	
Chapter 11	**Spectroscopy**	**8 Lectures**
	11.1 Concept of spectroscopy, electromagnetic spectrum 11.2 Beer – Lamberts law, principles and applications of colorimetry, UV-VIS spectrophotometry 11.3Concepts of fluorimetry, flame photometry, AAS, AES, Infrared, ESR, NMR, CD & ORD and X – ray diffraction 11.4Flowcytometry, cell sorting and their applications	
Chapter 12	**Discussion/guidance of experiential learning through field work.**	**2Lectures**

References:

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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP205
Course Name: Pracyical

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Course Code : 19**Sc**BotP205 **Course Name : Practical**

(24practicals)

Practicals based Pteridophytes, Gymnosperms and Paleobotany

Pteridophytes

A. Morphological, anatomical and reproductive studies of Pteridophytes:

1. Psilopsida: *Psilotum* and *Tmesipteris* (Figure of *Tmesipteris* must be shown) 1P
2. Lycoposida and Sphenopsida: *Lycopodium, Selaginella, Equisetum, Isoetes* 4P
3. Pteropsida: *Ophioglossum, Angiopteris, Osmunda, Salvia, Azolla, Marsilea, Lygodium, Pteris, Adiantum, Gleichenia, Cheilanthus, Blechnum, Acrostichum* 4P
4. Fossil Pteridophytes: Any eight forms (At least one from each group) 3P

Note: Collection and submission of any eight Pteridophytes and excursion report onstudies of Pteridophytes from Western Ghat is compulsory. Submissionof any five photographs of Pteridophytes form each group.

Gymnosperms

1. Study of external, internal and reproductive morphology of *Cycas* and Z*amia*. 2P
2. Study of external, internal and reproductive morphology of *Pinus,Cupressus, Araucaria, Agathis and Podocarpus.*(Any two) 3P
3. Study of external, internal and reproductive morphology of *Gnetum and Ephedra*. 3P
4. Study of fossil specimens of gymnosperm (any six) from order *Pteridospermales, Cycadeoidales* and *Pentoxylales***.** 4P

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First Year of M.Sc. (2019 Course)

Course Code: 19ScBotP206

Course Name: Practical

Teaching Scheme: TH – 4 hrs/week **No. of credits: 2**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

(18Practicals)

Practicals based on Biochemistry

1. Preparation of solution of different concentrations, buffers, conductivity and pH measurements. 1P
2. Enzyme assays- extraction and estimation of enzyme activity- Catalase amylase/lipase/peroxidase. 3P
3. Purification of enzyme by ammonium sulphate precipitation/gel filtration. 1P
4. Effect of pH and enzyme concentrations on enzyme activity. 2P
5. Effect of substrate concentration on rate of enzyme action and calculation of Km by Michalie's Menten Curve. 3P
6. Studies on induction of amylase activity by GA3 in germinating cereal grains. 2P
7. To perform colour test for carbohydrates (reducing and non-reducing sugars), lipids and proteins. 2 P
8. Isolation and estimation of chlorophylls and carotenoids. Separation of pigment using column chromatography. Determination of absorption spectra of each pigment. 2P
9. To separate amino acids by means of paper chromatography and TLC (thin layer chromatography) method. 2 P