

Curriculum and Syllabus
For B. Sc. (Honours) Botany
Submitted to



THE UNIVERSITY OF BURDWAN

Under

Choice Based Credit System (CBCS)
(*w.e.f.* Academic Year 2017-2018)

Structure of B.Sc. Honours Botany under CBCS

Core Courses

1. Microbiology and Phycology
2. Archegoniatae
3. Mycology and Phytopathology
4. Morphology and Anatomy of Angiosperms
5. Plant Ecology and Phytogeography
6. Plant Systematics
7. Economic Botany
8. Palaeobotany and Palynology
9. Biomolecules and Cell Biology
10. Molecular Biology
11. Plant Physiology
12. Plant Metabolism
13. Genetics and Plant Breeding
14. Plant Biotechnology

Skill Enhancement Courses: Elective (Two)	
Semester –III SEC-I	<p><u>SEC-I (Any one)</u></p> <ol style="list-style-type: none"> 1. Ethnobotany 2. Intellectual Property Rights 3. Medicinal Botany 4. Mushroom Culture Technology 5. Agricultural Botany
Semester -IV SEC-II	<p><u>SEC – II (Any one)</u></p> <ol style="list-style-type: none"> 1. Biofertilizers 2. Herbal Technology 3. Nursery & Gardening 4. Floriculture 5. Plant Diversity & Human Welfare

Generic Electives (Four) Offered to the students of other Departments	
Semester –I GE-I	<p><i>GE-I (Same as core course-1 of B.Sc. Botany general)</i></p> <ol style="list-style-type: none"> 1. Biodiversity (Microbes, Algae, Fungi and Archegoniatae)
Semester –II GE-II	<p><i>GE-II (Same as core course-II of B.Sc. Botany general)</i></p> <ol style="list-style-type: none"> 2. Plant Ecology and Taxonomy
Semester –III GE-III	<p><i>GE-III (Same as core course-III of B.Sc. Botany general)</i></p> <ol style="list-style-type: none"> 3. Plant Anatomy and Embryology
Semester –IV GE-IV	<p><i>GE-IV (Same as core course-IV of B.Sc. Botany general)</i></p> <ol style="list-style-type: none"> 4. Plant Physiology and Plant Metabolism

Discipline Specific Electives (Four)

SEMISTER - V	<p>DSE-1. (Any One)</p> <ol style="list-style-type: none"> 1. Techniques in Plant Sciences 2. Reproductive Biology of Angiosperms (Rep. Biol. of Angio.) 3. Sylviculture & Forest Management (Sylvi. Cult. & Forest Mangt.) <p>DSE-2. (Any One)</p> <ol style="list-style-type: none"> 1. Biostatistics 2. Bioinformatics 3. Natural Resource Management (Nat. Res. Mgmt)
SEMISTER - VI	<p>DSE-3 (Any One)</p> <ol style="list-style-type: none"> 1. Phytoremediation & Immunology (Phyt. Rem & Immn) 2. Plant Evolution & Biodiversity (Plnt. Evl. & BioDv) 3. Marine Biology & Phycotechnology (Mar. Biol. & PyTec) <p>DSE-4 (Any One)</p> <ol style="list-style-type: none"> 1. Horticulture Practices & Post-Harvest Technology (Hort. Prct. & PHT) 2. Industrial and Environmental Microbiology (Ind & Env. Microb.)

Ability Enhancement Compulsory Course

AECC-1. Environmental Studies (ENVS)

AECC-2. English Communication / MIL

OUTLINE OF DISTRIBUTION

Semester	Core Course (14)	Ability Enhancement Compulsory Course (AEC) (2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective: (DSE) (4)	Generic Elective: GE) (4)
I	Microbiology and Phycology	ENVS			GE-1 (For other than Botany Hons student)
	Archegoniatae				
II	Mycology and Phytopathology	English Communication / MIL			GE-II (For other than Botany Hons student)
	Morphology & Anatomy				
III	Plant Ecology & Phytogeography		<u>SEC-I (Any one)</u> 1. Ethnobotany 2. Intellectual Property Rights 3. Medicinal Botany 4. Mushroom Culture Technology 5. Agricultural Botany		GE-III (For other than Botany Hons student)
	Plant Systematics				
	Economic Botany				
IV	Palaeobotany & Palynology		<u>SEC-II (Any one)</u> 1. Biofertilizers 2. Herbal Technology 3. Nursery & Gardening 4. Floriculture 5. Plant Diversity & Human Welfare		GE-IV (For other than Botany Hons student)
	Biomolecules & Cell Biology				
	Molecular Biology				
V	Plant Physiology			<u>DSE-I (Any One)</u> 1. Techniques in Plant Sciences 2. Rep. Biol. of Angio. 3. Sylvi. Cult. & Forest Mangt.	
	Plant Metabolism			<u>DSE-II (Any One)</u> 1. Biostatistics 2. Bioinformatics 3. Nat. Res. Mgmt	
VI	Genetics & Plant Breeding			<u>DSE-III (Any One)</u> 1. Phyt. Rem & Immn 2. Plnt. Evl. & BioDv 3. Mar. Biol. & PyTec	
	Plant Biotechnology			<u>DSE-IV (Any One)</u> 1. Hort. Prct. & PHT 2. Ind & Env. Microb.	

CREDIT DISTRIBUTION

SEMESTER	COURSE OPTED	COURSE: NAME	Credits
SEM - I Total Credit 22	Ability Enhancement Compulsory Course-I	ENVS	4
	Core Course-I	Microbiology and Phycology	4
	Core Course-I Practical	Microbiology and Phycology- Practical	2
	Core Course-II	Archegoniate	4
	Core Course-II Practical	Archegoniate - Practical	2
	Generic Elective-I	GE-I	4
	Generic Elective-I Practical/Tutorial	GE-I- Practical	2
SEM - II Total Credit 20	Ability Enhancement Compulsory Course-II	English Communication/MIL	2
	Core Course-III	Mycology and Phytopathology	4
	Core Course-III Practical	Mycology and Phytopathology- Practical	2
	Core Course-IV	Morphology & Anatomy	4
	Core Course-IV Practical	Morphology & Anatomy - Practical	2
	Generic Elective-II	GE-II	4
	Generic Elective-II Practical	GE-II – Practical	2
SEM - III Total Credit 26	Core Course-V	Plant Ecology & Phytogeography	4
	Core Course-V Practical	Plant Ecology & Phytogeography - Practical	2
	Core Course-VI	Plant Systematics	4
	Core Course-VI Practical	Plant Systematics –Practical	2
	Core Course-VII	Economic Botany	4
	Core Course-VII Practical	Economic Botany - Practical	2
	Skill Enhancement Course-I	SEC-I (Any one)	2
	Generic Elective-III	GE-III (Any one)	4
	Generic Elective-III Practical	GE-III - Practical	2

SEM - IV Total Credit 26	Core Course-VIII	Palaeobotany & Palynology	4
	Core Course-VIII Practical	Palaeobotany & Palynology – Practical	2
	Core Course-IX	Biomolecule & Cell Biology	4
	Core Course-IX Practical	Biomolecule & Cell Biology – Practical	2
	Core Course-X	Molecular Biology	4
	Core Course-X Practical	Molecular Biology - Practical	2
	Skill Enhancement Course- II	SEC-II (Any one)	2
	Generic Elective-IV	GE-IV	4
	Generic Elective-IV Practical	GE-IV - Practical	2
SEM - V Total Credit 24	Core Course-XI	Plant Physiology	4
	Core Course-XI Practical	Plant Physiology - Practical	2
	Core Course-XII	Plant Metabolism	4
	Core Course-XII Practical	Plant Metabolism - Practical	2
	Discipline Specific Elective-I	DSE-I	4
	Discipline Specific Elective-I Practical	DSE-I- Practical	2
	Discipline Specific Elective-II	DSE-II	4
	Discipline Specific Elective-II Practical	DSE-II – Practical	2
SEM - VI Total Credit 24	Core Course-XIII	Genetics	4
	Core Course-XIII Practical	Genetics - Practical	2
	Core Course-XIV	Plant Biotechnology	4
	Core Course-XIV Practical	Plant Biotechnology- Practical	2
	Discipline Specific Elective-III	DSE-III	4
	Discipline Specific Elective-III Practical	DSE-III - Practical	2
	DSE – IV	DSE – IV	4
	DSE – IV – Practical	DSE – IV – Practical	2
TOTAL			142

Core Courses

Semester-I

Core Course I: Microbiology and Phycology

(Credits: Theory-4, Practical-2)

THEORY

Lectures: 60

Unit 1: Introduction to microbial world

Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in medicine and as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and antibiotics). (8 lectures)

Unit 2: Viruses

Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to TMV, T₂-Phage, viroids and prions; lytic and lysogenic cycle. (8 lectures)

Unit 3: Bacteria

Discovery, general characteristics; Principles in Bacterial Taxonomy, Bergey's Man. of Syst. Bact.; 2nd Ed. – 2001-05; Types-Archaea, Eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Bacterial Chromosome & extra-chromosomal genetic elements; Nutritional types; Vegetative Reproduction and genetic recombination (conjugation, transformation and transduction), Endospore. (14 lectures)

Unit 4: Algae

General characteristics; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, general concept of endosymbiosis, system of Fritsch' 1935 (only upto class), and evolutionary classification of Lee' 2008 (only upto groups); Significant contributions of important phycologists (F.E. Fritsch & M.O.P. Iyengar); Role of algae in the environment, agriculture, biotechnology and industry. (6 lectures)

Unit 5: Cyanophyta and Xanthophyta

Ecology and occurrence; Cell structure; Reproduction, Genetic recombination (in Cyanophyta); Morphology and life-cycle of *Vaucheria*. (6 lectures)

Unit 6: Chlorophyta and Charophyta

General characteristics; Occurrence; Cell structure. Life-cycles of *Volvox*, *Zygnema*, *Oedogonium*, *Coleochaete* and *Chara*. (10 lectures)

Unit 7: Phaeophyta and Rhodophyta

Characteristics; Occurrence; Cell structure; Reproduction. life-cycles of *Fucus* and *Polysiphonia*. (8 lectures)

Practical

Microbiology

1. Aseptic method
 - a) Sterilization technique by Autoclaving, Hot air oven and surface sterilization.
 - b) Preparation of standard bacteriological medium (Nutrient agar, Nutrient broth and glucose – peptone medium).
 - c) Preparation of slant and plates.
 - d) Subculturing of pure bacteriological culture.
 - e) Pure culture technique: dilution streak method.
2. Simple staining; Differential staining: Gram staining.
3. Microscopic examination of bacteria from natural habitats: curd and root nodules of leguminous plants.

Phycology

1. Study and Camera Lucida drawings of vegetative and reproductive structures of *Nostoc*, *Scytonema*, *Zygnema*, *Oedogonium*, *Chara* and *Vaucheria* temporary preparations and identification from permanent slides.
2. Identification of all the genera included in the theoretical syllabus from Permanent slides (vegetative and reproductive structures).

Suggested Readings

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
6. Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

Core Course II: Archegoniate
(Credits: Theory-4, Practical-2)
THEORY
Lectures: 60

Unit 1: Introduction Unifying features of archegoniates; Transition and adaptation to land habit; Alternation of generations. **(4 lectures)**

Unit 2: Bryophytes

General characteristics & Classification [upto order] of Schuster (1968); Adaptations to land habit; Range of thallus organization. **(6 lectures)**

Unit 3: Type Studies- Bryophytes

Morphology, anatomy, reproduction and evolutionary trends in *Riccia*, *Marchantia*, *Pellia*, *Anthoceros*, *Sphagnum* and *Funaria* (developmental stages not included). Ecological and economic importance of bryophytes (a brief account). **(12 lectures)**

Unit 4: Pteridophytes

General characteristics; Classification (Pichi Sermolli, 1977 upto order); early land plants (*Cooksonia* and *Rhynia*). **(6 lectures)**

Unit 5: Type Studies- Pteridophytes

Morphology, anatomy and reproduction of *Lycopodium*, *Selaginella*, *Equisetum*, *Pteris* and *Marsilea* (Developmental details not to be included). Apogamy, and apospory, heterospory and seed habit, telome theory, stelar evolution; Ecological and economic importance **(14 lectures)**

Unit 6: Gymnosperms

General characteristics, classification (Stewart and Rothwell 1993, up to order), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum* (Developmental details not to be included); Ecological and economic importance. **(18 lectures)**

Practical

1. **Marchantia**- Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (from permanent slides).
2. **Anthoceros**- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (from permanent slide).
3. **Pellia** - Study from Permanent slides.
4. **Funaria**- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule.
5. **Lycopodium**- Morphology, whole mount of leaf, transverse section of stem (temporary slide), longitudinal section of strobilus (from permanent slide).
6. **Selaginella**- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (from permanent slide).
7. **Equisetum**- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (temporary slide), transverse section of rhizome (from permanent slide).
8. **Pteris**- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (from permanent slide).
9. **Cycas**- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).
10. **Pinus**- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone (Permanent slide), tangential longitudinal section & radial longitudinal sections stem (permanent slide).
11. **Gnetum**- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)

Suggested Readings

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
5. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University

Semester-II

Core Course III: Mycology and Phytopathology

(Credits: Theory-4, Practical-2)

THEORY

Lectures: 60

Unit 1: Introduction to true fungi

General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification (Alexopoulos & Mims, 1979). (6 lectures)

Unit 2: Chytridiomycota and Zygomycota

Characteristic features; Thallus organisation; Life cycle with reference to *Synchytrium* and *Rhizopus*. (5 lecture)

Unit 3: Ascomycota

General characteristics, sexual reproduction and development of ascus and ascospores, types of ascocarp; Phenomenon of Heterokaryosis and parasexuality in asexual members; Life cycle of *Saccharomyces*, *Talaromyces*, *Neurospora* and *Ascobolus*. (8 lectures)

Unit 4: Basidiomycota

General characteristics; Phenomenon of dikaryotization, development of basidia and basidiospores and basidiocarp, Life cycle of *Puccinia* (Physiological Specialization) and *Agaricus*, Bioluminescence, Fairy Rings and Mushroom Cultivation. (8 lectures)

Unit 5: Allied Fungi

General characteristics; Status of Slime molds, Occurrence; Types of plasmodia. (3 lectures)

Unit 6: Oomycota

General characteristics; Life cycle of *Phytophthora* and *Albugo*. (4 lectures)

Unit 7: Symbiotic associations

Lichen – Occurrence; General characteristics; Range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza with special reference to VAM and their significance. (4 lectures)

Unit 8: Applied Mycology

Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides). (10 Lectures)

Unit 9: Phytopathology

Terms and concepts; General symptoms; Geographical distribution of diseases; Symptomology; Koch's Postulate; Host-Pathogen relationships; Disease cycle and environmental relation; types of diseases, host defense mechanism; prevention and control of plant diseases (biological & chemical), and role of quarantine.

Bacterial diseases – Citrus canker and bacterial blight of rice. Viral diseases – Tobacco Mosaic virus.

Fungal diseases & Control – Late blight of potato, Ergot of rye; Black stem rust of wheat, loose and covered smut of wheat, White rust of crucifers. (12 Lectures)

Practical

Fungi

1. Study of the following genera and their identification: *Rhizopus*, *Talaromyces*, *Alternaria*, *Ascobolus*, *Agaricus* and *Polyporus*.
2. Identification of all the macroscopic and microscopic genera included in the theoretical syllabus.

Plant Pathology

1. Identification of diseases prescribed in the theoretical syllabus.
2. Study of the following diseases: White rust, Rust of wheat/*Justicia*, loose smut of wheat.
3. Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early & Late blight of potato, Black stem rust of wheat and White rust of crucifers.
4. Mycorrhizae – Ecto and Endo mycorrhizae (photographs only)

Suggested Readings

1. Agrios, G.N. (1997). Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

**Core Course IV:
Morphology & Anatomy of Angiosperms
(Credits: Theory-4, Practical-2)
THEORY
Lectures: 60**

Unit 1: Introduction and scope of Plant Anatomy

Applications in systematics, forensics and pharmacognosy.

(1 Lectures)

Unit 2: Structure and Development of Plant Body

Internal organization of plant body: The three tissue systems, types of cells and tissues; Development of plant body: a brief account.

(3 Lectures)

Unit 3: Tissues

Classification of tissues; Simple and complex tissues (no phylogeny); cyto-differentiation of tracheary elements and sieve elements; Cell wall and its secondary growth; Pits and plasmodesmata; Ergastic substances. Hydathodes, cavities, lithocysts and laticifers.

(10 Lectures)

Unit 4: Apical meristems

Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structural differences of dicot and monocot stem, root & leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Endodermis, exodermis and origin of lateral root.

(14 Lectures)

Unit 5: Vascular Cambium and Wood

Structure, function and seasonal activity of cambium; Secondary growth in root and stem with special reference to *Bignonia*, *Dracaena (Cordyline)*, *Boerhaavia* and *Strychnos*. Types of rays and axial parenchyma; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm; General account of Rhytidome and lenticels.

(14 Lectures)

Unit 6: Adaptive and Protective Systems

Epidermal tissue system, cuticle, epicuticular waxes, trichomes(uni-and multicellular, glandular and nonglandular, two examples of each), stomata (classification).

(8 Lectures)

Unit 7: Leaves and Inflorescence

Leaves – types, phyllotaxy and modifications; Inflorescence – Types and evolution

(4 Lectures)

Unit 8: Flower, Fruit and Seed

Types of flower; Aestivation, placentation – types and evolution. Floral formula & floral diagram; Adhesion-Cohesion of floral parts, micro and mega gameto- and sporogenesis; embryosac, Fruits – types, dispersal. Seed dispersal.

(6 Lectures)

Practical

1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/museum specimens with the help of suitable examples.
2. Study of the secondary structures of stem of the following genera: *Bignonia*, *Dracaena* (*Cordyline*), *Boerhaavia* and *Strychnos*.
3. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates;xylem fibres. (from permanent slides)
4. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres. (from permanent slides)
5. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular, lenticels.
6. Root: monocot, dicot, secondary growth (from permanent slides).
7. Stem: monocot, dicot - primary and secondary growth; periderm (from permanent slides);
8. Leaf: Different variations; C4 leaves (Kranz anatomy).
9. Cystolith, lithocysts and Raphides.
10. Types of inflorescence, placentation and fruits.

Suggested Readings

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
4. Evert, R.F. (2006). Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

NOTE:- Details of Syllabus for SEM – III, IV,V, VI under revision.