RAJA NARENDRA LAL KHAN WOMEN'S COLLEGE
(AUTONOMOUS)

MIDNAPORE

Botany Syllabus for M.Sc. Degree

Choice Based Credit System (CBCS)

DEPARTMENT OF BOTANY [PG]

Raja Narendra Lal Khan Women's College
(Autonomous)

MIDNAPORE - 721102

COURSE STRUCTURE

SEMESTER	COURSE NO.	COURSE TITLES		Full Marks	Credit
I	BOT 101	MICROBIOLOGY		50	4
	BOT 102	PHYCOLOGY & BRYOLOGY		50	4
	BOT 103	MYCOLOGY & PLANT PATHOLOGY		50	4
	BOT 104	PTERIDOPHYTES & GYMNOSPERMS		50	4
	BOT 105	*BOT 105A*	MICROBIOLOGY	25	2
		BOT 105B	PHYCOLOGY & BRYOLOGY	25	2
	BOT 106	*BOT 106A*	MYCOLOGY & PLANT PATHOLOGY	25	2
		BOT 106B	PTERIDOPHYTES & GYMNOSPERMS	25	2
	TOTAL			300	24
II	BOT 201	ANGIOSPERM TAXONOMY & BIOSYSTEMATICS		50	4
	BOT 202	PALAEOBOTANY, PALYNOLOGY & PLANT REPRODUCTIVE BIOLOGY		50	4
	BOT 203	PLANT ANATOMY AND PHARMACOGNOSY		50	4
	C-BOT 204	*PLANTS AND SOCIETY-I (CBCS)*		50	4
	BOT 205	BOT 205A	ANGIOSPERM TAXONOMY & BIOSYSTEMATICS	25	2
		BOT 205B	PALAEOBOTANY, PALYNOLOGY & PLANT REPRODUCTIVE BIOLOGY	25	2
	BOT 206	BOT 206A	PLANT ANATOMY & PHARMACOGNOSY	25	2
		BOT 206B	FIELD SURVEY REPORT	25	2
	TOTAL			300	24
III	BOT 301	CELL BIOLOGY, GENETICS & BIOTECHNOLOGY		50	4
	BOT 302	PLANT PHYSIOLOGY, BIOCHEMISTRY& MOLECULAR BIOLOGY		50	4
	BOT 303	ECOLOGY & ENVIRONMENTAL BIOLOGY		50	4
	C-BOT 304	*PLANTS AND SOCIETY-II (CBCS)*		50	4
	BOT 305	BOT 305A	CELL BIOLOGY, GENETICS& BIOTECHNOLOGY	25	2
		BOT 305B	PLANT PHYSIOLOGY, BIOCHEMISTRY& MOLECULAR BIOLOGY	25	2
	BOT 306	BOT 306A	ECOLOGY & ENVIRONMENTAL BIOLOGY	25	2
		BOT 306B	SEMINAR	25	2
	TOTAL			300	24
IV	BOT 401	SILVICULTURE, FOREST MENSURATION, SILVICULTURE SYSTEM & FOREST MANAGEMENT		50	4
	For BOT 402 & BOT 403 (SPECIAL PAPER)				
	BOT 402	BOT 402A	ECOLOGY	50	4
	BOT 403	BOT 403A	BIODIVERSITY	50	4
	BOT 404	FOREST MENSURATION & SURVEY(practical)		25	2
	BOT 405	BOT 405A	ECOLOGY & BIODIVERSITY (practical)	50	4
	BOT 406	PROJECT WORK (SPECIAL PAPER BASED)		50	4
	BOT 407	GRAND VIVA		25	2
	TOTAL			300	24
	GRAND TOTAL			1200	96

List of Special Paper

1. **Ecology & Biodiversity**
    - **402A: Ecology**
    - **403A: Biodiversity**

Programme outcome: Plant sciences in the present day is a combination of basic and applied science. Conventional studies like plant identification is now being supplemented and augmented with molecular techniques like DNA Barcoding, Plant Genomics, rDNA Technology and so on. The courses have been designed to benefit all Botany students to study various aspects of plant science including its practical applications. Keeping in mind that these students can take up teaching at different levels, research work in research institutes and or industry, doctoral work, environment impact assessment, biodiversity studies, entrepreneurship, scientific writing relevant topics have been included in the curriculum. It is hoped that after completion of the syllabus they will be able to:

- Tackle practical problems with theoretical knowledge in Botany.
- Demonstrate research aptitude and training for laboratory works for basic botanical research.
- Develop competitive examination aptitude for NET / SET/ GATE and others
- Pursue research in institutes of National and International repute.
- Get absorbed in various career and job opportunities.

SEMESTER – I

THEORY

PAPER: BOT 101

Course Outcome: After effective completion of this course students are expected to be able to:

- Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures
- Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also understand the structural similarities and differences among various physiological groups of bacteria/archaea
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization
- Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae
- Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively
- Comprehend the various methods for identification of unknown microorganisms
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy
- Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.
- Know the various applications of microbial formulations for industrial uses, techniques like fermentation etc.
- In depth knowledge about Medical Microbiology including diseases, symptoms, cure etc.

MICROBIOLOGY **Full Marks: 50**

1. ***History:*** Six Kingdoms hypothesis (Woese et al.1977) & Three Domains concept (Woese et al. 1990); scopes and areas of microbiology.
2. ***Principle characteristics used in the classification and identification of microbes***.
3. ***Morphology:*** Ultrastructure & chemical nature of capsule; cell wall; flagella; pili; Nucleoids; inclusions bodies; reserve substances; endospore-structure and formation.
4. ***Nutrition of microbes:*** Classification with examples.
5. ***Growth:*** growth curve; generation time; synchronous cyclic batch culture & continuous growth.
6. ***Microbial metabolism:*** Respiration, fermentation pathway (ED pathway); Biological nitrogen fixation – symbiotic and non-symbiotic, Nitrogenase enzyme, *nif* genes, leghemoglobin and hydrogenase, *nod* genes, Nod factors.
7. ***Genetic recombination in bacteria:*** Plasmids and its types; conjugation, transformation, and transduction.
8. ***Viruses:*** Structural organization and chemistry of viruses; Virus purification and assays (hemagglutination and plaque assay); Replication of viral nucleic acids; Lytic and Lysogenic cycle; regulations of lysogeny; virusoids, viroids and prions; virus-induced cancer and oncogenesis.
9. ***Applied microbiology:*** Industrial production of organic acid, antibiotics, alcohol, wine and beer.
10. ***Immunology:*** Cells and organs of the immune system; Lymphocytes, Antigens, Antibodies, Immunoglobulin classes; their Structure and function; Polyclonal and monoclonal antibodies; Interferon, Vaccine; Agglutination (Widal test, latex agglutination test, Viral Hemagglutination).

PAPER: BOT 102

Course Outcome:

Phycology is an important branch of biology since algae is a vital part of aquatic ecosystem. They produce energy by photosynthesis, provide a food source for other organisms and also provide shelter and protection for small sea animals like fishes. Understanding the Biology of Algae is increasingly important in terms of Evolution as it can provide the foundation of the aquatic food chain and also important in Environment, Agriculture and Biotech industry. It encompasses parameters in classifying algae, algae in diversified habitats, salient features of different groups and their phylogeny and evolutionary tendencies as well as economic importance of algae. Algae can grow well in wastewater where other organisms would not survive. Phycologists have developed ways to clean up waste water naturally by using Algae. As the course includes both the fundamental and applied aspect of Phycology, the students will be benefitted by both. This can direct them towards research in phycology.

Bryology is the branch of Botany concerned with scientific study of bryophytes, the amphibians of plant kingdom. The course comprises of the outline of recent classification of bryophytes; origin evolution and fossil history, ecology physiology culture economic importance cytogenetics taxonomic implication, biotechnology of bryophytes. Practical studies of basic aspects of bryophytes are also included. Bryophytes are very important in initiating soil formation on barren terrain, in maintaining soil moisture and in recycling nutrients in forest vegetation. Hence, studying bryophytes will help in assessing the productivity and nutrient status of forest types.

PHYCOLOGY & BRYOLOGY **Full Marks: 50**

UNIT I: PHYCOLOGY Marks: 25

1. ***Parameters used in classifying algae:*** Classification and recent status of various algal groups; concept of Streptophyta and algal origin of land plants.
2. ***Algae in diversified habitats:*** Range in thallus organization; ultra-structure; physiology and biochemistry of algal cell; Endosymbiotic theory of origin of chloroplasts.
3. ***Salient features:*** Cyanobacteria, Chlorophyta, Heterokontophyta (Xanthophyceae, Bacillariophyceae, Phaeophyceae) and Rhodophyta with special emphasis on evolutionary tendencies and phylogeny.
4. ***Economic importance:*** Phycocolloids - agar-agar, alginic acid, carageenan; Reclamation of soil by algae; Single cell protein; Algae in pisciculture; source of hydrocarbon from algae; Pheromone in algae, pathogenic algae.

UNIT II: BRYOLOGY Marks: 25

1. ***Outline of recent classification of bryophytes into three coordinate phyla:*** Marchantiophyta (liverworts), Anthocerophyta (hornworts) and Bryophyta (mosses).
2. ***Origin, evolution and fossil history of bryophytes.*** Characteristics, affinities and systematic position of Calobryales, Takakiales and Sphagnales. Comparative study of the gametophyte and sporophyte of major groups with special reference to Indian forms.
3. ***Ecology, physiology, culture and economic importance of bryophytes;*** Role of bryophytes in plant succession and pollution monitoring. Bryophyte as site indicators; Bryomonitoring.
4. ***Cytogenetics of bryophytes,*** taxonomic implication of chromosome numbers and sex chromosome.
5. ***Bryophyte chemistry and taxonomic implications***
6. ***Biotechnology of Bryophytes.***

PAPER: BOT 103

Course Outcome:

This course offers a broad overview of **Mycology** which is the study of fungi including the basic knowledge about general features of this group of organisms. This course provides basic insights on general characteristics, life cycle, physiology, molecular basis of mating systems and vast use of fungi in biotechnology agriculture and forestry. Students can learn about the role of fungi in Biotechnology, food industry agriculture and pharmaceutical industry. Studying the relationship among these organisms can be instrumental for students in understanding the dynamic nature of biological interactions.

Plant pathology which deals with etiology and symptoms of several plant diseases, history of plant pathology, host pathogen interactions, defense mechanisms of hosts, epidemiology and disease forecasting and control of plant diseases will be taught. These topics are of utmost importance in order to fully understand the disease biology. It also imparts basic practical plant pathological knowledge. It will provide vast understanding about the disease causing factors and simultaneously preventive controls for several plant diseases. Studying in details the disease cycle and environmental relations of the pathogens will broaden the perspective about establishing more means of finding controls. This course will provide the perfect impetus to the students for using biotechnological means for developing disease resistant plants that will have economic as well as environmental benefits.

MYCOLOGY & PLANT PATHOLOGY **Full Marks: 50**

UNIT I: MYCOLOGY **Marks: 25**

1. ***Introduction to fungi***: Thallus structure; nutrition and reproduction; any modern classification with characters upto subclass.
2. ***Homothallism, heterothallism, physiological and molecular basis of mating systems.***
3. ***Ascomycota:*** Diversity of thallus structures; asexual and sexual reproductions, Development and types of ascocarps; Mechanism of ascospore discharge.
4. ***Basidiomycota:*** Somatic structures, reproduction; structures of basidiospores, basidia, and basidiocarps; Mechanism of basidiospore discharge.
5. ***Applied Mycology:*** Use of fungi in antibiotics, organic acids and food production, role of fungi in biotechnology including vaccine production, in agriculture and forestry.
6. ***Mycotoxins:*** A general account with reference to aflatoxins & phytoalexins.

UNIT II: PLANT PATHOLOGY **Marks: 25**

1. ***History of plant pathology***: Classification of plant diseases, epidemiology and disease forecasting.
2. ***Host pathogen interaction:*** Concept of inoculums and its potential; mechanism of pathogenesis, role of growth regulators.
3. ***Defense mechanism of host:*** Structural and biochemical defense mechanisms with reference to role of PR-proteins: systemic acquired resistance.
4. ***Epidemiology & Disease forecasting***
5. ***Selected plant diseases***: Powdery mildew of crop plants, Black stem rust of wheat, Loose smut of wheat, Brown spot, Crown gall diseases, Red rot of sugarcane, Tikka disease of ground nut.
6. ***Control of plant diseases***: Exclusion and eradication; classification of controlling methods (cultural, physical, chemical, biological and biotechnological).

PAPER: BOT 104

Course Outcome:

This course offers a broad overview of **Pteridophytes** also known as vascular cryptogams which are seedless vascular plants that evolved after bryophytes and are economically very important. This course covers detailed knowledge on different groups of pteridophytes; their economic and ecological significance. The students will be accustomed to the economic and ecological importance of pteridophytes. Pteridophytes are economically valuable in terms of biofertilizers. Students will learn about how pteridophytes, the first land plants-tracheophytes colonized the terrestrial environment forming forests.

This course particularly offers both theoretical and practical insights on origin of seed habit, general characteristics of different groups of **Gymnosperms** and their economic importance with reference to wood, resin, essential oils, drugs and food. Gymnosperms have major economic uses. Pine, Fir, spruce and cedar are all examples of conifers that are used for lumber, paper production and resin. Gymnosperms offer important economic, ecological and aesthetic values. The students will be well accustomed to the vast economic importance of gymnosperm in producing products we use in our daily lives. This will motivate them to conserve some of the rare gymnosperms on the evrge of extinction. The students will be benefitted by learning the forest ecology and the contribution of gymnosperm in maintaining the forest ecosystem.

PTERIDOPHYTES & GYMNOSPERMS **Full Marks: 50**

UNIT I: PTERIDOPHYTES **Marks: 25**

1. ***Introduction:*** Early land plants and their adaptation for successful colonisation on land habitats.
2. ***Rhyniopsida:*** characteristic features; important representatives and gametophytic structures.
3. ***Zosterophyllopsida:*** characteristic features, representative taxa exhibiting morphological diversity of the group; potentiality of the group as a progenitor of Lycopsida.
4. ***Lycopsida:*** Characteristic features; diversity in vegetative structures; significance of the group in the evolutionary trends.
5. ***Trimerophytopsida:*** Characteristic features; diversity in vegetative structures; significance of the group in the evolution of higher clads of pteridophytes.
6. ***Filicopsida:*** Characteristic features, major clads of extinct and extant taxa of the group; classification of filicalian ferns as per Pichi-Sermolli (1977); phyletic slide and evolution of soral structures in the filicalian ferns.
7. ***Apospory and apogamy:*** Definition, factors for induction and significance.
8. ***Progymnosperms:*** concept, characteristics, classification, origin and evolution.

UNIT II: GYMNOSPERMS **Marks: 25**

1. ***General features and classification.***
2. ***Origin of seed habit***: Pre-pollen and pre-ovule concept; origin of true ovule.
3. ***General features***: Characteristics; geologic range and phylogeny of Pteridospermales; Glossopteridales; Pentoxylales and Caytoniales.
4. ***General features***, evolutionary trends of leaves and megasporophylls among extinct and extant members of Cycadales; geographic distribution of extant cycads.
5. ***Coniferales***: Characteristic features; distribution pattern of modern conifers in India; Origin of seed-cone complex among extinct and extant conifers.
6. ***Gnetophytes:*** Characteristics; comparative accounts of three genera; present status of gnetophytes based on molecular phylogeny.

7. ***Economic importance of gymnosperms with reference to wood, resin, essential oils, drugs and food.***

PRACTICAL

PAPER: BOT 105A

MICROBIOLOGY **Marks: 25**

1. Methods of sterilization, idea about microbiological instruments and laboratory.
2. Sterilization of media and glass goods, demonstration of antibiotic sensitivity assay.
3. Demonstration of Inoculation techniques.
4. Negative staining technique.
5. Gram staining.
6. Demonstration of endospore staining.
7. Demonstration of antibiotic sensitivity assay.
8. Visit to a place of microbiological interest

PAPER: BOT 105B

PHYCOLOGY & BRYOLOGY **Marks: 25**

PHYCOLOGY:

1. Study of vegetative structures of gametophytic and sporophytic plant bodies of the members from different algal taxa.
2. Study of reproductive and other perennating structures of different members of algae.
3. Study of live algal species from nature and their habitat.
4. Collection of algal species from natural sources and submission in the examination.
5. ** (Submission of laboratory records including permanent slides)

BRYOLOGY:

1. Comparative morphology and anatomy of the gametophytes and sporophytes of the different groups of Bryophytes
2. Study of peristome structures of Nematodonteae and Arthrodonteae of the Bryopsida
3. Field work [Spot dominated with lower Cryptogams inside State or Outside state)]
4. Students are required to submit field survey report and laboratory records, preserved and dried specimens and permanent slides.

PAPER: BOT 106A

MYCOLOGY & PLANT PATHOLOGY Marks: 25

1. Study of morphological characters and reproductive structures of common fungal taxa.
2. Submission of fungal specimens.
3. Study of diseased specimens.
4. Isolation and simple culture of pathogens.
5. Submission of plant pathological specimen.
6. Submission of laboratory notebooks.

PAPER: BOT 106 B

PTERIDOPHYTES & GYMNOSPERMS **Marks: 25**

PTERIDOPHYTES

1. A comparative study of the vegetative and reproductive parts of some extant Pteridophytes occurring in West Bengal.
2. Study of some fossils (slide and megafossils).
3. Field work
4. ** (Submission of field and laboratory records including permanent slides)

GYMNOSPERMS

1. A comparative study of the vegetative and reproductive parts of extant gymnosperms.
2. Study of some fossil gymnosperms.
3. Fieldwork.
4. ** (Submission of field and laboratory records including permanent slides).

SEMESTER – II

THEORY

PAPER: BOT 201

Course Outcome:

This course offers a broad overview of **Plant Taxonomy and Biosystematics.** Upon the completion of the course the students will be able to:

- Recognize the plant families of major flowering plants and their diagnostic features and acquire basic knowledge on the principles of phylogeny and biosystematics.
- Gain hands on experience on herbarium preparation techniques as it is an art but require skill also herbaria are source of plant identification, Digitization make may provide global accesses.
- Develop writing skills this help them to write a report prepare field data book.
- To familiarize knowledge on plants with immense economic values.

Full Marks: 50

UNIT I : ANGIOSPERM TAXONOMY

1. Introduction: Definition of terms: Systematics, Taxonomy, Classification, Nomenclature, Identification; Flora, Vegetation, Monographs, Revision.
2. Classification: History and current systems of classification with Putative Relationships: Takhtajan (2009) and Cronquist system of classification(1988), Salient features, evolutionary trends and phylogeny in Magnoliidae, Caryophyllidae, Asteridae, Alismatidae and Liliidae (*sensu lato* Cronquist, 1981) and Outline concept of APG-IV System of plant classification (2016), concepts of palaeoherbs, eudicots.
3. Herbarium: Traditional and digital Herbarium, national and international Herbaria. Utilities of Herbarium. Botanical Garden & its importance.
4. ICN: Principles of ICN, Typification, Effective and valid publications, Author's citation, Rejection of Names, Preliminary knowledge of Biocodes & Phylocodes.

UNIT-II : BIOSYSTEMATICS

1. Biosystematics: Definition, principles, categories, methods and differences with classical taxonomy.
2. Homology and homoplasy; plesiomorphy and apomorphy; monophyly, paraphyly and polyphyly, parallelism & convergence
3. Taxonomic supportive evidences: Palynology, Ultrastructural morphology (Micro-morphology), Phytochemistry.
4. Numerical Taxonomy: Phenetic and cladistic methods, merits and demerits of numerical taxonomy.

PAPER: BOT 202

Course Outcome:

This course offers a broad overview of **Paleobotany.** Upon the completion of the course the students will be able to:

- Learn about the climate in the past and can help to better understand the flora and fauna of the prehistoric times.
- Understand biostratigraphic correlation, calculation of age of rocks and to ascertain palaeophytogeography.
- Learn how plants preserve and fossilize, the origin and diversification of plant groups through Earth's history, geologic time periods in Earth's history and the ecological changes and impacts of plants on the Earth.

The course **Palynology & Plant Reproductive Biology** encompasses introduction to the fossil record of land plants and algae, their evolution, biology, and morphology. The primary goal is to provide students with the practical skills to analyze

pollen/spores and algae remains with microscopic techniques. Pollens extracted from fossil deposits maybe used for radiocarbon dating and for studying past climates and environments by identifying plants then growing. The students will have a basic knowledge about the basic and applied aspects of Palynology and many exciting potential career options like Aeropalynology, Melissopalynology and Forensic palynology

PALAEOBOTANY, PALYNOLOGY & PLANT REPRODUCTIVE BIOLOGY

Full Marks 50

UNIT I: PALAEOBOTANY — Marks 25

1. Fossils: Definition, types , modes of preservation (Schopf 1975), Fossilization process – factors;
2. Principles of correlation and stratigraphy; outline of Standard Geologic time Scale including Radiometric dating.
3. Major events of plant life through geologic history.
4. Indian Gondwana System , Classification and distribution of the sequence; megafloristic assemblages in Gondwana Sequence.
5. Continental Drift Hypothesis and Plate Tectonic

UNIT II: PALYNOLOGY & PLANT REPRODUCTIVE BIOLOGY — Marks 25

1. Microspore tetrads and polarity of spores and pollen grains.
2. Spore-pollen morphology: Symmetry, shape, size, aperture patterns, NPC System of pollen-spore classification, exine stratification, surface structures and sculptures of sporoderm; LO-analysis.
3. Sporopollenin: physical and chemical nature, function; [Ubisch body]
4. Extraexinous wall material - perine, viscin-threads, pollen-kit.
5. Application of palynology in taxonornic and phylogenetic deductions.
6. Aeropalynology with reference to allergy : Some important allergenic pollen/spores of West Bengal.
7. Objectives and importance of Melissopalynology. Important bee plants of West Bengal plains.
8. Forensic palynology: Definition and significance.
9. Pollination Biology: Pollen dispersal units; pollination types, contrivances for crossand self-pollination; pollen vectors, pollination modes and floral and floral types.
10. Breeding systems : Autogamy & Allogamy (Geitenogamy & Xenogamy

PAPER: BOT 203

Course Outcome:

This course **Plant Anatomy** helps us to understand the structural adaptations of plants with respect to diverse environmental conditions. It also helps us to distinguish between the anatomical features of monocots, dicots and gymnosperms. Such a study is also linked to plant physiology. The course particularly aims at imparting the detailed knowledge pertaining to the plant cell wall structure, stomatal characteristics, secretory tissues, laticifers, xylem and phloem ontogeny and structure, wood, nodal anatomy, and economic importance of several parts of the plants and their anatomical significance. Upon the completion of the course the students will be able to:

- Conceptually integrate organismal structure and function.
- Understand the relationship between structure, function, taxonomy, ecology and developmental genetics.

Pharmacognosy is the study of medicines or crude drugs produced from natural sources like plants, microbes etc. This includes analysis of their biological chemical biochemical and physical properties. This course includes the introduction and scope of pharmacognosy, organoleptic morphological and chemical characteristics and uses of some crude plant drugs,secondary metabolites in plants and their significance, chemical nature and active principles of some important plant alkaloids and their uses, adulteration of drugs and detection. 1.Pharmacognosy

gives a sound knowledge of plant based drugs. Scientific study of crude drugs and medicinal products has great potential of curing diseases naturally and plays a key role in drug discovery. The students will have the basic knowledge about how drugs are adulterated and the ways of detecting them which has a very important practical implication.

PLANT ANATOMY & PHARMACOGNOSY — Full Marks: 50

UNIT 1: PLANT ANATOMY — Marks: 25

1. Cell wall: Chemistry, Ultrastructure, biosynthesis .
2. Stomata: Types (Metchalfe and Chalk), Ontogeny.
3. Secretory tissues in plants: Structure and distribution of secretory trichomes (*Drosera, Nepenthes*), Bark: types, development and ultrastructure.
4. Laticifers: Types & Structure.
5. Xylem: ontogeny, ultrastructure, lignification pattern and phylogeny.
6. Phloem: structure, and function
7. Wood : Structure & properties
8. Nodal anatomy: Types with examples.
9. Special tissues in plants- laticifers , secretory tissues, Transfer cells, plant fibres (types & distribution)
10. Plant fibers: Distribution, structure and commercial importance of coir, jute, and cotton.

UNIT II: PHARMACOGNOSY — Marks: 25

1. Pharmacognosy: Introduction & scope of pharmacognosy.
2. Organoleptic, micromorphological and chemical characteristics & uses of crude plant drugs –Strychnos, Rauvolfia & Adhatoda.
3. Secondary metabolites in plants and their significance. Schematic overview of Mevalonate pathway & Shikimic acid pathway.
4. Alkaloids – Chemical nature of active principal of Datura from stramonium, belladonna, ergot, rauwolfia, catharanthus, cinchona, tea, holarrhena, senna and their uses.
5. Adulteration of drugs and detection.

PAPER: BOT 204
ELECTIVE – I — Full Marks: 50
PLANTS AND SOCIETY (Part - I)

Unit I: General Concept on Plant Kingdom — Marks: 25

1. Five Kingdom Concept (R. H. Whittaker, 1969)
2. General account of different groups of plants – Algae, Bryophyta, Pteridophyta, Gymnosperm and Angiosperms.
3. An outline approach on plant cell, tissues and organs.

Unit II: Socio-Economic Uses of Plant — Marks: 25

1. Major parts & their Uses of : Cereals and pulses (rice, wheat, maize, mung, gram, pea), edible and essential oil yielding (mustard, sunflower, Lemon grass & clove oil), species and condiments (coriander, foeniculum, nigella, carum, black pipper, chilli, termaric, zinger), beverage (tea, coffe), fiber yielding (jute, cotton), dye yielding (Morinda citrifolia, Butea monosperma, Crocus sativus, Indigofera tinctoria, Lawsonia inermis).
2. Plants of special uses [Saccharum officinarum, Babui grass (Eulaliosis binata), vetiver grass(Chrysopogon zizanioides)]
3. Ethnomedicinal plants. (Adhatoda zeylanica, Ocimum sp., Aloe vera, Andrographis paniculata, Centella asiatica, Strychnos nux-vomica)
4. Biofertilizers
5. Commercial uses of fossil plants (Coal , Petroleum , Amber , Diatomite

PRACTICAL

PAPER: BOT 205 A

ANGIOSPERM TAXONOMY & BIOSYSTEMATICS

Marks: 25

1. Drawing and description of a specimen from locally available representative families, identification up to species.
2. Study of the different types of fruit and seed morphology.
3. Fields survey for familiarization with and study of any different ecological area (Long Excursion)
4. Preparation of Key to the genera / Species
5. Submission of Herbarium consisting at least 25 common weeds except RET
6. Submission of field and laboratory notebook.

PAPER: BOT 205 B

PALAEOBOTANY, PALYNOLOGY & PLANT REPRODUCTIVE BIOLOGY Marks: 25

Palaeobotany

1. Study of representative megafloral assemblages Megafossil by Photographs/Slides/Megafloral specimens
2. ** (Submission of laboratory records including permanent slides)

Palynology & Reproductive Biology

1. Pollen morphological studies of some pterodophytes, gymnosperms, and angiosperms representing different morphological types using acetolysis / alkali maceration method.
2. Extraction of pollen grains from honey sample and characterization of the different morpho-types.
3. Study of in vivo and in vitro germination of pollen grains.
4. ** (Submission of laboratory records including permanent slides)

PAPER: BOT 206 A

Plant Anatomy & Pharmacognosy Marks: 25

1. Study of various types of stomata and determination of stomatal index.
2. Study of various types of trichomes.
3. Study of different types of crystals.
4. Study of nodal anatomy – unilacunar, trilacunar & multilacunar types.
5. Microscopic study of powder of some selected crude drugs.

6. Biochemical tests of some crude drugs.

PAPER: BOT 206B

Field survey, submission of report and viva-voce. Visit at different phytogeographical regions of India.

Evaluation of BOT 206B /UNIT II: Only by External Experts.

SEMESTER – III

BOT 301: CELL BIOLOGY, GENETICS & BIOTECHNOLOGY F.M. 50

Course Outcome: Cell biology, Genetics and Biotechnology include topics enlightening students about basics of cell biology and genetics having much bearing on the applied subject of biotechnology. Topics under biotechnology provide fair knowledge on different advanced technology and techniques.

UNIT I: CELL BIOLOGY & GENETICS Marks: 25

1. Extension of Mendelian genetic analysis: Gene interactions and modified Mendelian ratios; Multiple factor and polygenic inheritance, linkage, crossing over, chromosome mapping, molecular basis of recombination, structural alteration of chromosome, mutation.
2. Ultra-structure of nucleus, nucleolus, plasma membrane, endoplasmic reticulum, Golgi apparatus, chloroplast including anterograde and retrograde signaling, mitochondria and microbodies (peroxisomes and glyoxysomes)
3. Cell cycle: Biochemical and molecular events associated with the cell cycle, Molecular mechanism of cell cycle regulation, cell death- programmed cell death (PCD) and necrosis.
4. Molecular organization of chromosome: DNA packaging in chromatin and chromosome, regulation of chromatin structure by histone n-terminal tails, ultra-structure of special chromosomes; Centromere & telomere: ultrastructure and function.
5. Chromosome banding: G banding, Fluorescent banding, R banding, C banding, NOR banding. FISH, GISH.
6. Genetic code: Properties of genetic code with evidences, deciphering of genetic code (code assignment).
7. Extranuclear inheritance: definition, types (maternal inheritance, organeller inheritance and infectious heredity) explained with the examples of skin pigmentation of larvae of *Ephestia kuehniella*, shell coiling of *Limnaea peregra*, variegated leaves of *Mirablis* and maize, kappa particle of *Paramoecium*, CO2 sensitivity and sex ratio of *Drosophila*.
8. Sex determination: basic types, Lyon hypothesis, dosage compensation - types, Barr body, Sex linked inheritance, sex influenced, sex linked and sex limited characters.
9. Transposable elements: definition, transposon and retroposon. Characteristic features of IS elements, Ac/Ds element and Copia element.
10. Population genetics: Hardy-Weinberg Hypothesis, factors affecting allelic frequency in population. Genetic drift, inbreeding depression. Effects of Migration & Mutation, Natural Selection
11. DNA replication (outline procedure only), requisite factors and their roles. Replication of bacteriophage (λ, M13)
12. DNA Repair- Nucleotide excision repair, mismatch correction, SOS repair, Photoreactivation.

UNIT II: BIOTECHNOLOGY Full Marks: 25

1. Recombinant DNA technology: Definition and properties of Plasmids, Cosmids, Phagemids, Bacterial artificial chromosomes (BACs), Yeast artificial chromosomes (YACs); Plasmid isolation, restriction enzymes, digestion, agarose gel electrophoresis and

transformation.

2. Cloning strategies & screening of recombinant clones: Lac operon: Blue/white selection; Purification and characterization of recombinant plasmid DNA; Expression vector - over expression and expression analysis; Applications of recombinant DNA in agriculture and medicine, Plant transformation strategies and generation of transgenic plants.
3. Transcription: Molecular mechanisms of transcription; Regulation of gene expression with special reference to two component gene regulatory system; RNA processing. inhibitors of transcription
4. Gene library: Construction of cDNA library and genomic library; Screening of libraries.
5. DNA hybridization & sequencing: Generation of radiolabeled probe and blotting techniques; Southern and Northern hybridization; DNA Sequencing methods, Characterization of cloned genes
6. Polymerase chain reaction: Principles, methods and application RT-PCR.
7. RFLP, RAPD, AFLP, ISSR, ITS, DNA finger printing, Chromosome walking, Chromosome jumping, Microarray, ESTs, SAGE; Gene editing and its application [Zinc finger, TALENs, CRISPR/Cas9]
8. Plant breeding: Plant introduction, back cross, apomixis, pedigree selection, pure line selection, mass selection and clonal selection (Procedures). Heterosis. Composite and Synthetic varieties, QTL mapping-Basic Introduction, Marker assisted selection Breeding [MASS], Cytological and physiological basis of plant breeding.
9. Plant tissue culture: basic requisites, MS and White's media. Roles of nutritional inputs. Principle, procedure and utility of callus culture, organogenesis, micropropagation and protoplast culture, Embryo and anther pollen culture.

PAPER: BOT 302: PLANT PHYSIOLOGY & BIOCHEMISTRY Full Marks: 50

Course Outcome: Students will get an overall knowledge about the structure, function and interaction of various biomolecules along with the study of different metabolic processes of plants which are associated with plant morphology, ecology and environmental effects on plants. This area of Botany is especially important because the physiology of a plant is directly associated with plant yield / crop yield which has an economic impact.

UNIT I: PLANT PHYSIOLOGY Marks: 25

1. Plant Water Relation: Regulation of water supply, Aquaporins and facilitated water Transport, Soil Plant Atmosphere Continuum (SPAC), recent concept in stomatal physiology, Signal transduction in guard cell.
2. Solute Transport: Diffusion, Nernst equation, Uniport, Symport, Channels, ATP driven active transport (Phloem loading and unloading)
3. Photochemistry and Photosynthesis: Photosynthetic pigments, absorption and transformation of radiant energy, Light harvesting complexes, ETS, photo inhibition, O2and H2O evolution, Regulation of Calvin cycle, RUBISCO activity, Photorespiration, CAM and C4 pathway.
4. Respiration: Overview of plant Respiration, EMP pathway, TCA cycle, PPP, Glyoxylate cycle, Mitochondrial ETS, Cyanide resistance pathway, Gluconeogenesis, High energy compounds: Synthesis and utilization, ATP synthesis.

5. Photoperiodism**:** Photoperiodic classes; Photoperiodic induction – importance of light and dark period; Mechanism of induction and role of phytochrome.
6. Plant growth regulators: Biosynthesis and action mechanism of: Auxins, Gibberellins, (GA), Cytokinins, Ethylene, Abscissic Acid, introduction of other hormones.
7. Seed Germination, Flowering and Fruit ripening: - Metabolic changes during seed germination, flowering initiation, maturity and fruiting, fruit ripening.
8. Senescence and ageing, senescence syndrome – physiological and biochemical changes; Regulation of senescence and SAGs; Abscission – cytological, physiological and biochemical changes in abscission zone; Hormonal and environmental control of senescence, programmed cell death in life cycle of plants.
9. Stress Physiology: Biotic and abiotic stresses.

UNIT II: BIOCHEMISTRY Marks: 25

1. Energy Dynamics: Structure of atoms, molecules and chemical bonds, principles of physical chemistry, principles of thermodynamics, free energy, Redox potentials, Dissociation and associations constants, Activation energy, Binding energy.
2. Enzymology: General classification, Isozymes, Factors affecting enzyme activity, Enzyme Kinetics, Michaelis - Menten equation, Competitive, uncompetitive and non-competitive inhibition, Allosteric mechanism.
3. Carbohydrates: General classification, Synthesis and breakdown of carbohydrates (starch, glycogen, pectin, Glucose).
4. Amino acids & proteins: General classification of amino acids and proteins, Structure, synthesis and properties of amino acids, protein structure (Primary, secondary, tertiary and quaternary), Ramchandran plot.
5. Nitrogen metabolism: Nitrogen uptake, NOD factor, root nodulation and nitrogen fixation.
6. Secondary metabolites: General classification of Major pathways, Phenolics (Lignins, tannins) Flavonoids, terpenoids (steroids), Alkaloids, pigments (Carotenoids, Anthocyanins).
7. Lipid metabolism: General classification of Phospho-, Spingo-, Glyco- lipids, biosynthesis and oxidation
8. Sulphur metabolism- sulfate assimilation pathway, glutathione synthesis and function.

PAPER: BOT 303: ECOLOGY & ENVIRONMENTAL BIOLOGY Full Marks: 50

Course Outcome: By studying ecology learners will get a thorough knowledge regarding ecosystem; different types of interaction between organisms and their environment; deep ecology and shallow ecology; habitat and niche concept; ecosystem organizations; energy dynamics; ecological succession and climax concept; population concepts. Environmental Biology will help students in understanding interrelationships between the living world and the environment; concept on hydrosphere, lithosphere and atmosphere; biodiversity and conservation (in situ and ex situ); concept of Ramsar sites; greenhouse effect and global warming; ozone depletion; acid rain, smog, deforestation; Environmental pollution: Environmental Movements in India like Silent valley, Chipko movement, Beej bachao andolan, Narmada dam movement, debates on Eucalyptus; Earth summits.

UNIT I: ECOLOGY

Marks: 25

1. Significance and scope of ecology; concept in ecology- deep ecology and shallow ecology.
2. Habitat and Niche concept and differences: Fundamental and Realised niche; Aspects of ecological niche, habitat niche, trophic niche and hypervolume niche; Niche construction and niche differentiation with examples.
3. Ecosystem organization: Structure and functions, ecological pyramids, food chains and food webs, primary production (methods of measurement, controlling factors); Energy dynamics (trophic organization, energy flow via grazing and detritus chains, ecological efficiencies).
4. Community Ecology**:** Concept of community and continuum; Mechanism of Ecological succession and climax concept (facilitation, tolerance and inhibition Models); Changes in ecosystem properties during succession.
5. Plant Adaptations, Hydrophytes, Xerophytes and Halophytes: Morphological, anatomical, physiological and biochemical.
6. Population concepts: Population growth, population regulation, r and k selection, population interactions.

UNIT II: ENVIRONMENTAL BIOLOGY Marks: 25

1. Interrelationship between the living world and the environment; Basic concept on hydrosphere, lithosphere and atmosphere.
2. Biodiversity (level, spatial scale, loss and importance) and conservation (*in situ* and *ex situ*); CBD and Ramsar sites - concept
3. Impact of human activities: greenhouse effect and global warming; ozone depletion; acid rain, classical and photochemical smog, deforestation.
4. Environmental pollution**:** pollution of air, water and soil: sources, impact, prevention and control measure.
5. Biological control: Biomonitoring of air and water pollution, bio-indicators, bio-remediation.
6. Environmental Movements in India: Silent valley, Chipko movement, Beej bachao andolan, Narmada dam movement, debates on *Eucalyptus*.
7. Carrying capacity, Sustainable development and Environmental impact assessment.
8. Earth summits, Central pollution control board, State pollution control board: general idea.

PAPER: C-BOT 304: PLANTS AND SOCIETY- II (CBCS) Full Marks: 50

Course Outcome: Students will understand about the role of different plants and microbial groups. Environmental issues related to plants will be discussed. Students will get information about biotechnological applications of plants.

Unit – I: Plant and Environment Marks: 25

1. Ecosystem – terrestrial, aquatic (fresh water and marine), hill, mangrove.
2. Plant and ecological balance, Biomonitoring,

3. Phytoremediation,
4. Biodiversity, conservation and sustainable development,
5. Social ecology (Silent valley movement, Chipko andolan, Joint Forest Management and laws-Forest Rights Act-2006).

Unit – II: Biotechnology and Human Welfare Marks: 25

1. Microbial biotechnology: Cheese, Sausage, Wine and oriental fermented food (SUFU, TOFU, Saki etc.).
2. Plant Biotechnology: Plant tissue culture, GM (transgenic) plants-few examples
3. Petro-crops and biodiesel.

PRACTICAL: PAPER BOT 305

Course Outcome: Practical subjects give good support in developing knowledge and skillon molecular biological technologies and biotechnological basics.

BOT 305. A: CELL BIOLOGY, GENETICS AND BIOTECHNOLOGY Marks: 25

1. Preparation of Pre-treating agents, fixatives and stains for cytological works.
2. Study of mitotic cell division through images and/ or(with the root tip).
3. Study of meiotic cell division, stages of meiosis I & II divisions through images and /or (with the Pollen Mother Cells of locally available plants).
4. Studies of abnormalities in cell division and chromosome morphology with the help of photographs.
5. Karyotyping: the basic methods (with the well spread chromosomes of mitotic metaphase from earlier drawn picture or photograph).
6. Dry lab experiments- solving problems related to linkage and crossing over, Chromosome mapping using point test cross data, Pedigree analysis for dominant and recessive autosomal and sex linked traits.
7. Gel electrophoresis: acquaintance with the apparatus, mechanism of operation, basic principle and demonstration, SDS-PAGE, Western Blotting (for demonstration only and not recommended for examination, except viva voce).
8. Plant Tissue Culture: Media preparation technique, Inoculation in front of laminar air- flow and maintenance of culture. Study of micropropagation, somatic embryogenesis & artificial seeds through photographs. Study of methods of gene transfer through photographs: Agrobacterium-mediated direct gene transfer. (for demonstration only and notrecommended for examination except viva voce).
9. Chi square test for goodness of fit of (Fixed ratio hypothesis, Homogeneity Ratio and Contingency table).

BOT 305 B: PLANT PHYSIOLOGY, BIOCHEMISTRY & MOLECULAR BIOLOGY Marks: 25

1. Determination of percentage seed viability of TTC test.
2. Effect of respiratory promoters/inhibitors on the rate of aerobic respiration.
3. Effect of photosynthetic promoters/ inhibitors on the rate of photosynthesis.
4. Determination of isotonic concentration and osmotic pressure of cell sap.

5. Isolation of chloroplasts and demonstration of Hill reaction.
6. Determination of isoelectric points of protein.
7. Extraction and comparative study of chlorophyll levels in leaves of different Chronological ages.
8. Preparation of a standard curve for proteins and determination of protein levels in unknown samples using Folin-phenol reagent.
9. Preparation of a standard curve for amino acid and determination of amino acid levels inunknown samples using ninhydrin reagent.
10. Preparation of a standard curve for carbohydrates and determination of carbohydrate levels in unknown samples using anthrone reagent.
11. Preparation of a standard curve for IAA and determination of IAA levels in unknownsamples using Salkowsky reagent.
12. Comparative study on the activities of catalase enzymes in different plant samples.
13. Comparative study on the activities of amylase enzymes in different plant samples.
14. Studies on paper chromatography of amino acids.

PAPER: BOT 306

Course Outcome: Students will know how to study life forms through quadrat and transect method and by study of frequency, abundance and density of plants following standard methods; Ecological adaptation of plants. During preparation for seminar students will gather knowledge on their topic of choice and will know how to collect information. Their writing and communication skill will also increase. Finally students will know how to interact with a large number of audiences.

BOT 306. A: ECOLOGY & ENVIRONMENTAL BIOLOGY Marks: 25

1. Study of vegetation survey through quadrat and transect method.
2. Study of frequency, abundance and density, IVI of plants following standard method.
3. Measurement of various indices using statistical tools
4. Ecological study on plant adaptation.
5. Ecological field study in adjoining area and/or (excursion) of a given area and preparationof project report.
6. Laboratory note book.

BOT 306 B SEMINAR Marks: 25

- A seminar report to be prepared in A4 pages either neatly handwritten or printed[maximum 3000 words, a total of 6 figures and tables].
- Students will choose topics based on 1st, 2nd and 3rd Semester PG syllabus.
- A PowerPoint presentation [maximum 10 slides]
- The seminar paper will be evaluated only by the external experts.

SEMESTER-IV

THEORY

PAPER: BOT 401

SILVICULTURE, MENSURATION, SILVICULTURE SYSTEM AND FOREST MANAGEMENT

Full Marks: 50

Course Outcome: As a postgraduate, students will be able to:

- Demonstrate knowledge of forest vegetation and its development over time using models of forest growth. Demonstrate an understanding of the importance of communication in both planning and practice settings, and be able to communicate effectively with coworkers and stakeholders on forest resource issues and practices.
- Demonstrate understanding of interaction of vegetation, wildlife, insects, and disease on forested landscapes.
- Demonstrate ability to identify major forest ecosystems, and describe their changes over time, with and without human influence/management.
- Develop alternative management scenarios for forest lands for an array of objectives including forest products, environmental services, social amenities cultural and other resource values.

UNIT I: SILVICULTURE & MENSURATION Marks: 25

1. Silviculture: Definition, scope & objective.
2. Classification of Forest, Farm Forestry, Social Forestry & Agro-forestry.
3. Factors of locality: climatic (Light, temperature & Frost).
4. Topographic (Affect of Altitude, Aspect & Exposure.
5. Edaphic: General, Parental rock influence on vegetation, Pan formation.
6. Biotic: Influence of plants, insects, wild animals, man and his animals.
7. Concept of regeneration of forest.
8. Mensuration: definition, object and scope.
9. Measurement of diameter and girth.
10. Breast height - Rules of diameter measurement, diameter and girth class.
11. Measurement of height of tree: Principles of height measurement (similar triangle, trigonometric).
12. Volume: Measurement of volume of standing and felled trees, volume table.

UNIT II: SILVICULTURE SYSTEM & FOREST MANAGEMENT

Marks: 25

1. Classification and objective
2. Clear felling system: clear strip and alternate strip system. Regeneration by Taungya and /or departmental plantation.
3. Uniform system: Shelter wood system, kinds and pattern of felling, Periodic Block, Indian Irregular shelter wood system
4. Selection system
5. Coppice - System : Simple, Coppice with Standard
6. Principles and objective of Forest conservation and management
7. Forest Policy 1988

8. Reserve, Protected and unclassed forest.
9. Management classification: Working plan, working circle, Felling.
10. Sustained yield and progressive yield
11. Joint Forest Management: Concept, working and sustainability.

PAPER: BOT 402 (Special paper I)

ECOLOGY & BIODIVERSITY

Special Paper– I: ECOLOGY Full Marks: 50

Course Outcome: This **Ecology** course as a special paper aims to introduce the concepts and principles of ecology, biological diversity, conservation, sustainable development, population, community and ecosystem structure and function, application of these concepts to solve environmental problems. This course also focuses on the Environmental Impact Assessment (EIA), Energy resources, various types environmental pollution, water pollution and conservation strategies with sustainable management. Upon the completion of the course, students will be able to:

- Understand the concept, types, development and functions of various ecosystems and their communication.
- Understand the various environmental factors governing these ecosystems.
- Understand the factors leading to Environmental degradation, their reasons and their impact on the Environment. Form strategies for conservation and sustainable management under the given legislative measures.

1. Principles and current concepts in ecology.
2. Structure and function of ecosystems including forest, mangrove and aquatic systems.
3. Plant community : Qualitative and quantitative characteristics, phytosociological methods
4. Environmental diary - Stockholm conference, Montreal protocol, Reo earth summit, Kyoto protocol, Ramsar convention, COP 16.
5. Environmental disasters – London smog, El Nino, Minamata tragedy, Chernobyl disaster, Bhopal tragedy.
6. Global environmental issues - Global warming, Acid rain, Smog, Ozone depletion, biological invasion.
7. Phytoremediation and plant response to environmental stresses - drought, water logging, high and low temperatures, salinity.
8. Population ecology - growth curve, carrying capacity, Sustainable development, population regulation, r-and K-strategy.

PAPER: BOT 403 Special paper: II

Special Paper – II: BIODIVERSITY Full Marks: 50

Course Outcome: This **Biodiversity** course as a special paper gives an introduction to terrestrial and aquatic biodiversity and conservation biology, and common methods to conserve the environment and the biological diversity. The goal of the course is to teach a critical and conceptual knowledge of biodiversity and wildlife in the context of natural landscape exploration, ecosystem dynamics, ecosystem functioning, and ecosystem service provision. The course design also addresses the indiscriminate use of natural resources, particularly floral resources, as well as the diminishing of wild animal natural habitats. This course focuses on the fundamental principles, concepts and abilities associated with plant and animal conservation and management. Science and management views will be discussed in the context of historical, current, and future initiatives aimed at preserving biological diversity. The course work will also be guided by work on scientific papers and field experience. The specific learning outcome s of the course are:

- The candidate will obtain knowledge and understanding of the values of biodiversity, threats to biodiversity and different methods within conservation biology.
- Enhance understanding of students on the general principles of ecology as how it related to terrestrial and aquatic plant and animal conservation and management.
- Impart field based training to students how it will be applicable to solve problems related to wildlife conservation and management.
- Students will be equipped with knowledge on wildlife conservation and management relates to the economy and environment, both currently and in the future.
- Encourage the students to carry out the research works in frontier areas of Ecology, Biodiversity Conservation during their doctoral studies.

1. Biodiversity - definition, components, types, levels, spatial scales (alpha, beta & gamma diversity).
2. Measurement of biodiversity: Species richness, species evenness and overall diversity using various indices, Gause's Law.
3. Global concern and global status on biodiversity. Like Minded Megadiverse Countries (LMMC), Biological hotspots with special reference to four Indian hotspots.
4. Economic and ecological values of biodiversity with special reference to genetic diversity.
5. Threats to biodiversity - natural and manmade; invasive species and biodiversity loss.
6. Biodiversity conservation - The type of species to be conserved, Red data book and Blue data book; ex situ conservation- role of botanical gardens, museum, seed banks, pollen banks, gene banks, in situ conservation- national park, sanctuary, biosphere reserve, tiger project, Ramsar site, conservation through traditional methods. CBD and CITES - general idea.
7. Role of government and non-government initiatives in biodiversity study - Forest Conservation Act 1988, Environmental Protection Act 1986, Biodiversity Conservation Act 2006, role of BSI, ZSI, Biodiversity boards, IUCN, WWF in conservation.

PRACTICAL PAPER – 404

FOREST MENSURATION & SURVEYING **Full Marks: 25**

1. Measurement of diameter and Girth.
2. Girth class distribution.
3. Measurement of height of a tree.
4. Volume calculation.
5. Chain surveying.
6. Plane table survey.
7. Practical records.

PAPER – 405

ECOLOGY & BIODIVERSITY [SPECIAL PAPER]

Full Marks: 50

1. Study plant community by different methods (quadrates and transects)
2. Determination of IVI
3. Study on Ecological Anatomy.
4. Physio-chemical studies on soil and water.
5. Field-based, ecological studies (excursion) on different ecological areas.
6. Field records/ reports and Laboratory note book.

BOT 406 **Full Marks 50**

PROJECT: M. Sc. Thesis/ Dissertation (Based on special paper)

BOT 407 Full Marks: 25

Grand Viva

GRAND VIVA SHOULD BE CONDUCTED EXCLUSIVELY BY EXTERNAL MEMBERS REPRESENTING ALL SUBDIVISIONS.

NB:

Answering of answer scripts should be in English only.