National Curriculum and Credit Framework (NCCF)
Syllabus
for
<<BOTANY>>
w.e.f. Academic Session 2023-24

Kazi Nazrul University

Asansol, Paschim Bardhaman
West Bengal 713340

SEMESTER- I

MAJOR COURSE - 1

Course Name : Plant Groups and Microbial World

Course Code : BSCBOTMJ101

Course Type: **Major (Theoretical & Practical)**	Course Details: **MJC-1**			L-T-P: **3 – 0 – 4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

***Course Learning Outcomes**:*

1. Combination of theoretical and practical components of this paper will provide comprehensive information and insight into the fascinating world of microbes and plants.
2. Hands on training will help students to learn use of microscope, various instruments handling, mounting, section-cutting and staining techniques for the study of bacteria and plant materials.
3. Making drawings in practical records will enhance understanding morphological and structural details and related functional aspects in diverse plant and microbial groups.
4. After the completion of the course the students will be able to develop understanding about the classification and diversity of different plants, microbes and their economic importance.
5. The students will develop conceptual skill about identifying plants and microbes.
6. The students will gain knowledge about developing commercial enterprise of the microbial products.

Detailed Syllabus -

Unit I: Plant Groups (Basic Concepts):

- Kingdom systems (*Two* kingdom, *Three* kingdom and *five* kingdom system), Classification of Plant Kingdom (By Eichler, 1883); Historical development of the discipline Botany (Contributions of Aristotle, Theophrastus, Dioscorides, Parasara, Sushruta, Charak, Carrolus Linnaeus, Engler and Prantl and Sir J.C Bose); General and Comparative account of plant group; Scope and prospects in Botany (include Archaeobotany, Astrobotany and Dendrology also); Alternation of Generations and concept of gametophyte and sporophyte; Origin and evolution of life on planet Earth, Geological Time Scale and Major events of plant lives.
- General Features and Classification: Engler and Prantl's Classification (upto Classes); General characteristics and classification of groups upto classes (Aglae By Fritsch (1935), Fungi By Gwenny-Vaughani and Barnes (1937), Bryophytes by Proskauer (1957), Pteridophytes by Sporne (1965), Gymnosperm by Bierhorst (1971).

- General features, systematic position and life cycle of the genera – *Spirogyra*, *Mucor*, *Riccia*, *Pogonatum*, *Pteris* and *Pinus*. Methods of collection, preservation, storage and recording of each of these plant groups.
- Lichens: Classification, thallus organization, internal anatomy, reproduction; ecological and economic significance.
- Phytochemistry – Structures, classifications and physiological roles of Carbohydrates (excluding derivatives), proteins, amino acids, lipids, terpenes, phenolics and alkaloids; Concepts of optical isomerism (L and D form), mutarotation, Different types of bonds (Glycosydic bond, ester bond and peptide bond), Zwitterion and pI.

Unit II: Introduction to microbial world

- Historical development in the field of microbiology - (contributions of Antoni van Leuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch and A. Fleming); Microbes and their types.
- Polyphasic approaches in bacterial taxonomy, General idea about Bergey's Manual, Three domain system by C. Woese (1991).
- Microbial nutrition: nutritional types, growth and Reproduction of bacteria.
- Economic importance of bacteria with reference to their role in agriculture, fermentation industry and medicine (This will include only a general list of microbial products and the microorganisms involved).
- Medical Microbiology – Epidemiology, pathogenesis, causal organism and control of air borne disease (influenza), water borne disease (Cholera) and food borne disease (Staphylococcal food poisoning).

Unit III: Bacteria and Viruses

- General Bacteriology: Size, shape and arrangement of bacteria; Structures and functions of – Bacterial Capsule, flagella, pili, cell wall (chemical composition and characteristics), plasma membrane, ribosomes, cytoplasmic inclusions, Plasmids and bacterial chromosome; endospore (structure, formation and germination).
- General characteristics of the domain Archaea and wall-less forms (Mycoplasmas, L-forms, Protoplasts and Spaheroplasts).
- Mechanism of gene transfer in bacteria: Transformation, Conjugation and Transduction.
- Viruses: General characteristics of viruses (size, symmetry, culture characteristics, general structure including concept of capsomere and peplomere, chemical composition).
- Structure of TMV, T_2 phage, HIV and SarsCov2.
- Viral multiplication – Lytic cycle and Lysogeny cycle (excluding regulation),
- Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics anb as causal organisms of plant diseases.
- General characteristics and diseases due to Prions and Viroids.

Unit IV: Basic immunology (only outline) – Innate and acquired immunity, active and passive immunity, humoral (antibody mediated) and cellular (cell mediated) immunity, primary and secondary response, general structure of antibody and its types, Vaccines and their types.

Practical

- Microscopic examination of genera – *Spirogyra (*whole mount), *Mucor* (whole mount), *Riccia* (t,s of mature thallus), *Pogonatum* (l.s of Capsule), *Pteris* (t.s of mature leaf) and *Pinus* (t.s of needle and stem).
- Qualitative tests of carbohydrates (reducing, non-reducing sugar, starch (Molisch test, Fehling's test and Iodine test), protein (biuret test), lipid (Sudan III test) from natural sources.
- Demonstration of the functioning of Autoclave, Hot-air oven, Laminar air-flow, Filtration, Incubator and tools like inoculating loops/needles, petriplates, spreader, culture tubes etc.
- Preparation of standard bacteriological media (Nutrient agar and Nutrient broth).
- Demonstration of Sub-culturing technique.
- Enumeration of soil/food microorganisms by serial dilution technique.
- Microscopic examination of bacteria from natural habitats: curd and root nodules of leguminous plants (simple staining only)

Bibliography –

1. College Botany Vol. –II.- Gangulee and Kar, New Central Book Agency, Kolkata.
2. Studies in Botany, Vol. I. - Mitra, Mitra, Choudhury. Moulik Library, Kolkata.
3. Text Book of Botany, Voli-1, Hait, Ghosh and Bhattacharya, New Central Book Agency
4. Advanced Botany Vol-1 and Vol-2, By Sanjeev Pandey, Books and Allied (P) Ltd.
5. Morphology of Vascular Plants, By George H. M. Lawrence, 1951, Oxford & IBH Publishing Co.

MINOR COURSE - 1

Course Name : Plant Groups and Microbial World

Course Code : BSCBOTMN101

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Course Learning Outcomes*:*

- ✓ Combination of theoretical and practical components of this paper will provide comprehensive information and insight into the fascinating world of microbes and plants.
- ✓ Hands on training will help students to learn use of microscope, various instruments handling, mounting, section-cutting and staining techniques for the study of bacteria and plant materials.
- ✓ Making drawings in practical records will enhance understanding morphological and structural details and related functional aspects in diverse plant and microbial groups.
- ✓ After the completion of the course the students will be able to develop understanding

about the classification and diversity of different plants, microbes and their economic importance.

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Unit I: Plant Groups (Basic Concepts):

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Practical –

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2. Text Book of Botany, Voli-1, Hait, Ghosh and Bhattacharya, New Central BookAgency
3. Advanced Botany Vol-1 and Vol-2, By Sanjeev Pandey, Books and Allied (P) Ltd.
Morphology of Vascular Plants, By George H. M. Lawrence, 1951, Oxford & IBH PublishingCo

SKILL ENHANCEMENT COURSE - 1

Course Name : Mushroom Technology

Course Code : BSCBOTSE101

Course Type: **SE (Theory)**	Course Details: **SEC-1**			L-T-P: **3-0-0**	
Credit: 3	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			15		**35**

Course Learning Outcomes:

On completion of this course, the students will be able to:

- Recall various types and categories of mushrooms.
- Demonstrate various types of mushroom cultivating technologies.
- Examine various types of food technologies associated with mushroom industry.
- Value the economic factors associated with mushroom cultivation
- Device new methods and strategies to contribute to mushroom production.

Detailed Syllabus -

Unit 1:

Introduction and history. Types of edible mushrooms available in India - *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*; Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.

Unit 2:

Methods of cultivation of edible mushrooms (Oyster, Button and Paddy straw mushrooms). Diseases of Mushroom fungi and methods of remedy. Methods of Mushroom span production. Equipments and Tools required for mushroom as well as spawn production.

Unit 3:

Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

Unit 4:

Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.

2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.

4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

MULTIDISCIPLINARY COURSE - 1

Course Name : Introduction to Local Flora

Course Code : MDC118

<table>
<tr><td>Course Type: MD (Theory)</td><td colspan="2">Course Details: MDC-1</td><td colspan="2">L-T-P: 2-1-0</td></tr>
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<tr><td></td><td>15</td><td></td><td>35</td></tr>
</table>

Detailed Syllabus -

- What is Life? Criteria and features of life; Five kingdom concept.
- Plants groups, basic classification and general features of individual plant groups.
- Different types of ecological interaction among different plant groups. (Root nodules of legumes, Mycorrhiza, Parasitic Angiosperms).
- Ecological roles of Algae, Fungi, Bryophyta and vascular plants to maintain ecological balance and sustainability of ecosystem.
- Economic importance and future prospects of all plant groups; Traditional Knowledge about economic and medicinal use of important plants.
- Survey based Field study of local flora (Documentation and Report submission in the form of texts, photographs, tables and graphs).

SEMESTER- II

MAJOR COURSE - 2

Course Name : Cryptogamic Botany & Palaeobotany

Course Code : BSCBOTMJ201

Course Type: **Major (Theoretical & Practical)**	Course Details: **MJC-2**			L-T-P: **3 – 0 – 4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

***Course Learning Outcomes**:*

1. Combination of theoretical and practical components of this paper will provide comprehensive information and insight into the fascinating world of cryptogams and plant fossils.
2. After the completion of the course the students will be able to develop critical understanding on morphology, anatomy and reproduction of Algae, Bryophytes, Pteridophytes & Gymnosperms and also an understanding of the plant evolution and their transition to land habit.
3. The students will learn the major patterns of diversity among cryptogams along with their characters.
4. The students will develop an understanding by observation and table study of representative members of phylogenetically important groups to learn the process of evolution in a broad sense.
5. The students will understand morphology, reproduction and developmental changes therein through typological study and create a knowledge base in understanding the basis of lower group of extant plants and fossil members'. They will also get acquainted to the diversity and economic values of such plants.

Detailed Syllabus -

Unit I: Algae:

- Introduction; Habitat and distribution; thallus organization; origin and evolution of sex in algae.
- Criteria for algal classifications; Broad outline of classification of Lee (2008) up to family and its basis.
- Comparative account and evolutionary relationship of: Cyanophyceae, Chlorophyceae, Charophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae.
- Cell structure and reproduction of Cyanophyceae and Diatoms.
- Life histories of *Nostoc*, *Oedogonium*, *Chara*, *Vaucheria*, *Ectocarpus* and *Polysiphonia*.
- Economic importance of algae; Algal cultivation methods, Commercial cultivation and production of algal food.

Unit II: Bryology:

- Origin and phylogeny of Bryophytes; Habit and distribution; Broad outline of Classification of Giffinet (2009), Crandall-Stotler (2009) and Renzaglia (2007), Comparative study of Hepaticopsida, Anthocerotpoida and Bryopsida.
- Morphology, anatomy, reproduction and evolutionary trends of *Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum* and *Funaria*.
- Ecological and economic importance of bryophytes with special reference to *Sphagnum*.

Unit III: Pteridophytes- Introduction and Classification

- Introduction to Pteridophyta – Concept of Vascular Cryptogams; Land habit; stellar organization and its evolution; General features of Pteridophytes; Apogamy and apospory; Telome theory, Enation Theory.
- PPG1 (2016) classification of pteridophytes up to Suborder.
- Geological history and morphoanatomical and reproductive features of *Rhynia*, *Psilophyton* and *Zosterophyllum*; *Lepidodendron (Lepidodendron, Lepidocarpon), Calamites* (stem and strobilus-*Calamostachys* and *Palaeostachya*).
- Distribution, morphoanatomical and reproductive features of *Psilotum,. Lycopodium, Selaginella, Equisetum, Pteris* and *Marsilea.*

Unit IV – Palaeobotany

- Introduction to Palaeobotany – Important terminologies and definitions; Types of fossil on the basis of modes of preservation; Nomenclature, Conditions suitable for fossilization; Importance of fossils and their study; Stratigraphy – Law of superposition, Stratigraphic correlation and stratigraphic deduction based on megafossil and microfossil assemblages.

Practicals:

- Micrometry-Standardization of compound microscope and measurement of cell size.
- Study of the vegetative and reproductive structures of the following genera using camera lucida: *Gloeotrichia, Scytonema, Zygnema, Oedogonium* and *Chara*.
- Study of the gametophytic and sporophytic structures of the following genera: *Riccia, Marchantia, Anthoceros and Funaria.*
- Study of external morphology and anatomical features of the following: *Lycopodium* (stem and strobilus), *Equisetum* (stem and strobilus) and *Marsilea* (Sporocarp).
- Macroscopic and microscopic identification of specimens of all genera included in the theoretical syllabus of Algae, Bryophytes and Pteridophytes.
- Study of the diagnostic features, geological time and mode of preservation of the following fossil members: *Lepidodendron*, (stem in T. S.), *Calamites* (stem in T. S.), *Bucklandia* (stem, specimen), *Glossopteris* (leaf, specimen), *Vertebraria* (root, specimen).
- Field Study: Specimen collection, identification and submission of collected and preserved materials with proper documentation.

- Preparation and Submission of permanent slides (with DPX/Canada balsam mount) of workout specimens.

Suggested Readings

1. College Botany Vol. –II.- Gangulee and Kar, New Central Book Agency, Kolkata.
2. Studies in Botany, Vol. I. - Mitra, Mitra, Choudhury. Moulik Library, Kolkata.
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4. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
5. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Algae. S Chand and Co, New Delhi.
6. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Fungi. S Chand and Co, New Delhi.
7. Cryptoganic Botany Vol-1 By G. M. Smith
8. Algae By O.P. Sharma.
9. A Text Book of Botany: Lower Plants (2nd edition) Part-I: Bryophta. Singh, Pandey and Jain. 1999. Rastogi Publications. Merut.
10. A Text Book of Botany, Pandey, S. N., Trivedi, P. S. and Misra, S. P. 1989. VikasPublishing House Pvt. Ltd.
11. Bryophytes, a broad perspective. Puri, P. 1973. Atma Ram & Sons. New Delhi.
12. The structure and life of Bryophytes, Watson, E. V. Hutchinson University Library, London.
13. Cryptogamic Botany Vol. II. GM Smith,Bryophtes and Pteridophytes (2nd edition). Mc.Graw Hill Book Co. New York.
14. E. M. Gifford and A. S. Foster. 1988. Morphology and Evolution of Vascular Plants.
15. N. S. Parihar: An Introduction to Embryophyta Vol-I and II. Central Book. Allahabad.
16. K. R. Sporne : The Morphology of Pteridophytes. B. S. Publications. Calcutta
17. P. C. Vasistha. 1980 Botany for degree student Pteridophyta. S. Chand & Company Pvt. Ltd. Rashid. 1976. An Introduction to Pteridophyta. Vikas Publishing . New Delhi.
18. S. SundarRajan. 1994. An introduction to Pteridophyta. New Age International Publishing Limited and Willey Eastern Ltd.

MINOR COURSE - 2

Course Name : Cryptogamic Botany & Palaeobotany

Course Code : BSCBOTMN201

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- Combination of theoretical and practical components of this paper will provide comprehensive information and insight into the fascinating world of cryptogams and plant fossils.
- After the completion of the course the students will be able to develop critical understanding on morphology, anatomy and reproduction of Algae, Bryophytes, Pteridophytes & Gymnosperms and also an understanding of the plant evolution and their transition to land habit.
- The students will learn the major patterns of diversity among cryptogams along with their characters.
- The students will develop an understanding by observation and table study of representative members of phylogenetically important groups to learn the process of evolution in a broad sense.
- The students will understand morphology, reproduction and developmental changes therein through typological study and create a knowledge base in understanding the basis of lower group of extant plants and fossil members'. They will also get acquainted to the diversity and economic values of such plants.

Detailed Syllabus -

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- Introduction; Habitat and distribution; thallus organization; origin and evolution of sex in algae.
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13. Cryptogamic Botany Vol. II. GM Smith,Bryophtes and Pteridophytes (2nd edition).Mc.Graw Hill Book Co. New York.
14. E. M. Gifford and A. S. Foster. 1988. Morphology and Evolution of Vascular Plants.
15. N. S. Parihar: An Introduction to Embryophyta Vol-I and II. Central Book. Allahabad.
16. K. R. Sporne : The Morphology of Pteridophytes. B. S. Publications. Calcutta
17. P. C. Vasistha. 1980 Botany for degree student Pteridophyta. S. Chand & Company Pvt. Ltd. Rashid. 1976. An Introduction to Pteridophyta. Vikas Publishing . New Delhi.
18. S. SundarRajan. 1994. An introduction to Pteridophyta. New Age International Publishing Limited and Willey Eastern Ltd.

SKILL ENHANCEMENT COURSE - 2

Course Name : Biofertilizer

Course Code : BSCBOTSE201

Course Type: **SE (Theory)**	Course Details: **SEC-2**			L-T-P: **3-0-0**	
Credit: 3	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			15		**35**

Course Learning Outcomes:

On the completion of this course, the students will be able to;

- Develop their understanding on the concept of bio-fertilizer
- Identify the different forms of biofertilizers and their uses
- Compose the Green manuring and organic fertilizers
- Develop the integrated management for better crop production by using both nitrogenous and phosphate bio fertilizers and vesicular arbuscular mycorrhizal (VAM).
- Interpret and explain the components, patterns, and processes of bacteria for growth in crop production

Detailed Syllabus -

Unit-1:

- General account about the microbes used as biofertilizer; Isolation, mass production and application of Rhizobia, *Azospirillum* and *Azotobacter* as a biofertilizer; Actinorrhizal symbiosis (Organisms, hosts and general features).

Unit -2:

- General idea about Plant growth promoting rhizobacteria (PGPR) and Phosphate solubilizing bacteria (PSB); PGPR traits; Stress hormone Ethylene and PGPR.

Unit- 3:

- Cyanobacteria (blue green algae/ BGA) and *Azolla* as biofertilizer; Blue green algae and Azolla production; Application of BGA and *Azolla* in rice cultivation.

Unit -4:

- Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution; VAM fungi, and their influence on growth and yield of crop plants. (6 lectures)
- Organic farming – Green manuring and organic fertilizers; Organic Compost and Vermicompost - production and application.

Suggested Readings -

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.

3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

MULTIDISCIPLINARY COURSE - 2

Course Name : Herbal Home Remedies

Course Code : MDC217

Course Type: **MD (Theory)**	Course Details: **MDC-2**			L-T-P: **2-1-0**	
Credit: 3	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			15		**35**

Course outcome:

1. Develop conceptual skill about traditional Indian medicinal system, herbal medicines, their processing, storage and marketing.
2. Gain knowledge about developing commercial enterprise of herbal medicines.
3. Learn the basic tools and techniques for phytochemical analysis and propagation of the medicinal plants.

Unit	**Topic**	**No. of lectures/ hrs (45)**
1	**Herbal medicines**: **History and scope** - Definition of medical terms – History and Prospect of Ayurveda and Siddha systems of medicine.	5
2	**Herbal remedies for common ailments** – Blood sugar (Diabetes), Blood Pressure, Piles, Common cough and cold sore, Viral or other chronic fever, irritable bowel syndromes, skin diseases, psoriasis etc.; Memory boosters; Nerve Stimulants.	10
3	**Herbal preparation Methods** – Infusion (svarasa), decoction (kwatha), Arishta (fermented herbal decoction), tincture (Solvent based infusion or decoction), poultices (Upanaha), salves (Lepa) etc. Techniques of harvesting and drying herbs. Quality control and storage. Dose and ill effect of overdose.	10
4	**Plants with healing properties** – (parts, their uses in medicine andmethods of uses) Trees – *Saraca asoka* (Ashoka), *Terminalia arjuna* (Arjuna), *Terminalia*	20

	chebula (Hartaki), *Terminalia bellerica* (Bahera), *Emblica officinale* (Amla), *Alstonia scholaris* (Chhatim), *Moringa oleifera* (drumstick/sajina plant), *Azadirachta india* (Neem), *Morinda citrifolia* (Noni), *Carica papaya* (Papaya) Shrubs – *Holarhena antidysenterica* (Kurchi), *Costus speciosus*, *Justicia adhatoda* (Basak), *Calotropis procera* (Arka/Akanda), *Datura metel* (Dhutra) Herbs – *Aloe vera, Aloe barbadense*, *Ocimum sanctum* (Tulsi), *Catharanthus roseus* (Nayantara), *Rauwolfia serpentina* (Sarpagandha), *Withania somnifera* (Aswagandha), *Clerodendron phlomoides* (Bamanhati), *Centella asiatica* (Thankoni), *Opium poppy* (Opium/Aphim), *Andrographis paniculata* (Kalmegh), *Senna alata*. *Achyranthes aspera* (Apang), *Eclipta alba* (Kesut), *Boerrhaavia repens* (Punarnava), *Baccopa monieri* (Brahmi), *Hygrophila spinosa* (Kulekhara). Spices – *Zingiber officinale* (Ada), *Curcuma longa* (Turmeric/Halud/Haldi), *Cinanamomum zeylanicum* (Darchini), *Foeniculum vulgare* (Fennel/sounf/Mouri), *Piper nigrum* (Pepper), *Ferula foetida* (Asafoetida/Hing), *Cuminum cyminum* (Cumin), *Coriandrumsativum* (Coriander). Climber – *Hemidesmus indicus* (Indian Sarsaparilla/Anantamul), *Cissus quadrangularis* (Harjoda). *Tinospora cordifolia* (Giloy), *Coccinia grandis* (telakuchu). [NB. Precautionary instructions must be associated with each drug]	

SEMESTER- III

MAJOR COURSE - 3

Course Name : Gymnosperms, Mycology and Plant Pathology-I

Course Code : BSCBOTMJ301

Course Type: **Major (Theoretical & Practical)**	Course Details: **MJC-3**			L-T-P: **3 – 0 – 4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes*:*

1. The concept of progymnosperms and its significance in plant evolutionary history will be determined.
2. General characteristics of gymnospermous plant group with special reference to their classification, morphology, reproduction, distribution and ecology will be described.
3. True fungi will be identified and the principles and application of plant pathology in the control of plant disease will be demonstrated.
4. The common plant diseases according to geographical locations will be identified and devices to control measures will be known.

Unit I:

Gymnosperms (Theory):

- General features of Gymnosperms and comparisons with pteridophyte and angiosperms; Comparative account of Cycadophyta, Coniferophyta, Ginkgoales and Gnetophyta. Outline Classification of gymnosperm by Stewart and Rothwell (1993) up to order.
- Progymnosperms; concept of the group emphasizing on overall description of *Archaeopteris*.
- General account of fossil members: Pteridospermales: *Lyginopteris* (*Crossotheca* male organ and *Lagenostoma* female organ); Glossopteridales: (*Vertebraria* root, *Araucarioxylon* trunk, *Glossopteris* leaf, *Glossotheca* male organ, *Denkania* female organ); Bennettitales: *Williamsonia sewardiana* reconstruction (*Bucklandia* stem, *Ptilophyllum* leaf, *Weltrichia* male organ, *Williamsonia* female organ).

Unit II:

Mycology (Theory):

- **Historical development**: Contributions of Heinrich Anton de Bary, Prof. C. V. Subramanian, Dr. K. C. Mehta and Dr. N. K. Rao.
- **Introduction** (General characteristics) – Fungal body and tissue organization (range of somatic structures);, Hyphal Modifications; Fungal cell structure; Cell-wall composition; Septum and its types; Occurrence and Mode of nutrition ; Different classes of spore and mode of sexual reproduction; Sexual degeneration.
- Broad outline Classification of Ainsworth, (1973) up to Sub-division. Concept of f*orma speciales* and physiological races in fungi.
- Detailed characteristics of individual classes* and life cycle of *Saprolegnia* (Mastigomycotina), *Rhizopus* (Zygomycotina), *Saccharomyces*, *Ascobolus* (Ascomycotina), *Agaricus* (Basidiomycotina); *Alternaria* (Deutromycotina).

*With special emphasis to the formation and development of ascus and ascospores (*Pyronema* type only), types of ascocarps; Mycelial types of Basidiomycotina, Cell division and Clamp-connection, Dikaryotization (Buller phenomenon), Basidial development, their types and types of fruitbodies in Basidiomycotina; Types of conidia and spores in Deuteromycotina, Conidial fruit body types in Asco- and Deuteromycotina.

Unit III:

Plant Pathology (Theory):

- Plant Diseases: Common Definitions; Koch's postulate; Disease cycle, Plant Disease Epidemiology.
- Classification of plant diseases based on symptoms and on spread and severity; Difference between Signs and Symptoms of plant diseases.
- Causal Organism, symptoms, disease cycles and control measures of **Bacterial diseases** – Bacterial blight of rice; **Viral diseases**- Tobacco Mosaic viruses **Fungal diseases**- Late blight of potato, Black stem rust of wheat, loose smut of wheat. **Nematode causing disease**- Root knot of rice; **Mycoplasmal disease** – little leaf disease of Brinjal.
- Disease Predisposing factors and disease forecasting; Use of modelling in disease forecast.

Practical:

- Studies on the morphological and anatomical features of the following: *Cycas* (leaflet) and *Pinus* (needle).
- Studies on the vegetative and reproductive structures of *Cycas, Ginkgo* and *Gnetum* from permanent slides.
- *Morphological studies of the following fossil specimens and determination of their mode of preservation: *Glossopteris* (leaf), *Vertebraria* (root, specimen), *Bucklandia* (stem), *Lyginopteris* (stem in T.S.)

  *[This part should be omitted from Sem-2 syllabus from Palaeobotany practical portion]
- Work out of the following with reproductive structure (Freehand drawing and drawing under drawing-prism with magnification): *Rhizopus* (asexual), *Ascobolus, Agaricus* (gill) and *Polyporus.*

MAJOR COURSE - 4

Course Name : Gymnosperms, Mycology and Plant Pathology-II

Course Code : BSCBOTMJ302

Course Type: **Major (Theoretical & Practical)**	Course Details: **MJC-4**			L-T-P: **3 – 0 – 4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

***Course Learning Outcomes**:*

1. The role and economic importance of gymnosperms in human welfare will be known.
2. The evolutionary significance of gymnosperms will be understood along with their prehistoric life forms and evolution through geological ages.
3. The skills in laboratory, field and glasshouse work related to mycology and plant pathology will be gained.

4. An idea will be generated to develop an understanding of microbes and fungi and also to know their adaptive strategies.

Unit I:
Gymnosperms (Theory):

- Origin of gymnosperm (origin of secondary wood, heterospory and evolution of seed habit*, concepts of prepollen and preovule).

  *Level of heterospory and seed habits in *Selaginella* and *Lepidocarpon* must be brought here in discussion.
- A comparative account of the life histories and their morpho-anatomical feature of the extant members - *Cycas, Pinus, Ginkgo* and *Gnetum*. Their distribution in India; Ecological and economic importance.

Unit II:
Mycology (Theory):

- Fungal cytogenetics: Sexual compatibility (homothallism and heterothallism); Parasexuality and haploidization, Nuclear behaviour in fungi (diplophase, haplophase and dikaryophase) and life cycle patterns; Karyochoresis; Phylogeny of fungi.
- A brief account on Myxomycota; Key to the classes of Myxomycota according to Ainsworth (1973); Outline life-cycle of Myxomycete and Plasmodiophoromycetes; Plasmodial development in *Stemonitis*.
- Fungal ecology: Mycorrhiza- Ectomycorrhiza, Endomycorrhiza and VAM fungi; Role of mycorrhizae and VAM in agriculture and forestry.
- Role of fungi in biotechnology; Application of fungi in food industry (Enlist application in Fermentation products, Baking and Brewing), Production of industrially important products from fungi viz. organic acids (citric acid), enzymes (protease) and applications of fungi in the production of pharmaceutical products. *Production of antibiotics (Penicillin) and vitamins (Vitamin B-complex and Vitamin B-12).

  *This should include media required, microorganism involved, fermentation process and optimal conditions (pH, temp., substrate), scale up and down-stream processing.
- Fungal toxins (Mycotoxins) with special reference to Aflatoxin (General View).

Unit III:
Phytopathology (Theory):

- Parasitism and Disease Development: Parasitism and Pathogenicity; molecular and biochemical basis of Plant-Pathogen interactions (pre-penetration, penetration, Post-penetration; Brief idea about the roles of cell wall degrading enzymes and pathotoxins are to be included here).
- Structural (Cell wall modifications, histological changes and structural barriers) and biochemical (oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors) defense mechanism of plants; Basic concept of R genes (qualitative and quantitative resistance).
- Control of Plant diseases: Prophylactic measures; Plant quarantine; Physical, chemical and biological methods of disease control (should include chemical and biological fungicides); Concpets of LD_{50}, ID_{50}, EC_{50} and MIC; Genetic engineering for disease resistance.

Practical

- Isolation of pathogen from diseased leaf. Inoculation of fruit and sub-culturing.
- Study of the following diseases: White rust of Crucifer or Amaranth, Rust of wheat/Justicia (Puccinia: Herbarium specimens of Black Stem Rust of Wheat or infected Barberry leaves; section/tease mounts of spores of wheat or permanent slides of both the hosts), smut of wheat (or any member of Poaceae).
- Spot identification with reasoning from all specimens included in the theoretical syllabus.

- Collection, preservation and submission of Fungal specimen (both dried and wet specimens)[This should be supported by field note book and field record]
- Submission of herbarium sheet of disease affected plant parts of the surroundings.

Suggested Readings:

1. Botany for degree students. Fungi. B. R. Vashistha, A. K. Sinha. V. R. Singha (Latest edition). S. Chand.
2. College Botany Vol. –II. - Gangulee and Kar, New Central Book Agency, Kolkata.
3. Introduction to Fungi. Webster, J. Cambridge University Press.
4. Introduction to Fungi, Dubey, H. C. Vikas Publishing House.
5. Introduction to Mycology. Alexopoulas, C. J., Mims, C. W. and Blackwell Wiley. Bastern Limited, New Delhi.
6. Introductory Mycology. R. S. Mehrotra and Aneja, K. R. New Age International.
7. Studies in Botany, Vol. I. - Mitra, Mitra, Choudhury. Moulik Library, Kolkata.
8. Plant Pathology. Agrios R. N. Academic Press.
9. Plant Pathology, Mehrotra, R. S. Tata Mc Graw Hill Publishing Company. New Delhi
10. Diseases of Crop Plants in India. Rangaswamy, G. Prentice Hall India Pvt. Ltd. New Delhi.
11. E. M. Gifford and A. S. Foster. 1988. Morphology and Evolution of Vascular Plants.
12. Stewart, W. N. & G. W. Rothwell. 1993. Palaeobotany and Evolution of Plants. Cambridge University Press.
13. Beck, C. B. 1988. Origin and evolution of gymnosperms. Columbia University Press.
14. Bhatnagar, S. P. & A. Moitra. 1996. Gymnosperms. New Age International Ltd., New-Delhi.

MINOR COURSE - 3

Course Name : Gymnosperms, Mycology and Plant Pathology

Course Code : BSCBOTMN301

Course Type: **Minor (Theoretical & Practical)**	Course Details: **MNC-3**			L-T-P: **3 – 0 – 4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes*:*

1. General characteristics of gymnospermous plant group with special reference to their classification, morphology, reproduction, distribution and ecology will be described.
2. True fungi will be identified and the principles and application of plant pathology in the control of plant disease will be demonstrated.
3. The common plant diseases according to geographical locations will be identified and devices to control measures will be known.

Unit I:

Gymnosperms (Theory):

General characteristics and Classification (Stewart and Rothwell's 1993 classification), morphology, anatomy and reproduction of *Cycas, Pinus* and *Gnetum*. (Developmental details not to be included). Economic importance of Gymnosperms.

Unit II:
Mycology (Theory):
Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition , nutrition, reproduction and classification (Ainsworth, 1973); True Fungi- General characteristics of all classes, life cycle of *Rhizopus* (Zygomycota) *Penicillium* (Ascomycota), *Puccinia* (Basidiomycota); Symbiotic Associations- Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance. Role of fungi in biotechnology; Application of fungi in food industry (Enlist application in Fermentation products viz, antibiotics, organic acids, enzymes, vitamins; Baking and Brewing).

Unit III:
Plant Pathology (Theory):
Common Definitions, Koch's Postulates, Classification of Plant disease based on symptoms, Plant defense mechanism against pathogens, role of environment in disease development. Control measures of plant diseases. Disease resistance in plants. General symptoms and control measures for the following plant diseases: bacterial blight of rice. Late blight of potato, rusts of wheat.

Practical

- Studies on the morphological and anatomical features of the following: *Cycas* (leaflet) and *Pinus* (needle).
- Studies on the vegetative and reproductive structures of *Cycas, Ginkgo* and *Gnetum* from permanent slides.
- Work out of the following with reproductive structure (Freehand drawing only): *Rhizopus* (asexual), *Ascobolus, Agaricus* (gill)
- Collection, preservation and Submission of Fungal specimen with proper documentation.
- Submission of herbarium sheet of disease affected plants of the surroundings.
- Study of plant diseases with help of infected plant specimen - loose smut of wheat, late blight of potato, rust of wheat.[All from herbarium sheets].
- Spot identification with reasoning from all specimens included in the theoretical syllabus.

Suggested Redings:

1. Botany for degree students. Fungi. B. R. Vashistha, A. K. Sinha. V. R. Singha (Latest edition). S. Chand.
2. Introduction to Fungi. Webster, J. Cambridge University Press.
3. College Botany Vol. –II. - Gangulee and Kar, New Central Book Agency, Kolkata.
4. Studies in Botany, Vol. I. - Mitra, Mitra, Choudhury. Moulik Library, Kolkata.
5. Plant Pathology. Agrios R. N. Academic Press.

SEMESTER- IV

MAJOR COURSE - 5

Course Name : Structural Botany, Economic Botany and Pharmacognosy-I

Course Code : BSCBOTMJ401

<table>
<tr><td>Course Type: Major (Theoretical & Practical)</td><td colspan="2">Course Details: MJC-5</td><td colspan="2">L-T-P: 3 – 0 – 4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
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Course Learning Outcomes:

On completion of this course, the students will be able to:

1. To know about different plants organ like root, stem and leaves and their importance.
2. Understand core concepts of Economic Botany and relate with environment, populations, communities, and ecosystems.
3. Increase the awareness and appreciation of plants & plant products encountered in everyday life.
4. Appreciate the diversity of plants and the plant products in human use.

Unit I:

Morphology (Theory):

- Roots, stems and leaves: Their structures with reference to modification with examples; Phyllotaxi and Fibonacci series; Stipules (types and modifications).
- Inflorescence: Types with examples, evolution (brief idea).
- Flowers: Types, calyx (modifications), corolla (forms, aestivation, modification), stamen (cohesion & adhesion, attachment of anther), carpel - apocarpous & syncarpous, evolution; Ovule – Organization of Orthotropous ovule and types of ovules.
- Placentation: types with examples, evolution (brief idea).
- Fruits and seeds: Types with examples, Dispersal mechanism.
- Defensive mechanism of plants (Homologous and analogous organs).

Unit II:

Economic Botany (Theory):

- Concept of Centres of Origin (Major Centres of origin according to Vavilov, 1951); Origin of Cultivated Plants of West Bengal; Crop domestication and loss of genetic diversity; Germplasm diversity.
- Cereals: Wheat and Rice (origin, morphology, processing & uses); cultivation of rice.
- Legumes: Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes.
- Sources of sugars and starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation and uses.
- Spices: Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper.
- Beverages: Tea, Coffee (morphology, processing and uses); cultivation of tea.

Unit III:

Pharmacognosy (Theory):

- Introduction; definitions of drug, crude drug, folk medicine, active principle, Pharmacognosy; Pharmacology, Pharmacopoeia, etc.
- Classification of drugs on alphabetical, morphological, chemical and therapeutic basis; Drug Constituents (active and inert); drug adulteration (sophistication) and drug evaluation.
- A general account on cultivation, harvesting, processing and storage of herbal drugs.

Practical:

- Morphological Studies of different types of roots, stem, leaves, stipules, flowers, fruits and seeds; Modification of roots, stem, leaves and stipules; Types of – Stipules, inflorescence, fruits and seeds.
- T.S. of potato tuber to show localization of starch grains through iodine staining.
- Qualitative test of starch; Wheat or Rice
- Qualitative test for lipid in Soybean/ Groundnut/ Mustard. (test of oil droplets in crushed seeds)

MAJOR COURSE - 6

Course Name : Structural Botany, Economic Botany and Pharmacognosy-II

Course Code : BSCBOTMJ402

Course Type: **Major (Theoretical & Practical)**	Course Details: **MJC-6**			L-T-P: **3 – 0 – 4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:

On completion of this course, the students will be able to:

1. Develop an understanding of concepts and fundamentals of plant anatomy.
2. Examine the internal anatomy of plant systems and organs.
3. Develop critical understanding on the evolution of concept of organization of shoot and root apex.
4. Analyze the composition of different parts of plants and their relationships.
5. Evaluate the adaptive and protective systems of plants.
6. To know about medicinal properties and uses of plants by folklore and ayurveda system.

Unit I:

Anatomy of Angiosperms (Theory):

- Introduction and scope of Plant Anatomy.
- Applications in systematics, forensics and pharmacognosy.
- Cell wall Structure, chemical composition, wall thickening with reference to pits.
- The tissue systems – dermal, ground tissue and vascular tissue (stems, roots and leaves). Types of vascular bundles, stomata and trichomes; Stelar organization and types; Root-stem transition.
- Classification of tissues: Definitions and types; Simple tissues - types, nature, distribution and functions; Complex tissues - Xylem and Phloem: Structure, ontogeny of tracheary elements and sieve elements; Sclereids; Transfer cells. Secretory structures and ergastic substances- brief idea.
- Apical meristems: Concept of organization of shoot and root apices (Different theories regarding the organizations of shoot and root apices) .
- Structure of primary bodies (dicot and monocot root, stem and leaf). General account on: Cuticle, Stomata, Hydathodes, Cavities, Laticifers, Kranz anatomy.
- Vascular Cambium and Cork Cambium: structure and function. Secondary growth in root and stem. Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood; Dendrochronology. Tyloses and tylosoids; Development of periderm, rhytidome and lenticels. Adaptive and Protective Systems Periderm- brief idea.
- Different principles regarding such distribution of mechanical tissues in flowering plants.
- Anomalous secondary growth in stem of *Boerrhavia*, *Bignonia, Dracaena*, *Tinospora*.

Unit II:

Economic Botany (Theory):

- Sources of oils and fats: Fixed Oils: General description, classification, extraction, their uses and health implications; groundnut, linseed, soybean, mustard and coconut (Botanical name, family and uses).

- Essential Oils: General account (sources and chemical nature), extraction methods, comparison with fatty oils, sources and uses of some common essential oils (Eucalyptus, lemongrass, citronella, cinnamomum, chamomile, clove, and rose).
- Natural Rubber Para-rubber: tapping, processing and uses.
- Timber plants: General account with special reference to sal and teak
- Fibres: Classification based on the origin; Cotton and Jute (morphology, extraction and uses); cultivation of Jute.

Unit III:
Pharmacognosy (Theory):

- Diagnostic features, active principles and therapeutic uses of:
  Rauwolfia serpentina (root), *Adhatoda vasica* (leaf), *Strychnos nux-vomica* (seed), *Cinchona succirubra* (bark), *Catharanthus roseus* (Whole plant), *Taxus* sp. (bark).
- Family, plant part used, therapeutic use and habit of following drugs: *Withania sominifera (*Aswagandha), *Andrographis paniculata* (kalmegh), *Zingiber* (Ginger), *Curcuma* (Turmeric), *Bacopa monnieri* (Bramhi), , *Digitalis purpurea* (foxglove), *Papaver sominferum* (Afeem) and *Cannabis sativa* (Marijuana).

Practical

- Study of anatomical details through temporary slide preparation of the stem - monocot (maize), dicot (sunflower); root – monocot (Canna), dicot (Chick pea) and leaf – monocot (grass leaf any preferably rice/maize), dicot (mango).
- Microscopic study from permanent slides of: Bulliform cells, stomatal types, hairs (glandular), lenticels, raphides (acicular and sphaeraphides), cystolith, cavities and laticifers.
- Study of wall thickennings and pittings on xylem vessels, fibres and tracheids through maceration in *Pinus* and *Cucurbita* (Any other suitable dicot).
- Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres - Permanent slides.
- Secondary anomalous structure in stem with specimens included in theoretical syllabus.
- Quality control of fibres*: Cotton (whole mount of seed/ seed epidermis to show lint and fuzz;), Jute (whole mount of fibre).*[This study should include, measuring the diameter and length of the fibre, number of convolutions in cotton fibre, lumen size, presence of defect like cracks, fissure or deformities and fungal or bacterial infection if any. In case of jute, lignin content is determined by adding phloroglucinol-HCl to the fibre to see its amount and distribution under compound microscope].
- Study of wood anatomy – Density, Hardness and Grain pattern (with respect to Sal and Teak)
- Organoleptic and microscopic examination of following plant drugs to be supplied fresh and powdered form – *Adhatoda vasica* (leaf), *Strychnos* (seed), Zinger (rhizome).

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 Benjammin/Cummings Publisher, USA.
4. 5. Pandey B.P.(2012) Plant Anatomy. S.Chand & Company Ltd., New Delhi
6. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
7. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
8. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett Publishers.
9. Sanjeev Pandey, Advance Botany, Volume-1, 2nd Edn, Pub. Books and Allied (P) Ltd. Kolkata.

MINOR COURSE - 4

Course Name : Plant Morphology, Plant Anatomy & Plant Taxonomy

Course Code : BSCBOTMN401

Course Type: **Minor (Theoretical & Practical)**	Course Details: **MNC-4**			L-T-P: **3 – 0 – 4**	
Credit: **5**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**15**	**20**	**35**

Course Learning Outcomes:

On completion of this course, the students will be able to:

1. To know about different plants organ like root, stem and leaves and their importance.
2. Develop an understanding of concepts and fundamentals of plant anatomy
3. Examine the internal anatomy of plant systems and organs
4. Interpret the rules of ICN in botanical nomenclature
5. Generalize the characters of the families according to Bentham & Hooker's system of classification
6. Evaluate the Important herbaria and botanical gardens

Unit I:

Plant Morphology (Theory):

- Roots, stems and leaves: Their structures with reference to modification with examples; stipules; phylotaxy
- Inflorescence: Types with examples (brief idea only).
- Flowers: Types, calyx (modifications), corolla (forms, aestivation, modification), stamen (cohesion & adhesion, attachment of anther), carpel - apocarpous & syncarpous.
- Placentation: types with examples.
- Ovules: types with examples.
- Fruits and seeds: Types with examples, Dispersal mechanism.

Unit II:

Plant Anatomy (Theory):

- Introduction of Plant Anatomy, Cell wall Structure.
- The tissue systems – dermal, ground tissue and vascular tissue. Types of vascular bundles.
- Classification of tissues: Simple tissues – types and functions; Complex tissues - Xylem and Phloem: Structure and functions.
- Apical meristems: Concept of organization of shoot and root apices (Tunica Corpus theory, Korper-Kappe theory). Structure of primary bodies (dicot and monocot root, stem and leaf).
- Secondary growth in root and stem. Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood.
- Anomalous secondary growth in stem of *Bignonia, Strychnos, Dracaena*.

Unit III:

Plant Taxonomy (Theory):

- Introduction to systematics; Plant identification, Classification, Nomenclature.

- Field inventory; Importance of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: intended (yolked) and bracketed keys.
- Plant classification - artifitial, natural and phylogenetic approach; Outline of the system of classification – Linnaeus (1753); Bentham and Hooker (1862-83) and Arthur Cronquist (1981).
- Botanical Nomenclature**:** Principles and rules (ICBN/ICN); Ranks and names; Typification, author citation.
- Diagonostic characters, floral formula, floral diagram and economic importance of the following plant families with examples from common Indian species.
  Dicotyledons: Magnoliaceae, Brassicaceae, Solanaceae, Malvaceae, Fabaceae, Apocynaceae, Scrophulariaceae, Lamiaceae, Verbenaceae, Acanthaceae, Rubiaceae, Asteraceae.
  Monocotyledons: Poaceae, Cyperaceae and Orchidaceae.

Practical

- Study of different types of stem, leaves, stipules, flowers and fruits.
- Study of primary structure: Stem: monocot (Maize), dicot (Sunflower); Root: monocot(*Canna*), dicot (Chick pea).
- Microscopic study from permanent slides of: Bulliform cells, stomatal types, lenticels, raphides (acicular and sphaeraphides), cystolith, cavities and laticifers.
- Study of the anomalous structures of stems of the following genera: *Bignonia, Dracaena* and *Boerhaavia*
- Study of vegetative and floral characters of the following families (Description, V.S.flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Malvaceae, Fabaceae, Apocynaceae, Solanaceae, Lamiaceae, Verbenaceae, Asteraceae (Take at least one genus from each family).
- Field visit (local or outside depending on situation).
- Mounting of a properly dried and pressed specimen of any 10 wild plants with Herbarium label (to be submitted during examination).

Suggested Readings:

1. College Botany Vol. I. New Central Book Agency. Calcutta.
2. College Botany Vol. III. New Central Book Agency. Calcutta.
3. Datta, S. C. 1991. Systematic Botany. Wiley Eastern Ltd. New Delhi, Calcutta.
4. Lawrence, G. H. M. 1981. Taxonomy of Vascular Plants. Mc Milian New York.
5. Naik, V. N. Taxonomy of Angiosperms. Tata Mc. Graw Hill Publishers Co. 1981. New Delhi.
6. Plant Groups. (Recent Edition). H. Mukherjee. New Central Book Agency.
7. Plant Systematics. Gurucharan Singh. 2005 (2nd Edition). Oxford & IBH.
8. Fahn, 1982. Plant Anatomy. John Willey.
9. P. Roy. Plant Anatomy, New Central Book Agency, Kolkata

SKILL ENHANCEMENT COURSE - 3

Course Name : Horticulture, Nursery and Gardening

Course Code : BSCBOTSE401

<table>
<tr><td>Course Type: SE (Theory)</td><td colspan="2">Course Details: SEC-3</td><td colspan="2">L-T-P: 3-0-0</td></tr>
<tr><td rowspan="3">Credit: 3</td><td rowspan="3">Full Marks: 50</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
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Course Learning Outcomes:

On completion of this course the students will be able to:

1. Understand the concept of different types of horticultural practices for value addition
2. Understand the process of sowing seeds in nursery
3. List the various resources required for the development of nursery
4. Distinguish among the different forms of sowing and growing plants
5. Analyse the process of Vegetative propagation
6. Appreciate the diversity of plants and selection of gardening
7. Examine the cultivation of different vegetables in nursery and gardening

Unit I: Horticulture:

- Types, classification (annuals, perennials, climbers and trees);
- Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Bonsai Production;
- Production of ornamental, fruits and vegetables, medicinal and aromatic plants.
- Identification and salient features of some ornamental plants [rose, marigold, tuberose].
- Ornamental flowering trees (Gulmohar, Lagerstroemia and areca palms);
- Description of plants and their economic products;
- Management and marketing of vegetable (Potato and Brinjal) and fruit crops (Mango and Banana);
- Cultivation, processing and marketing of products of major medicinal plants (*Senna*, Ashwagandga, Amla, Vetiver, *Aloe vera*).

Unit II: Nursery and Gardening:

- Definition, objectives and scope and building up of infrastructure for nursery,
- Planning and seasonal activities - Planting - direct seeding and transplants.
- Different types of gardening: ornamental, kitchen, vertical, and rooftop gardens
- Seed storage: Seed banks, factors affecting seed viability.
- Vegetative propagation: air-layering, cutting; treatment of cutting, rooting medium and planting of cuttings.
- Hardening of plants – Principles and methods.
- Protected cultivation methods - greenhouse, mist chamber, , shade house and glasshouse;
- Landscape and home gardening – Principles and landscape designing, planning and designing of home gardens; Xeriscaping, Growing plants of aesthetic value.
- Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes and carrot;
- Post harvest management and marketing - Storage and marketing procedures, Factors affecting storage; Marketing strategies for nursery plants and other plant produce, Problems related to nursery maintenance and marketing, possible solutions.

Suggested Readings:

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.