Bankura University, Bankura, W.B

Syllabus for the **Post Graduate Course** in **Botany** from **2017 onwards**

Summary of the Course and Credit

Course Code	Course Title	Credits	Marks				No. of Hours		
			IA	ESE		Total	Lecture	Theory	Practical
Sem I				TH	PR				
BOT 101 C	Microbiology	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 102 C	Mycology, Plant Pathology	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 103 C	Phycology, Bryology	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 104 C	Pteridology, Gymnosperms	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 105 I.A.	Assignment (20 marks), Seminar (20 marks), Tutorial etc. (10 marks)	4 (Assignment 2, Seminar 2, Tutorial 1)	50 (Evaluated by the DC)	-		50	-	15	
Compulsory Foundation Course									
106 CF	Communicative English and Personality Development	1	40 + 50	-		-	15	15	-
Note: Two assignments to be done from the Theoretical Courses. The foundation courses are to be conducted by the University. The course shall have internal assessment only and so, credit earned for these courses, shall not be considered while preparing the final result. However, the candidates are required to obtain Satisfactory or Not Satisfactory to become eligible for the final semester examination/ award of the PG Degree.									
Total in Semester I		20	40 +50	120	40	250	315	195	120

Course Code	Course Title	Credits	Marks				No. of Hours		
			IA	ESE		Total	Lecture	Theory	Practical
Sem II				TH	PR				
BOT 201 C	Plant Physiology	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 202 C	Biochemistry and Molecular Biology	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 203 C	Morphology, Palynology and Reproductive Biology	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 204 C	Taxonomy of Angiosperm	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 205 I.A.	Assignment (20 marks), Seminar (20 marks), Tutorial (10 marks) and Library work	4 (Assignment 2, Seminar 2, Tutorial 1)	50	-		50	-	15	
Compulsory Foundation Course									
206 CF	1. Yoga and Life Skill 2. Education Value Education and Human Rights	1	50	-		-	15	15	-
Note: Two assignments to be done from the Theoretical Courses. The foundation courses are to be conducted by the University. The course shall have internal assessment only and so, credit earned for these courses, shall not be considered while preparing the final result. However, the candidates are required to obtain Satisfactory or Not Satisfactory to become eligible for the final semester examination/ award of the PG Degree.									
Total in Semester II		20	40 +50	120	40	250	315	195	120

Course Code	Course Title	Credits	Marks				No. of Hours		
			IA	ESE		Total	Lecture	Theory	Practical
Sem III				TH	PR				
BOT 301 C	Cytogenetics and Plant Breeding Biostatistics	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 302 C	Ethnobotany and Pharmacognosy, Tissue culture	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 303 C	Plant Anatomy, Palaeobotany, Bioinstrumentation	3(TH) 1(PR)	10	30	10	50	75	45	30
Elective Courses – Major (any one of the following)									
BOT 304 EA	**Taxonomy of Angiosperms and Biosystematics**	**3(TH) 1(PR)**	**10**	**30**	**10**	**50**	**75**	**45**	**30**
BOT 304 EB	**Microbiology**	**3(TH) 1(PR)**	**10**	**30**	**10**	**50**	**75**	**45**	**30**
Elective Courses – Minor (any one of the following) (Courses are mandatory choice based and students (other than Department) of any Department of PG level can opt for the course. Monday, Wednesday, Thursday and Friday from 1.00 pm to 2.00 pm)									
305 EID A	Evolution and Plant Life	3(TH)+ 1(PR)	10	30	10	50	75	45	30
305 EID B	Plant Systems and Organization	3(TH)+ 1(PR)	10	30	10	50	75	45	30
305 EID C	Ecology and Conservation Biology	3(TH)+ 1(PR)	10	30	10	50	75	45	30
Total in Semester III		20	50	150	50	250	375	225	150

Course Code	Course Title	Credits	Marks				No. of Hours		
			IA	ESE		Total	Lecture	Theory	Practical
Sem IV				TH	PR				
BOT 401C	Ecology and Evolution,	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 402C	Plant Anatomy, Silviculture	3(TH) 1(PR)	10	30	10	50	75	45	30
BOT 403 I. A.	Educational Excursion, Tutorial, Library work (Participation – 10 marks, Report – 30 marks, Viva – 10 marks) evaluated by the (Supervisor – 10 marks, All Faculties - 40 marks)	4				50			
Elective Courses – Major (any one of the following)									
BOT 404 EA	**Taxonomy of Angiosperms and Biosystematics**	**3(TH) 1(PR)**	**10**	**30**	**10**	**50**	**75**	**45**	**30**
BOT 404 EB	**Microbiology**	**3(TH) 1(PR)**	**10**	**30**	**10**	**50**	**75**	**45**	**30**
BOT 405 DN	Dissertation Work (Start from 3rd Semester and will be continued upto 4th Semester) (To be assessed by HOD, supervisor and one External Expert	4		50		50	60	-	60
Total in Semester IV		20	40	90+50	30	250	285	135	150

Grand Total of Semester I, II, III and IV							

Core Courses: Every student will be taking only core courses in all the Semesters. In Semester – III and IV, the students will opt for following major elective courses – Bot 303EA and Bot 403EB (Special Papers) along with core courses:
Major Elective Courses:
EA: Taxonomy of Angiosperms and Biosystematics
EB: Microbiology

Minor Elective Courses: M.Sc. Botany students will opt for one Minor Elective Course in Semester – III offered by other P.G. departments.

Dissertation: Students have to submit a project work/dissertation based on major elective course offered in Semester – III and Evaluated in Semester IV.

C = Core Course

CF = Compulsory Foundation Course

DN = Dissertation

EID = Elective Interdisciplinary

ESE = End Semester Examination

IA = Internal Assessment

I. A. = Internal Assignment

PR = Practical

TH = Theory

Semester – I

BOT – 101 C (TH) / Core Course

Microbiology (Theory) 45L

Credit - 3

1. History of Microbiology and bacterial classification: Early history and milestone discoveries in Microbiology.
2. Bacterial Taxonomy: Brief idea about the modern approach of bacterial taxonomy.
3. Ultrastructure of prokaryotic cell: Cell wall and cell membrane of bacteria and archaea; Muerin biosynthesis; capsule, pili, and flagella, chemotaxis; reserve material and other cytoplasamic inclusions, Endospore – structure, molecular approaches of regulation of endospore formation and germination.
4. Bacterial genetic material: Structure and replication of bacterial chromosome; Plasmid – structure type and properties, episome.
5. Bacterial growth and nutrition: Growth curve, factors affecting growth, growth kinetics, batch and continuous culture, synchronous culture, diauxic growth, microbial growth control by disinfectant, antiseptic and chemotherapeutic agents, a brief account of different antimicrobial agents and mode of action of. Brief idea about Autotrophy, heterotrophy and Mixotrophy.
6. Genetic recombination in bacteria: Molecular mechanism of transformation, conjugation, transduction, gene mapping through conjugation.
7. Gene regulation and metabolic inhibition in bacteria: Operon concept; lac and trp operon; catabolic repression, attenuation and riboswitch, isozyme.
8. Microbes in N_2 Cycle: Nitrification, Denitrification, Ammonification; Mechanism of biological N_2 fixation; structure and regulation of nif gene.
9. Virus: Types structure and organisation, Description of TMV and Cauliflower mosaic virus. Cultivation of viruses, Replication of virus, Lytic and lysogenic cycle of bacteriophage, regulation of lysogeny, induction of lysogeny, viroid and prion.
10. Fundamentals of Immunology:- Innate and acquired immunity, T-cell, B-cell, MHC, cytokines, antigen- types and characteristics; structure and functions of immunoglobulins, cell mediated and humoral immunity; Ag-Ab reactions and immunological techniques – RIA, ELISA .

BOT – 101 C (PR) / Core Course

Microbiology (Practical) 30L

Credit - 1

1. Aseptic method: Autoclave, hot air oven, Incubator, bacterial filter and laminar air flow.
2. Morphological characteristics of bacteria and microscopic examination of stained cell preparation - simple staining, Gram staining, endospore staining.
3. Direct examination of root nodule bacteria in microscope and isolation of Rhizobium from root nodule.

3. Microbial growth measurement by turbidity, total count, construction of growth curve, determination of generation time. Effect of pH and Temperature on growth.

4. Isolation and enumeration of microorganisms from soil by agar plate technique.

5. Physio-biochemical test for identification of bacteria:-

a) Catalase b) Protease, c) Amylase e) Indole production

6. Determination of antibiotic sensitivity of some bacteria by disc diffusion method.

7. Demonstration of replica plating technique for isolation of auxotrophic mutants.

8. Enrichment culture of Nitrogen fixer, Spore former, cellulose decomposer and phosphate solubilizer

BOT – 102 C (TH) / Core Course

Credit – 1.5 **Mycology and Plant Pathology (Theory)** **45L**

Mycology (Theory)

1. Position of fungi in modern systematic: Modern approaches towards classification of fungi. (Definite classification should be included)

2. Ultrastructural features of fungal cell structures: Nucleus and its division, cell wall and its biochemical composition, tissue organization, modifications of fungal hyphae.

3. Life cycle patterns: Basic pattern of sexuality, sexual mechanisms and their correlations in different groups of fungi, Parasexual cycle.

4. Fungal symbionts: Mycorhizae and their applications. Lichen-Phycobiont and mycobiont, histology, biology and physiology of lichen thallus, economic importance of lichen.

5. Beneficial uses of fungi: Fungi in medicine and antibibtic production, alcohol production and organic acid production; industrial production of alcohol and penicillin.

6. Edible Mushrooms: cultivation technology, nutritional and medicinal properties of mushrooms.

7. Mastigomycotina: A comprehensive knowledge with emphasis on occurrence of sex hormones and sporangia to conidia transition.

8. Ascomycotina: A comprehensive knowledge with emphasis on types of ascocarps, their development and methods of spore dispersal.

9. Basidiomycotina: A comprehensive knowledge with emphasis on fruiting structures, development and methods of spore dispersal.

10. Deuteromycotina: A general account with emphasis on sporulating structures of the members, classification with special reference to conidial ontogeny.

11. Fungal diseases in animal and man and their management.

Plant Pathology (Theory)

1. History of the development of Plant Pathology.

2. Plant diseases: classification and types.

3. Pathogenesis: Contact, entry and penetration, infection of host tissue and disease development relationship between pathogen and host factor(s).

4. Plant pathogen in offence: Roles of enzymes, toxins and growth regulators in disease development.

5. Host plant in defence: structural and biochemical defence; concept of horizontal and vertical resistance.

6. Physiological changes in host plants as a result of infection.

7. Plant disease epidemiology: Factors responsible for development of plant disease epidemic; Disease forecasting and Remote Sensing.

8. Strategies of plant disease management: Cultural, chemical, biological and integrated management of pest and diseases; Biopesticides and their applications in management of plant diseases.

9. Seed pathology: Factors responsible for seed deterioration, effect of fungal deterioration of seeds and grains, mycotoxin production and control of seed deterioration.

10. Wood decay: Decay of wood and wood products by wood rotting fungi; Structural and biochemical changes of wood as a result of decay.

11. Study of plant diseases: Symptoms, etiology, disease cycles and control measures of some important diseases of the following crops: Rice, Wheat, Potato, Sugarcane and Tea.

BOT – 102 C (PR) / Core Course

Credit: 1 **Mycology and Plant Pathology (Practical)** **30 L**

Mycology (Practical)

1. Principles of sterilization and application of sterilization techniques
2. Preparation of media and their sterilization.
3. Study of fungal tissue organization.
4. Study of different spore forms in fungi.
5. Study of vegetative and reproductive structures of some important members of the following groups and their identification: (a) Phycomycetes, (b) Ascomycetes, (c) Basidiomycetes, (d) Deuteromycetes.
6. Demonstration for subculturing of fungal cultures and inoculation technique.
[Students are required to submit field and laboratory records, preserved and dried specimens and permanent slides]
7.Mushroom Culture maintenance (seed production) as well as cultivation.
8.Isolation of different fungus from different natural habitat (water/soil/air).

Plant Pathology (Practical)

1. Study of different types of symptoms of plant diseases.
2. Study of some important plant pathogens in relation to suspect and symptoms produced by members of
a) Phycomycetes b) Ascomycetes c) Basidiomycetes d) Deuteromycetes
3. Isolation of plant pathogens from diseased plants.
4. Study of some important rusts showing different spore forms.

5. Smut spore forms.

BOT – 103 C (TH) / Core Course

Credit – 3 **Phycology and Bryology (Theory)** **45L**

Phycology (Theory)

1. Modern criteria of algal classification with special emphasis on chloroplast ultrastructure, flagella and pigments. Lee's classification of Algae, its basis and importance. Use of molecular biology in Algal classification'
2. Endosymbiosis and its significance in algae. Prochlorophyta its features, chloroplast of chlorophyta and prochlorophyta.
3. General features and reproduction of Cyanophyta, Rhodophyta, Chlorophyta. Special emphasis on life cycles.
4. Photosynthetic Stramenopiles: distinctive features like thallus structure , pigments, reproduction typesand life cycles.
    a) Diatoms: Features and ecology.
    b) Xanthophyceans: General features, parallelism with green algae & affinities.
    c) Phaeophyceans: General features & ecology; lifecycle patterns.
5. Economic importance of algae, special discussion on SCP and soil fertility reclamation.
6. Origin and evolution of sexual reproduction in algae
7. Algal biotechnology, Culture and cultivation process of *Spirullina* , *Scenedesmus* and *Chlorella*.

Bryology (Theory)

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, biotechnology of Bryophytes.

BOT – 103 C (PR) / Core Course

Credit – 1 **Phycology and Bryology Practical** **30L**

Phycology (Practical)

1. Collection & identification of local algae of West Bengal. (Field report and laboratory notebooks should be mentioned).

2. Study of common phytoplankton.Thallus and reproductive structures . Camera lucida drawing and measurement of collected specimens.

3.Study of representative marine algae.

4. Algal culture technique (Fresh water and marine)

Bryology (Practical)

1. *Methods of collection and preservation of Bryophytes.*
2. *Comparative morphology and anatomy of the gametophytes and sporophytes of the different groups of Bryophytes (6 Members from Marchantiophyta, 1 Member from Anthocerophyta and 5 Members from Bryophyta)*
3. *Study of peristome structures of Nematodonteae and Arthrodonteae of the Bryopsida*
4. *Field work [Spot dominated with lower cryptogams inside state or outside state]*
5. *Students are required to submit field survey report and laboratory records preserved and dried specimens and permanent slides.*

BOT – 104 C (TH) / Core Course

Credit – 3 **Pteridology and Gymnosperm Theory** **45L**

Pteridology (Theory)

1. Classification of Pteridophytes
2. Early vascular plants: Rhyniophyta, Trimerophytophyta and Zosterophylophyta
3. Brief account of the range of structure and reproduction in Ferns
4. Telome concept, apogamy and apospory, heterospory and seed habit
5. Economic importance of Pteridophytes

Gymnosperms (Theory)

1. Classification of Gymnosperms.

2. Kinds of fossils, process of fossilization.

3. General account of Glossopteridaceae.

4. Comparative study of Coniferales (Pinaceae, Cupressaceae, Araucariaceae, Podocarpaceae, Cephalotaxaceae,
Taxodiaceae), Taxales and Gnetales (Gnetaceae, Ephedraceae and Welwitschiaceae).

5. Economic importance of Gymnosperms.

BOT – 104 C (PR)/Core Course

Credit – 3 **Pteridology and Gymnosperm Practical** **30L**

Pteridology (Practical)

1. Anatomical, morphological and palynological studies of some members of Pteridophytes occurring in West Bengal, Identification up to the genus. (Locally available)
2. Study of some fossils of pteridology

Gymnosperm (Practical)

1. Field work including submission of field and laboratory records.
2. Study of general habit, external and internal morphology with special reference to their male and female reproductive structures, pollen grains, Cycas, Ginkgo, Pinus, Cryptomeri, Thuja, Araucaria, Podocarpus, Cephalotaxus, Ephedra, Gnetum

3. Study of some fossils of Gymnosperm.

BOT – 105 I. A.

Credit – 4 **Internal Assignment** **15L**

6. Assignments: 2 from core papers
7. Seminar: One topic to be selected from of the core papers

BOT – 106 CF

Credit – 4 **Compulsory Foundation Course** **15L**

Communicative English and Personality Development

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Semester – II

BGOT – 201 C (TH) / Core Course

Credit – 3 **Plant Physiology (Theory)** **45 L**

1. Solute transport and photoassimilates translocation: uptake, transport and translocation of water, ions, solutes and macromolecules, mechanisms of loading and unloading of photoassimilates.
2. Photosynthesis: Z-scheme, Phosynthetic Carbon fixation, Different modes of CO_2 concentrating mechanisms, energetics and significance.
3. Present day concept of phytohormones and plant growth regulators; Phytohormone families and members of each family; growth promoting and retarding chemicals; general mode of phytohormone action; hormone binding proteins; second messengers; gene activation; examples of target cells for hormone action, antihormones, hormone mutants.
4. Phytohormones: Chemistry, biosynthesis, signalling, mode of actions, physiologcal functions and degradation/deactivation of auxins, gibberellins, cytokinins, abscisic acid and Ethylene.
5. Seed dormancy: Types, control mechanism, chemical and physical manipulative methods of breaking seed dormancy; biological significance of dormancy.
6. Flowering: Photoperiodic control, hormonal regulation; nature of floral stimulus; experimental evidence to prove the mobile nature of floral stimulus, gene- induced regulation floral development, ABC model, second messenger and flowering.
7. Senescence: Types of senescence, biochemical indices of senescence, physiobiochemical changes occurring during leaf senescence, senescence regulatory genes.

BOT – 201 C (PR) / Core Course

Credit – 1 **Plant Physiology (Practical)** **30L**

1. *Determination of water potential of plant samples by Chardakov's method.*
2. *Isolation of chloroplast and Study of photolysis of water by demonstration of Hill reaction.*
3. *Effect of high temperature stress on membrane deterioration in terms of membrane permeability test.*
4. *Effect of respiratory inhibitor on the rate of respiration.*
5. *Effect of sodium azide on water uptake by plants.*
6. *Demonstration of a bioassay method for IAA by wheat coleoptile test.*
7. *Extraction and estimation of photosynthetic pigments from leaf tissues.*

BOT – 202 C (TH) / Core Course

Credit - 3 Biochemistry and Molecular Biology of Plants (Theory) 45 L

1. The atom and chemical bonds, stabilizing interactions, reaction orders, pH, buffer, physicochemical properties of water.

2. Respiration: Glycolysis and its control and significance; TCA Cycle and Oxidative Phosphorylation; Pentose phosphate pathway and its control and significance; Gluconeogenesis and its control and significance, Glyoxalate cycle.

3. Amino acids and Proteins : Classification and structures, properties, determination of amino acid sequence in a polypeptide; Structural organization of Proteins, Post translational modification of protein, , chaperone and protein folding, protein targeting, Ramachandran plot

4. Enzyme kinetics: Deduction of Michaelis-Menten equation, Lineweaver-Burk plot; enzyme inhibition, isozymes, allosteric enzymes, ribozymes and abzymes.

5. Lipid metabolism: biosynthesis and oxidation of fatty acids

6. Photorespiration: Compartmentalized reactions, regulation, energetics and significance; Structural and functional characteristics of Rubisco and its regulation. Gene expression:

7. Regulation of gene expression in eukaryotes – at transcriptional level and post transcriptional level.

8. Recombinant DNA technology: Principles and methods of recombinant DNA technology-expression of cloned genes in E. coli, cloning in yeast: transformation in yeast, yeast artificial chromosome (YAC), retrovirus like vector (Ty) in yeast/shuttle vector, Molecular improvement of crops.

BOT – 202 C (PR) / Core Course

Credit - 1 Biochemistry and Molecular Biology of Plants (Practical) 30 L

1. *Molecular Biology tools: PCR, Gel electrophoresis (Agarose gel), Isolation of plasmid and genomic DNAs (Demonstration).*
2. *Assay of enzymes from plant sample: Catalase, Protease.*
3. *Spectrophotometric estimation: reducing sugar, amino acids, DNA, RNA, Protein, phenolics.*
4. *Protein purification from plant tissue.*
5. *Biochemistry tools: Different Centrifuges, including Ultracentrifuge, Spectrophotometry, Spectroflurometry, Chromatography, 1D SDS-PAGE (Demonstration).*

BOT- 203 C (TH) / Core Course

Credit- 3 Morphology, Palynology & Reproductive Biology (Theory) 45 L

Morphology (Theory)

1. Metamorphosis of different plant parts, Homology and analogy, Origin and evolution of Inflorescence, Morphology of stamens and carpels, Ontogeny of carpels, Evolution of placenta and placentation.

Palynology (Theory)

1. Microspore tetrads, polarity of spores and pollen grains.

2. Spore-pollen morphology: Symmetry, shape, size, aperture patterns, NPC System for numerical expression of apertural details, exine stratification, surface structures and sculptures of sporoderm; LO-analysis and edge-analysis.

3. Chemical nature of sporopollenin, development of pollen wall, Ubisch body, exineless pollen grains. Extraexinous wall material - perine, viscin-threads, pollen-kit.

4. Application of palynology: Palynology in taxonornic and phylogenetic deductions; Aeropalynology with reference to allergy; Melissopalynology; Palaeopalynology; Forensic palynology.

5.Pollen dispersal units; concept of anthesis; Pollination modes; floral constructions with respect to specific pollination modes.

Reproductive Biology (Theory)

Microsporogenesis and megasporogenesis, Fertilization, post fertilization modification of ovule; Breeding systems, self-incompatibility and compatibility control with reference to pollen-pistil interactions.

6. Development of flower, embryo formation and endosperm development

BOT- 203 C (PR) / Core Course

Credit- 1 Morphology, Palynology & Reproductive Biology (Practical) 30 L

1. Identification of the morphological parts and description.

2. Pollen morphological studies of selected taxa of pterodophytes, gymnosperms, and angiosperms representing different morphological types using acetolysis/alkali maceration method; preparation of pollen key.

3. Extraction of pollen grains from honey sample and qualitative and quantitative analyses (with graphical representation) of pollen morpho-types.

4. Study of in vivo and in vitro germination of pollen grains.

5. Study of the growth of pollen tube through stigma and style.

6. (Submission of laboratory records, educational excursion reports including collected specimens and permanent slides)

BOT – 204 C (TH) / Core course

Credit-3 Taxonomy of Angiosperms (Theory) 45L

1. Taxonomy and systematics -concept, objectives and significance

2. Plant nomenclature-ICN, Principles, rules, recommendation and appendices, type concept, rules of priority, effective and valid publication, rejection of names. Taxonomic Hierarchy-definition, concept of species, genus, family and other categories.

3. Angiosperm classification: - Phenetic versus Phylogenetic systems, Cladistics in taxonomy; classification, relative merits and demerits of major system of classifications-Bentham and Hooker, Takhtajan, Cronquiest and APG-III (2009).

4. Biosystematics- methods, categories and relation with traditional taxonomy.

5. Role of Botanic garden and Herbaria in taxonomic study; Botanical Survey of India, its contribution and functions.

6. Taxonomic literatures- types, definition and Examples.

7. Salient features, floral diversity, diversity of families and phylogeny of the following orders- Ranales, Centrospermae, Amentiferae, Tubiflorae, Helobieae and Glumiflorae.

8. Principle of Phytogeography:-Static and dynamic concepts. Continental drift theory and endemism. Invasion and introductions. Local plant diversity and its Socio-economic importance.

BOT – 204 C (PR) / Core course

Credit-1 Taxonomy of Angiosperms (Practical) 30L

1. *Study of about 10 wild taxa representing different families and identification to species level.*
2. *Study of flora of any forest patch of West Bengal.*
3. *Construction of Taxonomic keys.*

4. *As a part of botanical tours, student must observe and record of the flora of vegetation types of the study area and submit a report at the time of practical examination.*
5. *Formation of Phenogram and Cladogram.*
6. *Study of some micromolecular data in plant taxonomy like Betalins, Glucosinolates, Flavonoids, Terpenoids and Alkaloids.*
7. *Part of practical- student should submit minimum 50 Herbarium specimens or image of soft copies of 30 plants of common wild taxa.*

BOT – 205 I. A.

Credit – 4 **Internal Assignment** **15L**

1. Assignments: 2 from core papers
2. Seminar: One topic to be selected from of the core papers

BOT – 206 CF

Credit – 4 **Compulsory Foundation Course** **15L**

1. Yoga and Life Skill

2. Education Value Education and Human Rights

The foundation courses are to be conducted by the University. The course shall have internal assessment only and so, credit earned for these courses, shall not be considered while preparing the final result. However, the candidates are required to obtain Satisfactory or Not Satisfactory to become eligible for the final semester examination/ award of the PG Degree.

Semester - III

BOT 301 C (TH) / Core Course

Credit – 3 Cytogenetics and Plant breeding, Biostatistics (Theory) 45 L

Cytogenetics & Plant breeding (Theory)

1. Introduction to Plant Genetics: Brief history of classical and molecular genetics; Extension of Mendelism; Allelism; Gene action, Penetrance and expressivity; Gene interaction – polygenic inheritance.
2. Genome Organization in Eukaryotes: Genome types; Eukaryote nuclear genome; gene concept; Organization of structural and functional components of chromosome-centromere, telomere, NOR; Sex chromosome in plants; Genome duplication, alteration and their evolutionary role; C-value paradox.
3. Structure and function of Transposable elements and their role in evolution
4. Biomembranes: Structural models, composition and dynamics, biogenesis and assembly, transport of macromolecules and ions.
5. Nucleus: Chromatin organization and activation, packaging and its higher order structure, chromosome, basic nucleolar structure structures and dynamics.
6. Cytoskeletons: Nature, intermediate filaments, microtubules, actin-binding filaments.
7. Cell cycle: Phases and control in Yeasts; Cancer – molecular events, proto-oncogenes, tumor-suppressor gene and their inter-play, therapy.
8. Bioinformatics: Genome and protein information resources, sequence analysis, multiple sequence alignment, homology and analogy, pattern recognition, analysis package, application and prospects in medicine and agriculture.
9. Genomes, Genomics and Proteomics: Gene Search and Comparative Genetic data.
10. Population Genetics and Plant Breeding: Defination, Gene Frequency in population; Genetic Equilibrium; Hardy-Weinberg Law; Speciation Mechanism; Breeding system and genetic consequences in plants; Qualitative and quantitative traits; Marker Assisted Breeding for agronomic importance; QTL mapping.

Biostatistics (Theory)

1. Variable and attribute, primary and secondary data.
2. Sampling and sample designs: Classification and tabulation of data; Frequency distribution; Diagrammatic and graphical presentation.
3. Central tendency: Arithmetic, geometric and harmonic mean; Median; Mode.
4. Measures of dispersion: Variance; Mean deviation; Standard deviation and error; Moment; Skewness and kurtosis.
5. Correlation and regression analysis: Bivariate and multivariate.
6. Normal, binomial and poisson distribution.
7. Test of hypothesis: t, u and Chi square test.
8. Analysis of variances and covariance: Bivariate and multivariate.

BOT 301 C (PR) / Core Course

Credit – 1 Cytogenetics and Plant breeding, Biostatistics (Practical) 30 L

Cytogenetics and Plant Breeding, Biostatistics (Practical)

1. Meiotic and Mitotic chromosome analysis and divisional phases.

2. Analysis of genotype – Environment interaction, Correlation coefficient and Yield component analysis.

3. Analysis of genetic polymorphism – Cytogenetic biomarker in mutagenesis, Isozymes and other molecular markers (RAPD) – Demonstration.

4. PCR based site directed mutagenesis.

5. Cell Biology: Isolation of plant genomic DNA; estimation of purity; agarose gel electrophoresis; protein gel electrophoresis; native and 1D SDS-PAGE; subcellular fractionation of plant tissue and isolation of cellular organelles.

8. *Determination of abnormality index and types of chromosomes/nuclear abnormalities in root tip meristem.*
9. *Bioinformatics: Data base, sequence analysis, phylogenetic inference package.*
10. *Calculations of mean, variance, standard deviation, standard error, coefficient of variance, Use of t-test for comparing two means.*

9. Determination of the relationship between variables using correlation and regression analysis.

10. Analysis of variance: ANOVA, ANCOVA, U-test.

11. Use of Chi-square test for goodness of fit.

12. Submission of laboratory records

BOT 302 C (TH) / Core Course

Credit: 3 Ethnobtany, Pharmacognosy and Plant Tissue Culture (Theory) 45**L**

Ethnobotany (Theory)

1. Definition, concept & importance.
2. Branches of Ethnobotany, categories of Ethnobotanical uses.
3. Method of study.
4. Tribes in India and their classification.
5. Study of some plants which have Ethnobotanical uses.
6. Study of some drugs which have discovered from Ethnobotanical leads – Plant source, Drug, Medicinal use.

Pharmacognosy (Theory)

1. Definition. History and scope of Pharmacognosy including indigenous system of medicine.

2. Drugs: Various systems of classification of drugs of natural origin, Morphological and microscopic examination of drugs.

3. Extraction and purification of natural products; Chromatographic study of drugs; Spectroscopic techniques; Methods of identification and analysis of results; Applications of phytochemical analysis.

4. Importance of Crude drug; Preparation of drugs for commercial market: a) Collection, Harvesting, Drying,

Garbling, Packaging, storage and preservation. b) Drug evalution. Significance of pharmacopoeial standards, Adulteration, contamination and substitution.

5. Pharmacological activities of natural products, its' importance in pharmaceutical industries.

Tissue Culture (Theory)

1.Recent advances in plant tissue culture. A brief idea about totipotency, somatic embryogenesis and somaclonal variation, Protoplast isolation. Methods of artificial seed production.

2.Micropropagation: Technology applications, *in vitro* propagation of Horicultural and Agricultural crops.

3.Role of plant tissue culture in Germplasm conservation.

4.Industrial applications of tissue culture with particular reference to secondary metabolites.

BOT 302 C (PR) / Core Course

Credit: 1 **Ethnobtany and Pharmacognosy (Practical)** 30**L**

1. *Organoleptic and microscopic studies in crude drug materials of plant origin in form of intact (fresh) and powdered samples: leaf, stem, rhizome, root, fruit and seed – drugs. (Kurchi – Holarrhena pubescence , Cinchona- Cinchona officinalis, Rauwalfia – Rauwalfia serpentine , Cascara – Rhamnus purshiana , Nayan tara - Catharanthus roseus., Kuchila – Strychnos nux- vomica).*
2. *Study of unorganized drugs - grains, resins, latex, oils etc.*
3. *Routine phytochemical tests for identification of certain secondary metabolites (alkaloids, tannins, terpenes, steroids, antroquinones, ellagic acid, gallic acid, glucosinolates etc.).*
4. *The fluorescence characteristics of powdered drug samples treated with inorganic acids and solvents under ordinary light and UV light.*
5. *Total antioxidants capacity of some edible parts of some medicinal plants.*
6. *Excursion to acquaint with the drug plants and ethnic specimens.*

BOT 303 C (TH) / Core Course

Plant Anatomy, Palaeobotany, Bioinstrumentation (Theory)

Credit-3 **45 L**

Plant Anatomy (Theory)

1. Organization of shoot and root apical meristems. Changes in shoot apex during transition to flowering.

2. Development and differentiation: Polarity, symmetry, pattern formation (brief idea of genetic control of differentiation and organogenesis)

3. Origin, differentiation and phylogeny of xylem and phloem.

4. Leaf morphogenesis (brief idea of genetic control of differentiation and organogenesis).

5. Xylotomy and its importance.

6. Ultra structural features of sieve tube elements and their importance.

Palaeobotany (Theory)

1. Definition of fossil.

2. Principals of correlation and stratigraphy; dating of rocks; outline of Standard Geologic Time Scale.

3. Chemical evolution and origin of life; early life forms as known from Precambrians; origin of eukaryotes.

4. Mass extinctions with special references to the floral changes through Permo-Trassic (P-T) and Cretaceous- Tertiary (K-T) transitions.

5. Continental Drift Hypothesis.

6. Introductory idea of the importance of fossil plants in palaeoecological studies.

Bionstrumentation (Theory)

1. Isolation and purification of Protein, RNA, DNA (genomic and plasmid); Analysis of and proteins, RNA and DNA by one and two dimensional gel electrophoresis, isoelectric focusing.

2. Protein sequencing methods, detection of post-translation modification of proteins;Isolation, separation and analysis of carbohydrate and lipid molecules.

3. DNA sequencing methods, strategies for genome sequencing; Methods for analysis of gene expression at RNA and protein level, Micro array based techniques.

4. Molecular cloning of DNA or RNA fragments in bacterial; expression of recombinant Proteins using bacterial and plant vectors; Isolation of specific nucleic acid sequences; generation of genomic and cDNA libraries in plasmid BAC and YAC vectors.

5. RFLP, RAPD and AFLP techniques.

6. Analysis of biomolecules using UV/visible, fluorescence, NMR; Structure determination using X-ray diffraction.

7. Different Radiolabeling techniques, Incorporation of radioisotopes in biological samples, molecular imaging of radioactive material.

8. Fermentation Technology.

10. Microscopy: Principles of light and electron microscopy; Light, Fluorescence, Confocal, SEM, TEM and AFM.

BOT 303 C (PR) / Core Course
Plant Anatomy, Palaeobotany, Bioinstrumentation (Practical)

Credit-1 **30L**

1. *Study of stomatal index, palisade ratio, vein-islet number.*
2. *Comparative study of nodal vascular: Unilacunar, Trilacunar, Multilacunar.*
3. *Comparative study of lacitifers.*
4. *Structural analysis of secondary xylem and secondary phloem in section.*
5. *Study of sieve elements in angiosperms and gymnosperms.*
6. *Study of representative megafloral assemblages and determination of age.*
7. *Field works for extant gymnosperms and palaeobotany.*
8. *Demonstration of instruments; Electrophoretic techniques (1D, 2D); ChromatographicTechniques (Paper, Thin Layer, HPLC, GC), Restriction Mapping, RAPD, Transformation, PCR, SEM, Confocal and TEM*
9. *Industrial and Laboratory visits*
10. *** (Submission of field and laboratory records including permanent slides).*

BOT 304 EA (TH) / Elective Course Major

Credit – 3 **Taxonomy of Angiosperms and Biosystematics (Theory)** **45 L**

1. Circumscription and Phylogeny of Dilleniidae, Hamamelidae, Caryophyllidae, Rosidae, Asteridae; Alismatidae, Arecidae, Commelinidae, Zingiberidae and Liliidae sensu Cronquist (1988).

2. Taxonomy of Parasitic, Saprophytic and Insectivorous plants and their specializations.

3. Centres of origin and diversity of cultivated plants.

4. Evolution and differentiation of species - Abrupt and gradual speciation; Isolating mechanism- Geographical, ecological, seasonal, temporal, mechanical and ethological.

BOT 304 EA (PR) / Elective Course Major

Credit – 1 **Taxonomy of Angiosperms and Biosystematics (Practical)** **30 L**

i. *Study of the representative species selected from the Subclasses mentioned in the Theory Syllabus*

ii. *2. Study of exomorphic features of plants*

iii. *Excursions should be arranged to study different vegetations*

BOT 304 EB (TH) / Elective Course Major

Credit – 3 **Microbiology (Theory)** **45 L**

1. Modern concept of bacterial taxonomy: Numerical taxonomy, Bergey's manual of Determinative & Systematic Bacteriology, Type culture collection centre.
2. Concise account of the following groups: a) Mycoplasmatales b) Myxobacteria c) Cyanobacteria d) Green sulfur bacteria e) Chemolithotrophic bacteria f) Actinobacteria g) Proteobacteria
3. Aerobic, Anaerobic respiration in bacteria & Bacterial Fermentation: - EMP pathway, HMP pathway, ED pathway, TCA Cycle, Glyoxalate Cycle, ETC, Protonmotive force, Chemiosmotic theory ; Dentrification, Alcohol Fermentation Lactate Fermentation.
4. Biosynthesis of Amino acids & Nucleic acids in Bacteria

5. Fermentation & Food Microbiology Fermenter –Basic principles, types, operation, surfactant; Microbial fermentation of industrial enzymes, antibiotics, amino acids.

6. Fermented foods :- dairy products, alcoholic beverages e.g. beer, wine, microbial cells as food (Probiotics), Food borne disease; contamination and spoilage of food , methods of food preservation (physical and chemical).

7. Agricultural Microbiology: Biological nitrogen fixation, nitrogenase and alternative nitrogenase system, nif genes; degradation of cellulose, hemicellulose and lignin, biofertilizers (mass production of Rhizobium and Azotobacter); Microbial control of insects. Use of viruses in agriculture.

8. Advanced approaches in Microbiology: Genomics, Proteomics, Metagenomics, Microarray, Bioinformatics.

BOT 304 EB (TH) / Elective Course Major

Credit – 3 **Microbiology (Practical)** **30 L**

1. Quantitative estimation of Sugar, Protein, DNA and RNA by spectrophotometric method.

2. Separation of mixture of sugars and amino acids by paper Chromatography and Thin Layer Chromatography.

3. Enrichment culture

a) Aerobic N_2 fixing bacteria b) Photosynthetic bacteria

c) Endospore forming bacteria d) Cellulase producing bacteria, e) Phosphate solubilizing bacteria.

4. Effect of pH,temperature and substrate concentration on bacterial amylase activity.

5. Determination of quality of milk by methylene blue reductase test method.

6. Physio-biochemical test for identification of bacteria:-

a) Catalase b) Protease, c) Amylase d) Acid & Gas Production, e) Indole production f) V-P Test, g) Citrate utilization test.

7. Isolation of Rhizobium from nodule of leguminous plant .Production of Rhizobium inoculant in laboratory fermenter.

8. Uses of Bioinformatics tools for bacterial gene sequences and protein sequences.

305 EIDA (TH) / Elective Course Minor
Evolution and Plant Life (Theory)

Theory Credit-3 **45 L**

1. The historical framework
   a. Before Darwin
   b. Darwin and Darwinian impact
   c. Arguments on Darwinism
   d. Fossils
2. The Physical and chemical framework
   a. The Universe and the Earth
   b. Molecules and origin of life
3. The organic framework
   a. Genetic consistency and variability
   b. Molecular phylogeny
   c. Origin of species
   d. Evolution of prokaryotes and eukaryotes
   e. Evolution of plants and fungi
4. Adaptation of plants

305 EIDA (PR) / Elective Course Minor
Evolution and Plant Life (Practical)

Credit-1 **30L**

1. *Study of plant fossils*
2. *One seminar from the given theoretical syllabus*

305 EIDB / Elective Course Minor
Plant System and Organisation of Plants (Theory)

Credit-3 **45 L**

1. Plant body – an outline, seed and seedling
2. Meristem organization, vegetative bud and floral bud
3. Epidermal and ground tissues
4. Vascular tissues and their evolution, stele
5. Plant cell and cell division
6. Central dogma and its role.
7. Proteins – the control molecules of metabolism
8. Photosynthesis as only mechanism for fixing radiant energy
9. Plant secondary metabolites, a general concept

305 EIDB (PR) / Elective Course Minor
Plant System and Organisation of Plants (Practical)

Credit-3 **30 L**

1. *Study of seeds*
2. *Study of different types of stele*
3. *Mitosis cell division*
4. *Measurement of dissolved oxygen in water after photosynthesis of aquatic plants*

305 EIDC (TH) / Elective Course Minor
Ecology and Conservation Biology (Theory)

Theory Credit-3 **45 L**

1. Definition and scope of ecology, Autecology and Syncology
2. Environmental factors
3. Ecosystem structures and interaction among organisms
4. Resources – degradation and conservation
5. Pollution and its managements
6. Biodiversity and wildlife conservation
7. Environmental monitoring
8. Environmental biotechnology
9. Environmental education in India

305 EIDC (PR)/Elective Course Minor
Ecology and Conservation Biology (Practical)

Credit-1 **30L**

1. *Study of soil carbon, soil nitrogen, soil humidity, soil microbes*
2. *Study of plant community: quadrat methods and study of vegetation density.*
3. *Excursion to study plant diversity*

SEMESTER IV

BOT – 401 C (TH) / Core Course
Credit-4 **Ecology and Evolution (Theory)**
45

1.Climate and Vegetation: Introduction to concepts developments in ecology. Atmosphere,Hydrosphere and Biosphere – Life zones. Major biomes of the world; Vegetation types of the world and India.

2.Plant Community and Population Biology: Concepts of community, analytical and synthetic characters, community coefficients, interspecific associations, ordination, organization. Concept of habitat; species coexistence and niche, Population Biology: Concepts and Growth models.

3.Species interactions: Types of species interactions.
4.Ecosystem: Structure and function. Energy dynamics – energy flow models and efficiencies. Mineral cycles: C, N, P and S mineral cycles, pathways, processes and budgets in terrestrial and aquatic systems.
5.Productivity and Plant Succession: Productivity: definition, types. Primary productivity - measurements, global pattern and controlling factors. Succession (Ecosystem development): Concept, kinds, mechanisms and models, changes in ecosystem properties during succession.
6.Environmental Pollution and Standard Parameters: Air, water and soil pollution – Definition, kinds, sources, quality parameters, effects on plants and ecosystem.Methods/techniques used in Phytoremediation / Bioremediation.
7.Biodiversity: Biodiversity: general concept, levels, importance, assessment of variation and isolation. Conservation principles and strategies, Red Data Book and different categories of threatened plants (IUCN). Hotspots.

Evolution (Theory)

1. Early ideas leading to the firm establishment of the reality of evolution.
2. Pre Darwinian scenario of the theories on evolution.
3. Darwinism, Natural Selection as the driving force of evolution.

BOT – 401 C (PR) / Core Course

Credit-4 **Ecology (Practical)** **30L**

1. Determination of species area curve by Quadrat method.

2. Determination of density, frequency, basal cover of species and IVI of the species.

3. Determination of association index of species.

4. Determination of index of similarity / dissimilarity between two communities.

5. Estimation of organic matter content of soil.

6. Determination of total soluble salts of soil / water.

7. Some field tests for the determination of soil texture.

8. Determination of nutrient content of soil by kit- method.

9. Colorimetric determination of nitrogen and phosphorus of soil.

10. Determination of dissolved oxygen in unpolluted and polluted water.

BOT – 402 C (TH) / Core Course

Credit-4 **Plant Anatomy, Silviculture** **45L**

Plant Anatomy

1. Organization of shoot and root apical meristems. Changes in shoot apex during transition to flowering.

2. Development and differentiation: Polarity, symmetry, pattern formation (brief idea of genetic control of differentiation and organogenesis)

3. Origin, differentiation and phylogeny of xylem and phloem.

4. Leaf morphogenesis (brief idea of genetic control of differentiation and organogenesis).

5. Xylotomy and its importance.

6. Ultra structural features of sieve tube elements and their importance.

Silviculture (Theory)

Definition, scope and objectives; Farm forestry, social forestry and agro forestry; Natural and artificial regeneration of forests; Non timber forest products of economic values

BOT – 402 C (PR) / Core Course

Credit-4 **Plant Anatomy, Silviculture (Practical)** **45L**

Plant Anatomy, Silviculture (Practical)

1. *Study of stomatal index, palisade ratio, vein-islet number.*
2. *Comparative study of nodal vascular: Unilacunar, Trilacunar, Multilacunar.*
3. *Comparative study of lacitifers.*
4. *Structural analysis of secondary xylem and secondary phloem in section.*
5. *Study of sieve elements in angiosperms and gymnosperms.*
6. *Wood anatomy of Sal, Teak, Gamar*
7. *Height measurement of trees*
8. *Plane table survey*
9. *Study of biodiversity index of a local forest*

** *(Submission of field and laboratory records including permanent slides).*

BOT 403 I. A.

Educational Excursion to industries and Laboratories for knowledge on Bioinstrumentation, Tutorial, Library work (Participation – 10 marks, Report – 30 marks, Viva – 10 marks) evaluated by the (Supervisor – 10 marks, All Faculties - 40 marks)

BOT 404 EA (TH) / Elective Course Major

Credit – 3 Taxonomy of Angiosperms and Biosystematics (Theory) 45 L

1. Biosystematics principles, practices, limitations and scope; phenotypic plasticity

2. Endemism, Definition, Different theories regarding endemism; Distribution of endemic plant families in the southern hemisphere of the globe.

3. Taxonomic Evidences: - Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Nucleic acid hybridization as a tool in taxonomy

Molecular markers in Plant Systematics and phylogenetic analysis: Nuclear ribosomal DNA, Chloroplast DNA and Mitochondrial DNA; DNA Barcoding, Computer application and GIS.

BOT 404 EA (PR) / Elective Course Major

Credit – 3 Taxonomy of Angiosperms and Biosystematics (Practical) 30 L

1. Phytography as per the pattern followed in the recent Floras.

2. Application of ICN rules in solving nomenclatural Problems.

3. Application of objective taxonomy (Phenetics and Cladistics) in resolving form relationship and phylogenetic relationship using.
4. Study of local vegetation by biological spectrum.
5. Excursions should be arranged to study different vegetations

BOT 404 EB (TH) / Elective Course Major

Credit – 3 Microbiology (Theory) 45 L

1. Concise account of the following groups:-
   a) Rickettsiales b) Chlamydiae c) Thermophiles d) Halophiles
2. Plasmid- Types, Compatibility, Copy numbers, maintenance & amplification;Ti plasmid & its application in Biotechnology.
3. Recombinant DNA Technology- Principles, Enzymes, Vectors, Methods, application of Recombinant DNA technology.
4. Virology, Cultivation of plant viruses, methods for detection and assay, phage typing, Classification of viruses,
   Hepatitis B and C, their salient properties, diagnosis, prevention and treatment, interferon and antiviral drugs.
5. Environmental Microbiology: Biological treatment of wastes and pollutants: solid wastes disposal, treatment of liquid wastes; Biodegradation of environmental pollulants: petroleum hydrocoarbons and xenobiotics. Bioremediation of heavy metals; Bioleaching and recovery of metals.

7.Chemotherapy:- Sulfar drugs & their mode of action ; Antibiotics – classification, mode of actions, antibiotic assay and sensitivity test, non-medical uses of antibiotics. Antiviral drugs and their mode of action; Drug resistance-origin, causes and clinical implications. Interferon – Chemical nature, mechanism of action, production and application.

8.Pathogenecity of human diseases: - Pathogenecity due to invasiveness, exotoxin, endotoxin, toxoid and their practical application; Plant microbe interaction, Quoram sensing.
9.Immunology- Innate & Adaptive immunity; Cell mediated and Humoral immunity; MHC types and function; Cytokines; Complement–types, pathways of fixation; Antibody diversity and Class switching; Hypersensitivity-and their types; Monoclonal antibody production and application; Ag-Ab reaction; Diagnostic serological test - Immunofluorescence, RIST, RAST, and FACS; Vaccines.

BOT 404 EB (TH) / Elective Course Major

Credit – 3 Microbiology (Practical) 30 L

1. Determination of MIC of antibiotic by tube dilution assay method. Assay of antibiotic by agar cup assay method.

2. Determination of phenol co-efficient.

3. Standard Quality analysis of water-
a) Presumptive test b) Confirmed test c) Completed test d) IMVIC test
4. Estimation of DNA, RNA and Proteins
5. Demonstration of the operation of following Instruments
a) Spectrophotometer UV-Vis, b) Lyophilizer c) Sonicator d) Fraction collector e) GC-MS f) Laboratory fermenter g) Cold Centrifuge h) Ultracentrifuge i) HPLC j) SEM k) PCR l) Gel documentation System.

6. Isolation of Plasmid / genomic DNA from bacteria and Agarose gel Electrophoresis of isolated DNA
7. Restriction enzyme digestion, electrophoresis & documentation. SDS-PAGE of protein.

BOT 405 DN

Dissertation Work (Start from 3rd Semester and will be continued upto 4th Semester and to be assessed by HOD, Supervisor and one External Expert)

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BOT – 103 C (TH) / Core Course

Credit – 3 **Phycology and Bryology (Theory)** **45L**

Phycology (Theory)

1. Modern criteria of algal classification with special emphasis on chloroplast ultrastructure, flagella and pigments.
2. Endosymbiosis and its significance in algae.
3. General features and reproduction of Cyanophyta, Rhodophyta, Chlorophyta
4. Photosynthetic Stramenopiles: distinctive features
    a) Diatoms: Features and ecology.
    b) Xanthophyceans: General features, parallelism with green algae & affinities.
    c) Phaeophyceans: General features & ecology; lifecycle patterns.
5. Algal biotechnology

6. BOT – 103 C (PR) / Core Course

Credit – 1 **Phycology and Bryology Practical** **30L**

Phycology (Practical)

1. Collection & identification of local algae of West Bengal.

2. Study of common phytoplankton.

3. Study of representative marine algae