SYLLABUS FOR FYUGP

IN

# BOTANY


**DEPARTMENT OF BOTANY**
**MADHABDEV UNIVERSITY, NARAYANPUR**
**ASSAM**

Approved in the BOS, Botany held on 13-02-2024

B.Sc. IN BOTANY (NEP)

**FOUR YEAR UNDER-GRADUATE PROGRAMME (FYUGP) IN BOTANY**

**MADHABDEV UNIVERSITY**

**1. Programme Learning Outcome:**

**P.O. 1:** Knowledge on diversity of plant resources and their importance.

**P.O. 2.** Scientific approach to address problems in plant science and use of plant based products for human welfare.

**P.O. 3.** Application of Botanical knowledge and skills in entrepreneurship.

**P.O. 4.** Develop new techniques/methods for solving the problems of the allied disciplines.

**2. Teaching Learning Process:**

The programme allows using varied pedagogical methods and techniques both within classroom and beyond.

1. Lecture
2. Practical
3. Tutorial
4. Documentary on related topic
5. Project Work/Dissertation
6. Group Discussion
7. Seminars/workshops/conferences
8. Field visits and Report/Excursions
9. Mentor/Mentee

**3. Assessment:**

1. Home assignment
2. Project Report
3. Seminars
4. Group Discussions
5. In semester examinations
6. End Semester examinations
7. Dissertation

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**FYUGP Structure as per UGC Credit Framework of December, 2022**

| Year | Semester | Course | Title of the Course | Total Credit |
|---|---|---|---|---|
| Year 01 | 1st Semester | Major - 1 | Algae, Fungi, Bryophyte & Pteridophyte | 4 |
| | | Minor -1 | Algae, Fungi, Bryophyte & Pteridophyte | 4 |
| | | MDC - 1 | Natural Resource Management | 3 |
| | | AEC 1 | | |
| | | VAC 1 | | |
| | | SEC 1 | | |
| | | | | **20** |
| | | | | |
| | 2nd Semester | Major - 2 | Morphology and Reproduction of Spermatophytes | 4 |
| | | Minor- 2 | Morphology and Reproduction of Spermatophytes | 4 |
| | | MDC- 2 | Plant Diversity and Human Welfare | 3 |
| | | AEC 2 | | |
| | | VAC 2 | | |
| | | SEC 2 | | |
| | | | | **20** |
| | | | | |
| Year 02 | 3rd Semester | Major - 3 | Cell Biology | 4 |
| | | Major - 4 | Plant Biochemistry & Molecular Biology | 4 |
| | | Minor- 3 | Plant Physiology & Metabolism | 4 |
| | | MDC – 3 | | |
| | | VAC - 3 | Environmental Studies | 3 |
| | | SEC – 3 | | |
| | | | | **22** |
| | | | | |
| | 4th Semester | Major - 5 | Microbiology & Plant Pathology | 4 |
| | | Major - 6 | Anatomy of Angiosperms | 4 |
| | | Major - 7 | Plant Systematics | 4 |
| | | Major - 8 | Economic Botany | 4 |
| | | Minor - 4 | Plant Ecology & Taxonomy | 4 |
| | | Internship | ---------- | 2 |
| | | | | **22** |

| | | | | |
|---|---|---|---|---|
| Year 03 | 5th Semester | Major - 9 | Genetics | 4 |
| | | Major - 10 | Plant Ecology & Phytogeography | 4 |
| | | Major - 11 | Natural Resource Management | 4 |
| | | Major - 12 | Plant Physiology | 4 |
| | | Minor - 5 | Plant Anatomy and Embryology | 4 |
| | | Internship | ---------- | 2 |
| | | | | **22** |
| | | | | |
| | 6th Semester | Major - 13 | Plant Metabolism | 4 |
| | | Major - 14 | Plant Breeding | 4 |
| | | Major - 15 | Plant Biotechnology | 4 |
| | | Major - 16 | Research Methodology | 4 |
| | | Minor - 6 | Economic Botany & Biotechnology | 4 |
| | | Project | Research project | 2 |
| | | | | **22** |

**Abbreviations Used:**

- **MDC = Multi Disciplinary Course**
- **AEC = Ability Enhancement Course**
- **SEC = Skill Enhancement Course**
- **VAC = Value Added Course**

# SYLLABUS OF 1st SEMESTER

**Title of the Course : Algae, Fungi, Bryophyte & Pteridophyte**
**Course Code : BOTM 101 TH & BOTM 101 PR**
**Nature of the Course : MAJOR/CORE COURSE I**
**Total Credits : 03 TH +01 PR**
**Distribution of Marks : 52 TH+ 18 PR + 30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on various forms of algae, fungi, bryophytes and pteridophytes - their characteristics, mode of reproduction and economic importance.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)**<br><br>I | **Introduction to Algae**<br>Classification system of Fritsch, and Basic concept of evolutionary classification viz. Lee; General characteristics; range of thallus organization; cell structure; pigment system, reserve food, methods of reproduction. Role of algae in the environment, agriculture, biotechnology and industry.<br>**Study of major divisions of Algae**<br>Comparative study of Characteristics; Occurrence; Mode of reproduction; Morphology and life cycles of *Anabaena, Volvox,Chara*, *Ectocarpus,* and *Polysiphonia*.<br>Diatoms and its importance. | 11 | 2 | - | 13 |
| II | **Introduction to fungi**<br>Salient features; Classification; Thallus organization; Cell wall composition; Nutrition; Classification. Mycorrhiza (Ectomycorrhiza, Endomycorrhiza and their significance); Lichen:Classification& Economic Importance.<br>**Study of major divisions of fungi:**<br>General characteristics of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, Oomycota: asexual and sexual fruiting bodies; Life cycle of *Phytophthora*, *Saccharomyces, Penicillium, Puccinia, Agaricus.*<br>Economic importance of fungi. | 11 | 2 | - | 13 |
| III | **Bryophytes**<br>General features; classification; thallus organization; morphology, anatomy and reproduction of *Marchantia, Anthoceros, Sphagnum;* Reproduction and evolutionary trends in bryophytes. Ecological and economic importance of bryophytes, Adaptation to land habits. | 09 | 1 | | 10 |
| IV | **Pteridophytes**<br>Classification, morphology, anatomy and reproduction of *Psilotum, Selaginella, Equisetum and Ophioglossum, Marselia*. Heterospory and seed habit, stelar evolution; Ecological andeconomic importance. | 08 | 1 | | 09 |
| **Practical (1 Credit)** | 1. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), *Volvox, Chara, Vaucheria, Ectocarpus* and *Polysiphonia,* through electron micrographs, temporary preparations and permanent slides.<br>*2.* Study of vegetative and reproductive structures of *Phytophthora, Saccharomyces, Aspergillus, Penicillium, Alternaria, Puccinia.*<br>*3.* Study of vegetative and reproductive structures of *Riccia, Marchantia, Anthoceros, Sphagnum/Polytrichum.*<br>4. . Study of vegetative and reproductive structures of *Selaginella, Equisetum and Ophioglossum, Marselia.* | | | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

***Where, L: Lectures T: Tutorials P: Practical***

**Title of the Course : Algae, Fungi, Bryophyte &Pteridophyte**
**Course Code : BOTN 101 TH & BOTN 101 PR**
**Nature of the Course : MINOR COURSE I**
**Total Credits : 03 TH +01 PR**
**Distribution of Marks : 52 TH+ 18 PR + 30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on various forms of algae, fungi, bryophytes and pteridophytes - their characteristics, mode of reproduction and economic importance.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Introduction to Algae**<br>Classification system of Fritsch, and Basic concept of evolutionary classification viz. Lee; General characteristics; range of thallus organization; cell structure; pigment system, reserve food, methods of reproduction. Role of algae in the environment, agriculture, biotechnology and industry.<br>**Study of major divisions of Algae**<br>Comparative study of Characteristics; Occurrence; Mode of reproduction; Morphology and life cycles of *Anabaena, Volvox,Chara*, *Ectocarpus,* and *Polysiphonia*.<br>Diatoms and its importance. | 11 | 2 | - | 13 |
| II | **Introduction to fungi**<br>Salient features; Classification; Thallus organization; Cell wall composition; Nutrition; Classification. Mycorrhiza (Ectomycorrhiza, Endomycorrhiza and their significance); Lichen:Classification& Economic Importance.<br>**Study of major divisions of fungi:**<br>General characteristics of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, Oomycota: asexual and sexual fruiting bodies; Life cycle of *Phytophthora*, *Saccharomyces, Penicillium, Puccinia, Agaricus.*<br>Economic importance of fungi. | 11 | 2 | - | 13 |
| III | **Bryophytes**<br>General features; classification; thallus organization; morphology, anatomy and reproduction of *Marchantia, Anthoceros, Sphagnum;* Reproduction and evolutionary trends in bryophytes. Ecological and economic importance of bryophytes, Adaptation to land habits. | 09 | 1 | | 10 |
| IV | **Pteridophytes**<br>Classification, morphology, anatomy and reproduction of *Psilotum, Selaginella, Equisetum and Ophioglossum, Marselia*. Heterospory and seed habit, stelar evolution; Ecological andeconomic importance. | 08 | 1 | | 09 |
| **Practical (1 Credit)** | 5. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), *Volvox, Chara, Vaucheria, Ectocarpus* and *Polysiphonia,* through electron micrographs, temporary preparations and permanent slides.<br>*6.* Study of vegetative and reproductive structures of *Phytophthora, Saccharomyces, Aspergillus, Penicillium, Alternaria, Puccinia.*<br>*7.* Study of vegetative and reproductive structures of *Riccia, Marchantia, Anthoceros, Sphagnum/Polytrichum.*<br>8. . Study of vegetative and reproductive structures of *Selaginella, Equisetum and Ophioglossum, Marselia.* | | | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

***Where, L: Lectures T: Tutorials P: Practical***

**SUGGESTED READINGS:**


1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
3. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
4. 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.
5. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
6. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition
7. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
8. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
9. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
10. Vanderpoorten, A. &Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.
11. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
12. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
13. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
14. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
15. 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.
16. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
17. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition
18. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
19. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
20. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
21. Vanderpoorten, A. &Goffinet, B. (2009) Introduction to Bryophytes. Cambridge UniversityPress.
22. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.

**Title of the Course** : **Natural Resource Management**

**Course Code** : **MDCN 101**
**Nature of the Course** : **Multi Disciplinary Course**
**Total Credits** : **03**
**Distribution of Marks** : **70 (End Sem.) + 30 (In-Sem.)**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on importance, sustainable utilization, conservation and management of natural resources.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| I<br>15 MARKS | Natural resources: Definition and types. Natural resources of NE India. | 8 | 01 | - | 09 |
| II<br>20 MARKS | Sustainable utilization of land and water resources; Soil degradation and management; water resources and their management. Renewable and non-renewable sources of energy. | 12 | 01 | - | 13 |
| III<br>15 MARKS | Forests: Definition, Significance; Types of vegetation in India; NTFC Depletion and Management, JFM. | 08 | 02 | - | 10 |
| IV<br>20 MARKS | Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. National and international efforts in resource management and conservation | 11 | 02 | - | 13 |
| | **Total** | **39** | **06** | **-** | **45** |

***Where,*** ***L: Lectures*** ***T: Tutorials*** ***P: Practical***

**MODES OF IN-SEMESTER ASSESSMENT:** **(30 Marks)**

- Two Sessional Examinations 20 Marks
- Attendance 5 Marks
- Assignment/Seminar 5 Marks

**LEARNING OUTCOMES:**

1. Know about the natural resources, its types, sustainable utilization and management practices.

**SUGGESTED READINGS:**


1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi

# SYLLABUS OF 2nd SEMESTER

**Title of the Course : Morphology and Reproduction of Spermatopythes**
**Course Code : BOTM 201 TH & BOTM 201 PR**
**Nature of the Course : MAJOR/CORE COURSE II**
**Total Credits : 03 TH + 01 PR**
**Distribution of Marks : 52 TH+ 18 PR + 30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on Gymnosperms and Angiosperms with their morphology, mode of reproduction, patterns of embryo development and economic and ecological importance.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Gymnosperms** General characteristics, classification, morphology, anatomy and reproduction of Cycas, Pinus, Ginkgo and Gnetum; Patterns of embryo development in gymnosperms. Ecological and economic importance. **Fossil plants** Process of fossilization; early land plants; *Rhynia*, *Cycadeoidea*, *Sphenophyllum*; Geological time scale; importance of fossil study. | 10 | 02 | | 14 |
| II | **Morphology of Angiosperms** Morphology and types of root, stem, and leaves; phyllotaxy and venation, hairs and trichomes, inflorescence and its types; aestivation. Arrangement and types of reproductive parts of flower, placentation and its types. | 09 | 01 | | 11 |
| III | **Anther and pollen biology** Anther wall: structure and functions, microsporogenesis, callose deposition and its significance; microgametogenesis; pollen wall structure, MGU (male germ unit) structure, NPC classification; palynology and scope (a brief account); pollen wall proteins; pollen viability, storage and germination, pollen allergy, melissopalynology. **Ovule** Structure and types of ovule; female gametophyte–megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis. | 10 | 02 | - | 07 |
| IV | **Pollination, fertilization and post fertilization developments** Pollination types and significance; adaptations for pollination; Double fertilization; Structure and types; general pattern of development of dicot and monocot embryo and endosperm; suspensor: structure and functions; embryo-endosperm relationship; nutrition of embryo; Polyembryony-causes & importance, apomixes, parthenocarpy and self- incompatibility**.** | 10 | 01 | | 15 |
| **Practical (1 Credit)** | 1. Study of morphology and reproductive parts of *Cycas, Pinus* & *Gnetum.*<br>2. Study of Fossil plants (Photographs/specimen).<br>3. Study of different types of roots (Morphology only).<br>4. Types of leaves, venation, hairs and trichomes, phyllotaxy, inflorescence and aestivation**.**<br>5. Types of placentation and ovule (Preparation of temporaryslides/photographs)<br>6. Study of pollen morphology (Malvaceae & Solanaceae) and pollen germination.<br>7. Study of types of embryos and endosperms (Permanent slides/ photographs) | | | 30 | |
| | **Total** | **39** | **06** | **30** | **75** |

***Where, L: Lectures T: Tutorials P: Practical***

**Title of the Course : Morphology and Reproduction of Spermatopythes**
**Course Code : BOTN 201 TH & BOTN 201 PR**
**Nature of the Course : Minor course-II**
**Total Credits : 03 TH + 01 PR**
**Distribution of Mark : 52 TH+ 18 PR + 30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on Gymnosperms and Angiosperms with their morphology, mode of reproduction, patterns of embryo development and economic and ecological importance.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Gymnosperms** General characteristics, classification, morphology, anatomy and reproduction of Cycas, Pinus, Ginkgo and Gnetum; Patterns of embryo development in gymnosperms. Ecological and economic importance. **Fossil plants** Process of fossilization; early land plants; *Rhynia*, *Cycadeoidea*, *Sphenophyllum*; Geological time scale; importance of fossil study. | 10 | 02 | | 14 |
| II | **Morphology of Angiosperms** Morphology and types of root, stem, and leaves; phyllotaxy and venation, hairs and trichomes, inflorescence and its types; aestivation. Arrangement and types of reproductive parts of flower, placentation and its types. | 09 | 01 | | 11 |
| III | **Anther and pollen biology** Anther wall: structure and functions, microsporogenesis, callose deposition and its significance; microgametogenesis; pollen wall structure, MGU (male germ unit) structure, NPC classification; palynology and scope (a brief account); pollen wall proteins; pollen viability, storage and germination, pollen allergy, melissopalynology. **Ovule** Structure and types of ovule; female gametophyte–megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis. | 10 | 02 | - | 07 |
| IV | **Pollination, fertilization and post fertilization developments** Pollination types and significance; adaptations for pollination; Double fertilization; Structure and types; general pattern of development of dicot and monocot embryo and endosperm; suspensor: structure and functions; embryo-endosperm relationship; nutrition of embryo; Polyembryony-causes & importance, apomixes, parthenocarpy and self- incompatibility**.** | 10 | 01 | | 15 |
| **Practical (1 Credit)** | 5. Study of morphology and reproductive parts of *Cycas, Pinus* & *Gnetum.*<br>6. Study of Fossil plants (Photographs/specimen).<br>7. Study of different types of roots (Morphology only).<br>8. Types of leaves, venation, hairs and trichomes, phyllotaxy, inflorescence and aestivation**.**<br>8. Types of placentation and ovule (Preparation of temporaryslides/photographs)<br>9. Study of pollen morphology (Malvaceae & Solanaceae) and pollen germination.<br>10. Study of types of embryos and endosperms (Permanentslides/ photographs) | | | 30 | |
| | **Total** | **39** | **06** | **30** | **75** |

***Where, L: Lectures T: Tutorials P: Practical***

**SUGGESTED READINGS:**


1. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) LtdPublishers, New Delhi, India.
2. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
3. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
4. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
5. Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.

**Title of the Course** : **Plant Diversity and Human Welfare**

**Course Code** : **MDCN 201**
**Nature of the Course** : **Multi Disciplinary Course**
**Total Credits** : **03**
**Distribution of Marks** : **70 (End Sem.) + 30 (In-Sem.)**

**COURSE OBJECTIVES**: The objective of this course is to provide knowledge to the students on biodiversity and its importance for human welfare.

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| I | Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes. | 10 | 01 | - | 11 |
| II | Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication. | 10 | 02 | - | 12 |
| III | Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. | 10 | 01 | - | 11 |
| IV | Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses. | 09 | 02 | - | 11 |
| | **Total** | **39** | **06** | **-** | **45** |

**Where, L: Lectures T: Tutorials P: Practical**

**MODES OF IN-SEMESTER ASSESSMENT**: (30 Marks)

One Internal Examination - 20 Marks

Others (Any one) - 10 Marks (Sessional Examinations or Assignment)

**LEARNING OUTCOMES**:

1. Know the scope, dimension and importance and threats to plant diversity.
2. Conservation ways of biodiversity and its Sustainable utilization.
3. Acquire knowledge of biodiversity for human welfare.

**SUGGESTED READINGS**:

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.

# SYLLABUS OF 3rd SEMESTER

**Title of the Course : Cell Biology**
**Course Code : BOTM 301 TH & BOTM 301 PR**
**Nature of the Course : MAJOR/CORE COURSE III**
**Total Credits : 03 TH + 01 PR**
**Distribution of Marks : 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide students the concept of cell as functional unit of life, structure of plant cell and functions of cellular components.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **The cell** Cell as a unit of structure and function; cell theory, Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory). | 8 | 0 | | 08 |
| II | **Cell wall and plasma membrane** Chemistry, structure and function of Plant cell wall; Overview of fluid mosaic model; Chemical composition of membranes; membrane function. **Cell organelles** Nucleus & its Structure. Microtubules, microfilaments and intermediary filament. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Mitochondria and Chloroplast: structure, functions & semiautonomous nature; Ribosomes- types, components and function; Lysosomes, Endoplasmic Reticulum, Golgi apparatus: structure, functions & protein sorting. | 12 | 02 | | 14 |
| III | **Membrane transport and Protein sorting & targeting** Membrane transport – Passive, active and facilitated transport, membrane channels, gates and pores; endocytosis and exocytosis; protein glycosylation, protein sorting and export from Golgi apparatus; protein folding& processing; Smooth endoplasmic reticulum and lipid synthesis, export of proteins and lipids. | 12 | 02 | | 14 |
| IV | **Cell division** Types of cell division, stages of mitosis and meiosis; Phases of eukaryotic cell cycle, Regulation of cell cycle-checkpoints, Interphase, role of protein kinases, significance. | 07 | 02 | | 09 |

| | | | | | |
|---|---|---|---|---|---|
| **Practical (1 Credit)** | 1. Study of plant cell structure with the help of epidermal peel mount of Onion/Crinum/Rheo.<br>2. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf, *Vallisnaria*.<br>3. Measurement of cell size by of micrometric method.<br>4. Cell counting using Haemocytometer (Yeast/pollen grains).<br>5. Study the phenomenon of plasmolysis and deplasmolysis.<br>6. Study of cell and its organelles with the help of electron micrographs.<br>7. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.<br>8. Study of different stages of mitosis and meiosis. | | | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

***Where,*** ***L: Lectures*** ***T: Tutorials*** ***P: Practical***

**SUGGESTED READINGS:**


1. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
2. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson EducationInc. U.S.A. 8th edition.
3. Cooper, G.M. and Hausman, R.E. (2009): The Cell: A Molecular Approach. 5th edition.ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

**Title of the Course : Plant Biochemistry & Molecular Biology**
**Course Code : BOTM 302 TH & BOTM 302 PR**
**Nature of the Course: MAJOR/CORE COURSE IV**
**Total Credits : 03 TH & 01 PR**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on Biomolecules of plants and their functions.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Biomolecules:** Definition, types and significance of chemical bonds; Structure and properties of water; pH and buffers. Carbohydrates: Nomenclature and classification; **Monosaccharides;** Disaccharides; Oligosaccharides and polysaccharides. **Lipids:** Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerides. **Proteins:** Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins. **Enzymes** Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theroy), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity. **Nucleic acids:** Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA. | 15 | 03 | | 18 |
| II | **Bioenergetics:** Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule**.** | 5 | 00 | | 5 |
| III | **Genetic material and its organization :** DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & Mc Carty experiment); denaturation and renaturation of DNA,; Organization of DNA- Prokaryotes, Virus (multiplication), Eukaryotes. RNA Structure; Organelle DNA-mitochondria and chloroplast DNA. **Replication and Transcription of DNA** General principles – bidirectional, semi-conservative and semi discontinuous replication, RNA priming; Important models of DNA replication, replication of linear & circular DNA. Transcription in prokaryotes and eukaryotes; Post-Transcriptional modification of RNA, Operon concept: Lac operon and its regulation. | 12 | 02 | | 14 |

| | | | | | |
|---|---|---|---|---|---|
| IV | **Genetic codes & Translation**<br>Genetic codes: salient features; Ribosome-structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, Post-translational modifications of proteins. | 07 | 01 | | 08 |
| **Practical (1 Credit)** | 1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.<br>2. Cytochemical staining of : DNA- Feulgen and cellwall in the epidermal peel of onion using PeriodicSchiff's (PAS) staining technique.<br>3. Estimation of plant proteins by Biuret/Lowry method.<br>4. Estimation of reducing and non-reducing sugars inplant samples.<br>5. DNA estimation by diphenylamine reagent/UV Spectrophotometry.<br>6. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication andsemi-discontinuous replication).<br>7. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase IIthrough photographs.<br>8. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments) | | | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

***Where,*** ***L: Lectures*** ***T: Tutorials*** ***P: Practical***

**SUGGESTED READINGS:**


1. Lehninger, Principles of Biochemistry, Nelson and Cox W.H. Freeman and Co., New York.
2. Biochemistry, Berg, Tymoczko and Stryer W.H. Freeman and Co., New York.
3. Molecular Biology of Cell, Elbert, Johnson, Lewis, Raff, Robertes and Walter: Garland Sc. (Taylor and Francis Gr.).
4. Harper's Illustrated Biochemistry, McGraw Hill Medical Publication.
5. Fundamentals of Biochemistry, A. C. Deb: New Central Book Agency Pvt. Ltd. Kolkata.
6. Fermentation Technology. M.L. Srivastava; Narosa Publishing House, New Delhi.
7. Principles of Fermentation Technology, Stanbury, Whitaker and Hall, Elsevier.
8. Biomolecules, Mohan P. Arora: Himalaya Publishing House.
9. Molecular Biology of the Cell .Alberts B., Bray D., Lewis J., Roberts K. & Watson, J. D. Garland Publishing, Inc. New York.
10. Genomes-2 .T. A. Brown, Wiley –Liss, USA.
11. Essentials of Molecular Biology. Freifelder, D 2nd edn, Jones & Barlett Publishers, USA.

**Title of the Course : Plant Physiology & Metabolism**
**Course Code : BOTN 301 TH & BOTN 301 PR**
**Nature of the Course: Minor course-III**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on plant physiological processes.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Plant-water relations:** Importance of water, water potential and its components; Ascent of sap, Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. **Translocation in phloem:** Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading. | 10 | 02 | - | 12 |
| II | **Mineral nutrition:** Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Biological nitrogen fixation; Nitrate and ammonia assimilation. | 07 | 01 | - | 08 |
| III | **Photosynthesis:** Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration. **Respiration:** Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway**.** | 15 | 02 | - | 17 |
| IV | **Plant growth regulators & plant responses:** Physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. Plant response to light and temperature; photoperiodism and its importance. | 07 | 1 | - | 08 |
| **Practical (1 Credit)** | 1. Determination of osmotic potential of plant cell sap by plasmolytic and weight method.<br>2. To study the effect of environmental factors (light and wind) on transpiration by excised twig.<br>3. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.<br>4. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.<br>5. Demonstration of Hill reaction.<br>6. To study the effect of light intensity and bicarbonate concentration on $O_2$ evolution in photosynthesis.<br>7. Determination of rate of transpiration. | | 30 | | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

***Where, L: Lectures T: Tutorials P: Practical***

**SUGGESTED READINGS:**


1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition. Hopkins,
2. W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley &Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Transport in Plants – Vol. 1-3 – Simmerman.
5. Plant Physiology – Pandeya & Sinha.
6. An Introduction to Plant Physiology – R. Sharma.

# ENVIRONMENTAL STUDIES

## UG 3rd SEMESTER

### FOR UNDER GRADUATE ARTS & SCIENCE – 2023-2024

Total Credits : 3
Distribution of Marks : 70 (End Sem.) + 30 (In-Sem.)

***Unit – I*** ***Class: 12***

The Environment: The Atmosphere, Hydrosphere, Lithosphere, Biosphere, Ecology, Ecosystem, Biogeochemical Cycle (Carbon Cycle, Nitrogen Cycle), Environmental Pollution: Air Pollution, Water Pollution, Soil Pollution, Radiation Pollution, Plastic Pollution.

***Unit – II*** ***Class: 10***

Population Ecology: Individuals, Species, Population, Community, Control Methods of Population, Urbanization and its effects on Society, Communicable Diseases and its Transmission, Non-Communicable Diseases; Ecosystem: Structure & Functions.

***Unit- III*** ***Class: 11***

Environmental Movements in India: Grass root Environmental movements in India, Role of women, Environmental Movements in Assam, River Dams: Its negative impact on environment & society with special reference to Assam. State Pollution Control Board, Central Pollution Control Board.

***Unit –IV*** ***Class: 12***

Natural Resources: Conservation of Natural Resources, Management and Conservation of Wildlife, Soil Erosion and Conservation, Water Resources of Northeast India. Environmental Laws: Water Act, 1974, Air Act, 1981, The Wildlife (Protection) Act, 1972, Environment Protection, 1986, Natural Disasters and their Management.

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# SYLLABUS OF 4th SEMESTER

**Title of the Course : Microbiology & Plant Pathology**
**Course Code : BOTM 401 TH & BOTM 401 PR**
**Nature of the Course: MAJOR/CORE COURSE V**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide students the concept of different types of microorganism and its positive & negative impacts on plants including diseases.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Introduction to microbial world** Introduction to Microbes, Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine). | 10 | 02 | - | 12 |
| II | **Viruses** Discovery, physiochemical and biological characteristics;, classification (Balitmore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cylec, RNA virus (TMV & Corona). | 07 | 01 | - | 08 |
| III | **Bacteria** Discovery, general characteristics; Types- archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Growth, Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). | 10 | 02 | - | 12 |
| IV | **Phytopathology** Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.<br>Bacterial diseases – Citrus canker<br>Viral diseases –Tobacco Mosaic viruses<br>Algal disease- Cephalurous,<br>Fungal diseases – Blight disease of potato, Black stem rust of wheat. | 12 | 1 | - | 13 |
| **Practical (1 Credit)** | 1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.<br>2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.<br>3. Gram staining.<br>4. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Viral diseases: TMV, Vein clearing, Fungal diseases: Blight of potato. *Puccinia*. | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**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. 4 th 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.
6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

**Title of the Course : Anatomy of Angiosperms**
**Course Code : BOTM 402 TH & BOTM 402 PR**
**Nature of the Course: MAJOR/CORE COURSE VI**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide students the concept of the internal structure of different parts of an angiospermic plant.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Introduction and scope of Plant Anatomy:** Importance of plant anatomy in systematics, forensics and pharmacognosy. | 03 | 00 | - | 03 |
| II | **Structure and Development of Plant Body:** Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: Polarity, Organogenesis during embryogenic development. | 05 | 01 | - | 06 |
| III | **Tissues:** Classification of tissues; Simple and complex tissues; cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers, Structure of dicot and monocot leaf, stem & root, Endodermis, Kranz anatomy. | 10 | 02 | - | 12 |
| IV | **Apical meristems:** Organization of shoot apex (Apical cell theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Origin of leaves; Organization of root apex (Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap. | 12 | 1 | - | 13 |
| V | **Vascular Cambium and Wood:** Structure, function and seasonal activity of cambium; Secondary growth in root and stem, Anomalous Secondary Growth in stem & root. Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; tyloses; Dendrochronology. Periderm, rhytidome and lenticels. | 06 | 02 | | 08 |
| VI | **Adaptive and Protective Systems: S**tomata (classification); adcrustation and incrustation; anatomical adaptations of xerophytes, hydrophytes and epiphytes. | 03 | 00 | | 03 |
| **Practical (1 Credit)** | 1. Study of anatomical details through permanent slides/temporary stain mounts (anatomy of dicot and monocot stem with anamolous structure)/ macerations/ museum specimens with the help of suitable examples.<br>2. Apical meristem of root, shoot and vascular cambium (through photographs/permanent slides).<br>3. Distribution and types of parenchyma, collenchyma and sclerenchyma (through photographs/permanent slides).<br>4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres (through photographs/permanent slides).<br>5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.<br>6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.<br>7. Periderm; lenticels (Photographs).<br>8. Leaf anatomy: isobilateral, dorsiventral, C4 leaves (Kranz anatomy) (Photographs).<br>9. Adaptive Anatomy: xerophytes, hydrophytes, | - | - | 30 | 30 |

| | | | | | |
|---|---|---|---|---|---|
| | epiphytes (Temporary preparation of slides). | | | | |
| | **Total** | **39** | **06** | **30** | **75** |

**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. 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.

**Title of the Course : Plant Systematics**
**Course Code : BOTM 403 TH & BOTM 403 PR**
**Nature of the Course: MAJOR/CORE COURSE VII**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide students the concept of plant classification and identification.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Significance of Plant systematic:** Introduction to taxonomy & systematics; Plant identification, Classification, Nomenclature, Importance of systematics. Evidences from palynology, cytology, phytochemistry and molecular data. Field inventory; Herbarium & Botanical Garden: Importance and Functions, herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora. | 06 | 00 | - | 06 |
| II | **Taxonomic hierarchy:** Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary). | 04 | 01 | - | 05 |
| III | **Morphology and Botanical nomenclature:** Angiosperm morphology, Principles and rules (ICN= International Code of Nomenclature of Algae, fungi & Plants); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids. | 06 | 02 | - | 08 |
| IV | **Systems of classification:** History of Plant Taxonomy: Linnaeus, Bentham and Hooker, Hutchinson, Engler and Prantl and Takhtajan (up to series), APG. | 05 | 00 | - | 05 |
| V | **Biometrics, numerical taxonomy and cladistics:** Characters; Variations; OTUs, Cluster analysis; Phenograms, cladograms (definitions and differences). | 04 | 00 | | 04 |
| VI | **Phylogeny of Angiosperms:** Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals. | 06 | 02 | | 08 |
| VII | **Major families of Angiosperms:** Study of morphological characters of some major families of Angiosperms: Magnoliaceae, Solanaceae, Fabaceae, Cucurbitaceae, Lamiaceae, Euphorbiaceae, Asteraceae, Poaceae, Orchidaceae. | 08 | 01 | | 09 |
| **Practical (1 Credit)** | 1. Taxonomic studies of locally available species.<br>2. Field visit (local).<br>3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).<br>4. Submission of herbarium (single specimen locally available) | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Singh, (2012). *Plant Systematics*: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). An Introduction to *Plant Taxonomy*. Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics- A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari, J.K. (1963). *Flora of Delhi*. CSIR, New Delhi.
5. Radford, A.E. (1986). Fundamentals of *Plant Systematics*. Harper and Row, New York.

**Title of the Course : Economic Botany**

**Course Code : BOTM 404 TH & BOTM 404 PR**

**Nature of the Course: MAJOR/CORE COURSE VIII**

**Total Credits : 03 +01**

**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to expose the students on various economically important plants and plant products.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Origin of Cultivated Plants:** Concept of Centres of Origin, Indigenous Knowledge System (IKS). Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity. | 06 | 01 | - | 07 |
| II | **Cereals:** Wheat and Rice (origin, morphology, processing & uses); Brief account of wheat. | 02 | 01 | - | 03 |
| III | **Legumes:** Morphology and economic importance of Chick pea, Pigeon pea and fodder legumes. | 03 | 00 | - | 03 |
| IV | **Sources of sugars and starches:** Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses. | 04 | 00 | - | 04 |
| V | **Spices:** Listing of important spices, their family and part used & economic importance with special reference to saffron, clove, cinnamommum, cardamom and black pepper | 04 | 00 | | 04 |
| VI | **Beverages:** Tea, Coffee (morphology, processing & uses) | 04 | 00 | | 04 |
| VII | **Sources of oils and fats:** General description, classification, extraction, their uses and health implications groundnut, mustard and coconut (Botanical name, family & uses).<br>Essential Oils: General account, extraction methods, comparison with fatty oils & their uses. | 05 | 02 | | 07 |
| VIII | **Natural Rubber:** Para-rubber: tapping, processing and uses. | 02 | 00 | | 02 |
| IX | **Drug-yielding plants:** Study of drug yielding plants with special reference to *Cinchona, Rawolfia* and *Phyllanthus* (Morphology, processing, uses and health hazards), Pharmacognosy. | 02 | 00 | | 02 |
| X | **Timber plants:** General account with special reference to teak, sal, pine & sisu. | 01 | 00 | | 01 |
| XI | **Fibers:** Classification based on the origin of fibers; Cotton & Jute (morphology, extraction and uses). | 03 | 01 | | 04 |
| XII | **Aromatics and Petrocrops:** General account with special reference to *Aquilaria, Vetiveria, Jatropha* and *Ricinus.* | 03 | 01 | | 04 |
| **Practical ( 1 Credit)** | <u>Study of morphology and economic importance</u>:<br>1. **Cereals:** Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).<br>2. **Legumes:** Soybean (habit, fruit, seed structure, micro-chemical tests).<br>3. **Sources of sugars and starches:** Sugarcane ( habit sketch; cane juice- micro-chemical tests).<br>4. **Beverages:** Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).<br>5. **Sources of oils and fats:** Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.<br>6. **Essential oil-yielding plants:** Habit sketch of Rosa, Vetiveria (specimens/photographs). | - | - | 30 | 30 |

| | | | | | |
|---|---|---|---|---|---|
| | 7. **Rubber:** specimen, photograph/model of tapping, samples of rubber products.<br>8. **Woods:** Tectona: Specimen, Section of young stem.<br>9. **Fiber-yielding plants:** Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose). | | | | |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. 1994: Plants, Genes and Agriculture. Jones & Bartlett Publishers.

**Title of the Course : Plant Ecology & Taxonomy**
**Course Code : BOTN 401 TH & BOTN 401 PR**
**Nature of the Course: MINOR COURSE IV**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**
**COURSE OBJECTIVES:** *The objective of this course is to expose the students to interaction of plant life with the surroundings and also to identification, classification and nomenclature of plants.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Introduction:** Ecology, branches of ecology | 02 | 00 | - | 02 |
| II | **Ecological factors:** Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes. | 08 | 01 | - | 09 |
| III | **Plant communities:** Characters; Ecotone and edge effect; Succession; Processes and types. | 04 | 01 | - | 05 |
| IV | **Ecosystem:** Structure; energy flow, trophic organisation; Food chains and food webs, Ecological pyramids, production and productivity; Biogeochemical cycling; Cycling of carbon & nitrogen. | 06 | 01 | - | 07 |
| V | **Phytogeography:** Principle biogeographical zones; Endemism. | 03 | 00 | - | 03 |
| VI | **Introduction to plant taxonomy:** Identification, Classification, Nomenclature. | 03 | 00 | - | 03 |
| VII | **Identification:** Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora. | 06 | 01 | - | 07 |
| VIII | **Botanical nomenclature:** Principles and rules (IUCN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations. | 07 | 02 | - | 09 |
| **Practical (1 Credit)** | 1. Study of morphological adaptations of hydrophytes and xerophytes.<br>2. Determination of minimal quadrat size for the study of herbaceous vegetation in the University campus by species area curve method (species to be listed).<br>3. 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): Asteraceae, Solanaceae, Lamiaceae. Musaceae.<br>4. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book). | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.

Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.

Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.

Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

# SYLLABUS OF 5th SEMESTER

**Title of the Course : Genetics**
**Course Code : BOTM 501 TH & BOTM 501 PR**
**Nature of the Course: MAJOR/CORE COURSE IX**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**
**COURSE OBJECTIVES:** *The objective of this course is to provide basic idea about plant genetics.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Mendelian genetics and its extension:** Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes, euchromatin & herterochomatin; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Non-Mendelian dihybrid Cross. | 10 | 02 | - | 12 |
| II | **Extrachromosomal Inheritance:** Chloroplast mutation: Variegation in Four o'clock plant; Maternal effects, Infective heredity- Kappa particles in Paramecium. | 06 | 01 | - | 07 |
| III | **Linkage, crossing over and chromosome mapping:** Linkage and crossing over-Cytological basis of crossing over; Interference and coincidence; Sex Linked, sex-limited and sex-influence traits. Chromosome map. | 06 | 00 | - | 06 |
| IV | **Variation in chromosome number and structure:** Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy, hereditary abnormalities in human. | 05 | 00 | - | 05 |
| V | **Gene mutations:** Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method. Role of Transposons in mutation.DNA repair mechanisms. | 06 | 01 | - | 07 |
| VI | **Population and Evolutionary Genetics:** Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation. | 06 | 02 | - | 08 |
| **Practical (1 Credit)** | 1. Meiosis through temporary squash preparation.<br>2. Mendel's laws through seed ratios.<br>3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.<br>4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).<br>5. Study of aneuploidy: Down's and Turner's syndromes.<br>6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.<br>7. Study of human genetic traits: Sickle cell anemia, red-green Colour blindness, Rolling of tongue. | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

## SUGGESTED READINGS:


1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

**Title of the Course : Plant Ecology & Phytogeography**
**Course Code : BOTM 502 TH & BOTM 502 PR**
**Nature of the Course: MAJOR/CORE COURSE X**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**
**COURSE OBJECTIVES:** *The objective of this course is to expose the students to interaction of plant life with the surroundings.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Introduction:** Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis. | 05 | 00 | - | 05 |
| II | **Soil & Water:** Importance, Origin, Formation, Composition, Physical, Chemical and Biological components, Soil profile, Role of climate in soil development; Water: Importance, States of water in the environment, Atmospheric moisture, Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle, Water in soil, Water table. | 08 | 02 | - | 10 |
| III | **Biotic interactions:** Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism; | 04 | 00 | - | 04 |
| IV | **Population ecology:** Characteristics and Dynamics. Ecological Speciation. | 04 | 00 | - | 04 |
| V | **Plant communities:** Concept of ecological amplitude; habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts. | 04 | 01 | - | 05 |
| VI | **Ecosystems:** Structure and Function, Ecological pyramids. Principles and models of energy flow; Production and productivity; Ecological Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus. | 07 | 02 | - | 09 |
| VII | **Phytogeography:** Principles; static and dynamic phytogeography, Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical regions of India with special reference of Assam. | 07 | 01 | | 08 |
| **Practical (1 Credit)** | 1. Determination of pH of various soil and water samples (pH meter).<br>2. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.<br>3. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.<br>4. Study of morphological adaptations of hydrophytes and xerophytes.<br>5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).<br>6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.<br>7. Quantitative analysis of herbaceous vegetation for density and abundance in the University campus.<br>8. Field visit to familiarize students with ecology of different sites. | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. $4^{th}$ edition.

**Title of the Course : Natural Resource Management**
**Course Code : BOTM 503 TH & BOTM 503 PR**
**Nature of the Course: MAJOR/CORE COURSE XI**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**
**COURSE OBJECTIVES:** *The objective of this course is to expose the students to interaction our natural resource and their management.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Natural resources:** Definition and types. | 02 | 00 | - | 02 |
| II | **Sustainable utilization:** Concept, approaches (economic, ecological and socio-cultural). | 04 | 01 | - | 05 |
| III | **Land:** Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management. Land resources of Assam | 04 | 01 | - | 05 |
| IV | **Water:** Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies. Water resources of Northeast India. | 05 | 01 | - | 06 |
| V | **Biological Resources:** Biodiversity-definition and types; Significance; Threats; Management strategies; Biodiversity Hot Spot (Terrestrial & Marine), IUCN Species categories, In situ & Ex situ conservation, Bio-prospecting; IPR; CBD; National Biodiversity Action Plan). Sustainable development. | 09 | 02 | - | 11 |
| VI | **Forests:** Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management. Forest resources of Assam. | 04 | 00 | - | 04 |
| VII | **Energy:** Renewable and non-renewable sources of energy. | 03 | 00 | - | 03 |
| VIII | **Contemporary practices in resource management:** EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. | 04 | 01 | - | 05 |
| IX | **National and international efforts in resource management and conservation:** National and international efforts in natural resource management and their conservation approaches. | 04 | 00 | - | 04 |
| **Practical (1 Credit)** | 1. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation.<br>2. Collection of data on forest cover of specific area.<br>3. Measurement of dominance of woody species by DBH (diameter at breast height) method.<br>4. Calculation and analysis of ecological footprint.<br>5. Ecological modeling. | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

**Title of the Course : Plant Physiology**
**Course Code : BOTM 504 TH & BOTM 504 PR**
**Nature of the Course: MAJOR/CORE COURSE XII**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**
**COURSE OBJECTIVES:** *The objective of this course is to expose the students to different physiological processes in plant life.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Plant-water relations:** Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure. Ascent of sap–cohesion-tension theory. Transpiration and factors affecting transpiration, anti-transpirants, mechanism of stomatal movement. Guttation. | 07 | 02 | - | 09 |
| II | **Mineral nutrition:** Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements. | 05 | 01 | - | 06 |
| III | **Nutrient Uptake:** Transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport. | 06 | 01 | - | 07 |
| IV | **Translocation in the phloem:** Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model. | 05 | 01 | - | 06 |
| V | **Plant Growth Regulators**: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Concept of plant movement: tropic and nastic. | 06 | 01 | - | 07 |
| VI | **Physiology of flowering:** Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy. | 04 | 00 | - | 04 |
| VII | **Phytochrome, crytochromes and phototropins:** Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action. | 06 | 00 | - | 06 |
| **Practical (1 Credit)** | 1. Determination of osmotic potential of plant cell sap by plasmolytic method.<br>2. Determination of water potential of given tissue (potato tuber) by weight method.<br>3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.<br>4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves.<br>5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).<br>6. To study the phenomenon of seed germination (effect of light).<br>7. To study the induction of amylase activity in germinating barley grains.<br>**Demonstration experiments**<br>1. To demonstrate suction due to transpiration.<br>2. Fruit ripening/Rooting from cuttings (Demonstration). | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

**Title of the Course : Plant Anatomy & Embryology**
**Course Code : BOTN 501 TH & BOTN 501 PR**
**Nature of the Course: MINOR COURSE V**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to provide students the concept of the internal structure of different parts of an angiospermic plant.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Meristematic and permanent tissues:** Characters of meristematic tissues, Root and shoot apical meristems; Simple and complex tissues. | 04 | 00 | - | 04 |
| II | **Organs:** Structure of dicot and monocot root, stem and leaf. | 04 | 01 | - | 05 |
| III | **Secondary Growth:** Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). | 04 | 01 | - | 05 |
| IV | **Adaptive and protective systems:** Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes. | 06 | 01 | - | 07 |
| V | **Structural organization of flower:** Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac. | 06 | 01 | - | 07 |
| VI | **Pollination and fertilization:** Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. | 05 | 01 | - | 06 |
| VII | **Embryo and endosperm:** Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship. | 06 | 01 | - | 07 |
| VIII | **Apomixis and polyembryony:** Definition, types and Practical applications. | 04 | 00 | - | 04 |
| **Practical (2 Credit)** | 1. Study of meristems through permanent slides and photographs.<br>2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs).<br>3. Stem: Monocot: *Zea mays*; Dicot: *Helianthus;* Secondary: *Helianthus* (only Permanent slides).<br>4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).<br>5. Leaf: Dicot and Monocot leaf (only Permanent slides). | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**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. 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.

# SYLLABUS OF 6th SEMESTER

**Title of the Course : Plant Metabolism**

**Course Code : BOTM 601 TH & BOTM 601 PR**
**Nature of the Course: MAJOR/CORE COURSE XIII**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**
**COURSE OBJECTIVES:** *The objective of this course is to expose the students to various metabolic processes involved with plant life.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Concept of metabolism:** Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes). | 05 | 01 | - | 06 |
| II | **Carbon assimilation**: Definition, Photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, $CO_2$ reduction, photorespiration, C4 pathways; Crassulacean acid metabolism; Factors affecting $CO_2$ reduction. | 08 | 02 | - | 10 |
| III | **Carbohydrate metabolism:** Synthesis and catabolism of sucrose and starch. | 02 | 00 | - | 02 |
| IV | **Carbon Oxidation:** Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration. | 08 | 02 | - | 10 |
| V | **ATP-Synthesis:** Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers. | 06 | 00 | - | 06 |
| VI | **Lipid metabolism:** Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation. | 05 | 01 | - | 06 |
| VII | **Nitrogen metabolism:** Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation. | 05 | 00 | - | 05 |
| **Practical (1 Credit)** | 1. Chemical separation of photosynthetic pigments.<br>2. Experimental demonstration of Hill's reaction.<br>3. To study the effect of light intensity on the rate of photosynthesis.<br>4. Effect of carbon dioxide on the rate of photosynthesis.<br>5. To compare the rate of respiration in different parts of a plant.<br>6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.<br>7. Demonstration of absorption spectrum of photosynthetic pigments. | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.

**Title of the Course : Plant Breeding**

**Course Code : BOTM 602 TH & BOTM 602 PR**

**Nature of the Course: MAJOR/CORE COURSE XIV**

**Total Credits : 03 +01**

**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to expose the students to different methods of plant improvement and breeding techniques.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Plant Breeding**: Introduction and objectives. Types of Breeding systems, modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding. | 08 | 01 | - | 09 |
| II | **Methods of crop improvement:** Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations. | 13 | 02 | - | 15 |
| III | **Quantitative inheritance:** Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings. Monogenic vs polygenic Inheritance. | 08 | 01 | - | 09 |
| IV | **Inbreeding depression and heterosis:** History, genetic basis of inbreeding depression and heterosis; Applications. | 05 | 01 | - | 06 |
| V | **Crop improvement and breeding:** Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement. | 05 | 01 | - | 06 |
| **Practical (1 Credit)** | 1. Hybridization technique, Selection and preparation of parents, floral biology study, emasculation, bagging, pollination.<br>2. Study of pollen morphology and viability<br>3. Study of purity of seeds from commercial seed sample.<br>4. Breeding importance of some common crop plants. | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

## SUGGESTED READINGS:


1. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
2. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

**Title of the Course : Plant Biotechnology**

**Course Code : BOTM 603 TH & BOTM 603 PR**

**Nature of the Course: MAJOR/CORE COURSE XV**

**Total Credits : 03 +01**

**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to expose the students to application of modern tools and techniques in Biology.*

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| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Plant Tissue Culture:** Historical perspective; Composition & types of media, instruments; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation. | 09 | 02 | - | 11 |
| II | **Recombinant DNA technology:** Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19), Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector. | 08 | 01 | - | 09 |
| III | **Gene Cloning:** Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, complementation, colony hybridization. | 07 | 01 | - | 08 |
| IV | **Methods of gene transfer:** *Agrobacterium*-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics–selectable marker and reporter genes (GUS, GFP). | 07 | 01 | - | 08 |
| V | **Applications of Biotechnology:** Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns. | 08 | 01 | - | 09 |
| **Practical (1 Credit)** | 1. Preparation of MS medium.<br>2. Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.<br>2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.<br>3. Isolation of protoplasts.<br>4. Construction of restriction map of circular and linear DNA from the data provided.<br>5. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.<br>6. Isolation of plasmid DNA (photographs). | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

**Title of the Course : Research Methodology**
**Course Code : BOTM 604 TH & BOTM 604 PR**
**Nature of the Course: MAJOR/CORE COURSE XVI**
**Total Credits : 03 +01**
**Distribution of Marks: 52 TH +18 PR+30 IA=100**
**COURSE OBJECTIVES:** *The objective of this course is to expose the students to methods of carrying out and reporting research in different fields.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Basic concepts of research:** Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs emperical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research. Application of biostatistics in research. | 18 | 02 | - | 12 |
| II | **General laboratory practices:** Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling. | 09 | 01 | - | 10 |
| III | **Data collection and documentation of observations:** Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. | 04 | 00 | - | 04 |
| IV | **Overview of Biological Problems:** History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics. | 06 | 01 | - | 07 |
| V | **Plant micro-techniques:** Staining procedures, classification and chemistry of stains. Staining equipment. | 03 | 00 | - | 03 |
| VI | **The art of scientific writing and its presentation:** Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism. | 07 | 02 | | 09 |
| **Practical (1 Credit)** | 1. Experiments based on chemical calculations.<br>2. Plant micro-technique experiments.<br>3. The art of imaging of samples through microphotography and field photography.<br>4. Poster presentation on defined topics.<br>5. Technical writing on topics assigned. | - | - | 30 | 30 |
| | | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

**Title of the Course : Economic Botany & Biotechnology**

**Course Code : BOTN 601 TH & BOTN 601 PR**

**Nature of the Course: MINOR COURSE VI**

**Total Credits : 03 +01**

**Distribution of Marks: 52 TH +18 PR+30 IA=100**

**COURSE OBJECTIVES:** *The objective of this course is to expose the students on various economically important plants and plant products and to expose the students to application of modern tools and techniques in Biology.*

| UNITS | CONTENTS | L | T | P | Total Hours |
|---|---|---|---|---|---|
| **Theory (3 Credits)** I | **Origin of Cultivated Plants:** Concept of centres of origin, their importance with reference to Vavilov's work. | 02 | 00 | - | 02 |
| II | **Cereals:** Rice- Origin, morphology, uses. | 03 | 00 | - | 03 |
| III | **Legumes:** General account with special reference to Gram and soybean. | 02 | 01 | - | 03 |
| IV | **Spices:** General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses). | 03 | 01 | - | 04 |
| V | **Beverages:** Tea & Coffee (morphology, processing, uses). | 03 | 00 | - | 03 |
| VI | **Oils and Fats:** General description with special reference to mustard. | 03 | 00 | - | 03 |
| VII | **Fibre Yielding Plants:** General description with special reference to Cotton (Botanical name, family, part used, morphology and uses) | 04 | 01 | - | 05 |
| VIII | **Introduction to biotechnology** | 02 | 00 | - | 02 |
| IX | **Plant tissue culture:** Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications. | 06 | 01 | - | 07 |
| X | **Recombinant DNA Techniques:** Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA. | 11 | 02 | - | 13 |
| **Practical (1 Credit)** | 1. Study of economically important plants : Rice, Wheat, Gram, Soybean, Black pepper, Clove, Tea, Cotton, mustard through specimens,<br>2. Sections and microchemical tests.<br>3. Familiarization with basic equipments in tissue culture.<br>4. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micro-propagation.<br>5. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE (Demonstarion). | - | - | 30 | 30 |
| | **Total** | **39** | **06** | **30** | **75** |

**SUGGESTED READINGS:**


1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology.


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