Kurukshetra University, Kurukshetra



Scheme of Examination and Syllabus

**for B.Sc. (Medical)**

**Subjects: Botany under**

**Choice Based Credit System (CBCS)**

**Semester 1st to 6th**

**w.e.f. session 2020-21 in Phased Manner**

# Programme Outcomes (POs) for UG courses of Faculty of Life Sciences

1. To develop skills in graduate students to be able to acquire theoretical and practical knowledge in fundamentals of biology in respective disciplines of plants, animals, microbes and environment.
2. To inculcate ability to critically evaluate problems and apply lateral thinking and analytical skills for professional development.
3. To create awareness on ethical issues, good laboratory practices and biosafety.
4. To develop ability in youth for understanding basic scientific learning and effective communication skills.
5. To prepare youth for career in teaching, industry, government organizations and self reliant entrepreneurship.
6. To make students aware of natural resources and environment and its sustainable utilization.
7. To provide learning experience in students that instills deep interest in biological science for the benefit of society.

# Programme Specific Outcomes (PSOs) for Botany subject of B.Sc. Medical

1. The students will be able to identify the various plants and compare the diagnostic characteristics of lower and higher groups of plants. This comparative approach will help the students to explain the evolution and degree of genetic diversity in plants.
2. The students will be able to explain the various biological processes in plants and how they are sustained and regulated at the cellular and molecular levels. Students will also be able to understand the ecology, development, and behavior of different forms of life.
3. The students will be able to describe and demonstrate the different experimental techniques and methods in various fields of plant sciences.
4. The students will also strengthen their ethical and moral values and shall be able to deal with psychological weaknesses. Students will also learn team workmanship in order to serve the institutions, industry, and society efficiently.
5. The students will possess minimum standards of communication skills expected from a Botany graduate in the country. They will also become acritical thinker and acquire problem-solving capabilities.
6. This programme will help the students in finding career opportunities in higher education in the field of plant sciences and other entrepreneurship programmes.

# Scheme of examination for B.Sc. Medical (General), Subject: Botany

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sem.** | **Type of paper/ Course** | **Paper code** | **Nomenclature of paper** | **Credits** | **Int. marks** | **Ext. marks** | **Total** | **Exam Duration (Hours)** | **Contact Hours per week** |
| I | Core Course**Botany-I** | BOT- 101 | Biodiversity –I (Microbes, Algae, Fungi) | 3 | 15 | 60 | 75 | 3 | 3 |
| BOT-102 | Biodiversity-II(Archegoniate) | 3 | 15 | 60 | 75 | 3 | 3 |
| BOT-103 | Biodiversity –I (Microbes, Algae, Fungi) & Biodiversity-II (Archegoniate)-Practical | 2 | 10 | 40 | 50 | 4 | 4 |
| II | Core Course**Botany–II** | BOT-201 | Plant Ecology | 3 | 15 | 60 | 75 | 3 | 3 |
| BOT-202 | Plant Taxonomy | 3 | 15 | 60 | 75 | 3 | 3 |
| BOT-203 | Plant Ecology & Plant Taxonomy - Practical | 2 | 10 | 40 | 50 | 4 | 4 |
| III | Core Course**Botany-III** | BOT-301 | Plant Anatomy | 3 | 15 | 60 | 75 | 3 | 3 |
| BOT-302 | Plant Embryology | 3 | 15 | 60 | 75 | 3 | 3 |
| BOT-303 | Plant anatomy & Plant Embryology Practical | 2 | 10 | 40 | 50 | 4 | 4 |
| IV | Core Course**Botany-IV** | BOT-401 | Plant Physiology | 3 | 15 | 60 | 75 | 3 | 3 |
| BOT-402 | Plant Metabolism | 3 | 15 | 60 | 75 | 3 | 3 |
| BOT-403 | Plant Physiology & Plant Metabolism- Practical | 2 | 10 | 40 | 50 | 4 | 4 |
| V | Discipline Specific Elective \* **Botany- I** | **Option-I** |  |  |  |  |  |  |
| BOT- 501 | Economic Botany | 2 | 10 | 40 | 50 | 3 | 2 |
| BOT- 502 | Plant Biotechnology | 2 | 10 | 40 | 50 | 3 | 2 |
| BOT- 503 | PracticalBOT-501 & BOT-502**(Option- I)** | 2 | 10 | 40 | 50 | 4 | 4 |
| **Option-II** |  |  |  |  |  |  |
| BOT- 501 | Cell Biology | 2 | 10 | 40 | 50 | 3 | 2 |
| BOT-502 | Molecular Biology | 2 | 10 | 40 | 50 | 3 | 2 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | BOT 503 | PracticalBOT-501 & BOT-502**(Option- II)** | 2 | 10 | 40 | 50 | 4 | 4 |
| VI | Discipline Specific Elective**\* Botany- II** | **Option-I** |  |  |  |  |  |  |
| BOT- 601 | Genetics | 2 | 10 | 40 | 50 | 3 | 2 |
| BOT- 602 | Plant Breeding | 2 | 10 | 40 | 50 | 3 | 2 |
| BOT- 603 | PracticalBOT-601 & BOT-602 (**Option- I)** | 2 | 10 | 40 | 50 | 4 | 4 |
| **Option-II** |  |  |  |  |  |  |
| BOT- 601 | Research Methodology- I | 2 | 10 | 40 | 50 | 3 | 2 |
| BOT- 602 | Research Methodology- II | 2 | 10 | 40 | 50 | 3 | 2 |
| BOT- 603 | PracticalBOT- 601& BOT-602 **(Option- II)** | 2 | 10 | 40 | 50 | 4 | 4 |
| Sem. IV- VI | Skill Enhance- ment Course-III\*\***Botany** | BOT- S1 BOT- S2 BOT- S3 BOT- S4BOT- S5 | Nursery and Gardening **/** Bio-fertilizers **/**Intellectual Property Rights **/**Floriculture **/**Organic Farming | 2 | 10 | 40 | 50 | 3 | 2 |

\*Students have to opt one option/stream of DSE Botany either (I) or (II)

Formula for 20 per cent Internal Assessment (10 Percent on the basis of two hand written assignments, 5 percent on the basis of one class test and 5 percent on the basis of attendance of the student).

\*\*SEC can be opted in any of the three semesters (IV-VI) as per feasibility and time table of College/Institution

# Nomenclature of Papers- B.Sc. Medical (General), Subject: Botany

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Type of paper/ Course** | **Paper code** | **Nomenclature of paper** |
| I | Core Course**Botany-I** | BOT-101 | Biodiversity - I (Microbes, Algae, Fungi) |
| BOT -102 | Biodiversity- II (Archegoniate) |
| BOT -103 | Biodiversity- I(Microbes, Algae, Fungi) & Biodiversity- II (Archegoniate)- Practical |
| II | Core Course**Botany–II** | BOT -201 | Plant Ecology |
| BOT -202 | Plant Taxonomy |
| BOT -203 | Plant Ecology &Plant Taxonomy- Practical |
| III | Core Course**Botany-III** | BOT -301 | Plant Anatomy |
| BOT -302 | Plant Embryology |
| BOT -303 | Plant Anatomy & Plant Embryology Practical |
| IV | Core Course**Botany-IV** | BOT -401 | Plant Physiology |
| BOT -402 | Plant Metabolism |
| BOT -403 | Plant Physiology &Plant Metabolism- Practical |
| V | Discipline Specific Elective **Botany- I** | **Option-I** |
| BOT-501 | Economic Botany |
| BOT-502 | Plant Biotechnology |
| BOT-503**(Option-I)** | PracticalBOT-501 & BOT-502 **based on option- I** |
| **Option-II** |
| BOT-501 | Cell Biology |
| BOT-502 | Molecular Biology |
| BOT 503**(Option-II)** | PracticalBOT-501 & BOT-502 **based on option- II** |
| VI | Discipline Specific Elective **Botany- II** | **Option-I** |
| BOT-601 | Genetics |
| BOT-602 | Plant Breeding |
| BOT-603**(Option-I)** | PracticalBOT-601 & BOT-602 **based on option- I** |
| **Option-II** |
| BOT-601 | Research Methodology- I |
| BOT-602 | Research Methodology- II |
| BOT-603**(Option-II)** | BOT-601 & BOT-602 **based on option- II** |
| Semester IV-VI | Skill Enhance- mentCourse-III**Botany** | BOT- S1 BOT- S2 BOT- S3 BOT- S4 BOT- S5 | Nursery and Gardening**/** Bio-fertilizers**/**Intellectual Property Rights**/** Floriculture**/**Organic Farming |

**SEMESTER-I PAPER CODE: BOT- 101**

**BIODIVERSITY –I (MICROBES, ALGAE, FUNGI)**

**Internal Assessment: 15 Marks External Marks: 60 Maximum Total Marks: 75 Credits: 3 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type).Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (12 marks each).**

**Objectives:** The objective of the course is to introduce students to the world of primary diversity of living systems.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** understand the general characters, economic importance and life-cycles of various groups of general microbes, algae and fungi.

**CO2** learners will also be able to explain their impact on environment, human welfare androle in industries.

**CO3** understanding the evolutionary significance of these organisms, in terms of phylogenetic implications on thallophyta.

# Table -1: CO-PO matrix for the course Botany -101 (Biodiversity 1-Microbes, Algae, Fungi)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 101.1 | 3 | --------- | --------- | 2 | 2 | 1 | 2 |
| BOT 101.2 | 2 | --------- | --------- | 2 | 2 | 3 | 3 |
| BOT 101.3 | 2 | --------- | --------- | 1 | 2 | 1 | 1 |
| Average | 2.33 | ---------- | --------- | 1.66 | 2.00 | 1.66 | 2.00 |

**Table -1: CO-PSO matrix for the course Botany -101(Biodiversity 1-Microbes, Algae, Fungi)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 101.1 | 3 | 2 | 1 | -------- | 2 | 3 |
| BOT 101.2 | 1 | 3 | 3 | -------- | 2 | 3 |
| BOT101.3 | 3 | 3 | 1 | -------- | -------- | 3 |
| Average | 2.33 | 2.66 | 1.66 | ------ | 1.33 | 3.00 |

**UNIT-I**

**Bacteria:** Structure, nutrition, reproduction and economic importance; General account of cyanobacteria (with reference to *Nostoc*).

**Algae:** General characters, classificationupto classes (Lee 1980) and economic importance; Important features and life-history (excluding development) of *Volvox*, (Chlorophyceae), *Chara*(Charophyceae) *Vaucheria* (Xanthophyceae), *Ectocarpus* (Phaeophyceae) and *Polysiphonia* (Rhodophyceae).

# UNIT-II

**Viruses:** General account of Viruses including structure of TMV and Bacteriophages.

**Fungi:** General characters, classification upto classes (Ainsworth 1971) and economic importance; important features and life-history of *Phytophthora* (Mastigomycotina), *Mucor* (Zygomycotina), *Penicillium* (Ascomycotina), *Puccinia* (Basidiomycotina), *Colletotrichum* (Deuteromycotina); General account of Lichens.

# SUGGESTED READINGS

* Ahluwalia, A.S. ( Ed. ). Phycology: Principles, Processes and Applications*.* Daya Publishing House, New Delhi. 2003.
* Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
* 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.
* Dube, H.C. 1990. An Introduction to Fungi, Vikas Publishing House Pvt. Ltd., Delhi.
* Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
* Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge.4th edition.
* Mehrotra,R.S.&Aneja,K.R.1990:AnintroductionofMycology,NewAgeInternationalPress,N.Delhi
* Mehrotra,R.S. and Aggarwal,Ashok (2013) Fundamentals of Plant Pathology, Tata McGraw-Hill Publishing company Ltd,New Delhi
* Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
* Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005).Biology. Tata McGraw Hill, Delhi.
* Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
* Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
* Sharma, O.P. 1992. Text Book of Thallophytes, McGraw Hill Publishing Co.
* Sharma, P.D. 1991. The Fungi. Rastogi& Co., Meerut.
* Smith, G.M. 1971. Cryptogamic Botany.Vol. I. Algae & Fungi. Tata McGraw Hill Publishing Co., New Delhi.
* Thakur, A.K. and Bassi, S.K. (2008). Diversity of Microbes and Cryptogams. S. Chand & Co., Delhi.
* Wiley J. M., Sherwood LM and Woolverton CJ. (2013) Prescott’s Microbiology. 9th Edition. McGraw Hill International.

# SEMESTER-I PAPER CODE: BOT - 102

**BIODIVERSITY-II (ARCHEGONIATE)**

**Internal Assessment: 15 Marks External Marks: 60 Maximum Total Marks: 75 Credits: 3 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type).Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (12 marks each).**

**Objectives:** The objective of the course is to introduce students to the world of diversity exhibited by lower plants.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** understand the general characters, economic importance and life-cycles of various groups of Bryophytes and Pteridophytes.

**CO2** explain their role in environment, human welfare and industrial applications.

**CO3** understanding the evolutionary significance of these plants.

# Table -2: CO-PO matrix for the course Botany -102(Biodiversity-II Archegoniate)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 102.1 | 3 | --------- | --------- | 1 | 2 | 2 | 1 |
| BOT 102.2 | 2 | --------- | --------- | 3 | 1 | 1 | 1 |
| BOT102.3 | 1 | --------- | --------- | ------- | 1 | 1 | 1 |
| Average | 2.00 | ------ | ------- | 1.33 | 1.33 | 1.33 | 1.00 |

**Table -2: CO-PSO matrix for the course Botany -102(Biodiversity-II Archegoniate)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 102.1 | 2 | 1 | -------- | ------- | 2 | 3 |
| BOT 102.2 | 2 | 1 | 2 | ------- | 2 | 3 |
| BOT 102.3 | 2 | 2 | 1 | 1 | 2 | 2 |
| Average | 2.00 | 1.33 | 1.00 | 0.33 | 2.00 | 2.66 |

**UNIT-I**

**Bryophyta:** General characters, classification upto classes (Smith, 1935), alternation of generations, structure and reproduction (excluding development) of *Marchantia* (Hepaticopsida), *Anthoceros* (Anthocerotopsida), *Funaria* (Bryopsida).

**Pteridophyta:** General characters, classification upto classes (Proskauer1957), alternation of generations, structure and reproduction (excluding development) of *Rhynia* (Psilopsida)

# UNIT-II

**Pteridophyta:** Structure and reproduction (excluding development) of *Selaginella* (Lycopsida),

*Equisetum* (Sphenopsida) and *Pteris* (Pteropsida).

**Gymnosperms-**General characteristics, classification up to family (Smith 1955), morphology, anatomy and reproduction of *Cycas*,*Pinus and Ephedra* (developmental details not to be included); Ecological and economic importance.

# SUGGESTED READINGS

* Bhatnagar, S.P. &Moitra, A. (1996).Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
* 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.
* Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
* Puri, P., 1980, Bryophyta, Atma Ram & Sons, Delhi.
* Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. 2005.Biology. Tata McGraw Hill, Delhi.
* Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., 2005. Biology. Tata McGraw Hill, Delhi, India.
* Sharma, O.P. 1990. Text Book of Pteridophyta, McMillan India Ltd.
* Sharma, O.P. 1992. Text Book of Thallophytes, McGraw Hill Publishing Co.
* Smith, G.M. 1971. Cryptogamic Botany, Vol.II, Bryophytes & Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi.
* Thakur, A.K. and Bassi, S.K. (2008). Diversity of Microbes and Cryptogams. S. Chand & Co., Delhi.
* Vanderpoorten, A. &Goffinet, B. (2009) Introduction to Bryophytes.Cambridge University Press.
* Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India

# SEMESTER-I

**PAPER CODE: BOT- 103**

**BIODIVERSITY–I (MICROBES, ALGAE, FUNGI) & BIODIVERSITY-II (ARCHEGONIATES)- PRACTICAL**

**Maximum Marks: 50 External marks: 40 Internal Assessment: 10**

**Credits: 2 Time: 4 Hours**

1. Identify, classify and write short morphological notes giving well labeled relevant diagrams on the given specimens A, B, C, D& E (one each from Algae, Fungi, Bryophytes, Pteridophytes & Gymnosperms). 15
2. Identify, giving two important characters of identification, the spots 1, 2, 3, 4& 5 (one slide or material each from Algae, Fungi, Bryophytes Pteridophytes& Gymnosperms). 10
3. Write short note on given chart/Photograph/Specimen 6 & 7 (one from Viruses/Bacteria & one from Cyanobacteria/ Lichen) 3
4. Note-book 4
5. Collection and collection report. 4
6. Viva-voce. 4

**List of Practicals**

* + **Viruses**: EMs/Models of viruses: T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycles.
	+ **Bacteria**: Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; BinaryFission; Conjugation; Structure of root nodule.
	+ **Cynobacteria&Algae**: Study of vegetative and reproductive structures of *Nostoc*, *Volvox*, *Chara*, *Vaucheria*, *Ectocarpus* and *Polysiphonia* through temporarypreparations and permanent slides.
	+ **Fungi**: Study of vegetative & reproductive structures of *Phytophthora, Mucor*, *Puccinia, Penicillium*&*Colletotrichum*: Asexual and sexual stagesthrough temporarypreparations and permanent slides.
	+ **Lichens**: Study of growth forms of lichens (crustose, foliose and fruticose)
	+ ***Marchantia***- Morphology of thallus, W.M. rhizoids and scales, V.S. thallus with gemma cup,W.M. gemmae, V.S. antheridiophore, archegoniophore, L.S. sporophyte (temporary/permanent slides).
	+ ***Anthoceros***- Morphology of thallus, W.M. rhizoids, V.S. thallus, VS Antheridia and Archegonia,

L.S. sporophyte (temporary/permanent slides).

* + ***Funaria***- Morphology, W.M. leaf, rhizoids, operculum, peristome, annulus, spores, slides showing antheridial and archegonial heads, L.S. capsule (temporary /permanent slides).
	+ ***Selaginella***- Morphology, W.M. leaf with ligule, T.S. stem, W.M. strobilus, W.M. microsporophylland megasporophyll, L.S. strobilus (temporary/ permanent slide).
	+ ***Equisetum***- Morphology, T.S. internode, L.S. strobilus, T.S. strobilus, W.M.sporangiophore,

W.M. spores (wet and dry)(temporary slides); T.S. rhizome (permanent slide).

* + ***Pteris***- Morphology, T.S. rachis, V.S. sporophyll, W.M. sporangium, W.M. spores, T.S. rhizome,

W.M. prothallus with sex organs and young sporophyte (temporary/permanent slide).

* + ***Cycas***- Morphology (coralloid roots, bulbil, leaf, megasporophyll), T.S. coralloid root, T.S. rachis,

V.S. leaflet, V.S. microsporophyll, W.M. micropsores, L.S. ovule, T.S. root (temporary/ permanent slide).

* + ***Pinus***- Morphology (long and dwarf shoots, W.M. dwarf shoot, male cones and female cones),

W.M. dwarfshoot, T.S. needle, T.S. stem, L.S./T.S. male cone, W.M. microsporophyll, W.M. microspores (temporary slides), L.S. female cone (temporary/ permanent slide).

* + ***Ephedra***- Morphology, T.S. internode, L.S./T.S. male and female strobilii, W.M. spores (wet and dry),T.S. rhizome (temporary/permanent slide).
	+ **Excursion Report**: Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and specimens related to archegoniates.

# SEMESTER-II PAPER CODE: BOT- 201

**PLANT ECOLOGY**

**Internal Assessment: 15 Marks External Marks: 60 Maximum Total Marks: 75 Credits: 3 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type).Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (12 marks each).**

**Objectives:** The objective of the course is to explain the impact of ecological implications on environment protection and human welfare.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** explain the concept of ecology and the influence of different environmental factors: climatic,

**CO2** physiographic and edaphic factors on plant life system.

**CO3** comprehend the concept of phytogeographic zonation of India, biodiversity and its conservation.

# Table -3: CO-PO matrix for the course Botany -201(Plant Ecology)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 201.1 | 3 | 1 | 2 | ------ | 2 | 3 | 3 |
| BOT 201.2 | 3 | 1 | 1 | 1 | 3 | 3 | 2 |
| BOT201.3 | 3 | 1 | 2 | ----- | 2 | 2 | 3 |
| Average | 3.00 | 1.00 | 1.66 | 0.33 | 2.33 | 2.66 | 2.66 |

**Table -3: CO-PSO matrix for the course Botany -201(Plant Ecology)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 201.1 |   | 1 | ----- | 1 | 1 | 1 |
| BOT201.2 | 2 |   | 1 | 1 | 1 | 1 |
| BOT 201.3 | 3 | 1 |   | 3 | 1 | 2 |
| Average | 1.66 | 0.66 | 0.33 | 1.66 | 1.00 | 1.33 |

**UNIT-I**

**Introduction to Ecology:** Definition; scope and importance; levels of organization. **Environment:**Introduction; environmental factors- climatic (water, humidity, wind, light, temperature), edaphic factors (soil profile, physico-chemical properties), topographic and biotic factors (species interaction). Adaptations of plants to water stress and salinity (morphological and anatomical features of hydrophytes, xerophytes and halophytes).

**Population Ecology:** Basic concept; characteristics; biotic potential, growth curves; ecotypes and ecads. **Community Ecology:** Concepts; characteristics (qualitative and quantitative-analytical and synthetic); methods of analysis; ecological succession.

# UNIT-II

**Ecosystem:** Structure (components) and functions (trophic levels, food chains, food webs, ecological pyramids and energy flow)

**Biogeochemical Cycles:**Carbon and Nitrogen; Hydrological (water) cycle.

**Phyto-geography:**Phyto-geographical regions of India; vegetation types of India (forests).

**Environmental Pollution:** Sources, types and control of air and water pollution.

**Global Change:** Greenhouse effect and greenhouse gases; impacts of global warming; carbon trading.

# Suggested Readings

* + Botkin, D.B. and E.A. Keller, 2004. Environment Science: Earth as a Living Planet, John Wiley & Sons Inc., New York.
	+ Kormondy, E.J. 1996: Concepts of Ecology, Prantice-Hall of India Pvt. Ltd., New Delhi.
	+ Mackenzie, A. et al. 1999: Instant Notes in Ecology, Viva Books Pvt. Ltd., New Delhi.
	+ Odum, E.P. 1983. Basic Ecology, Saunders, Philadelphia.
	+ Sharma, P.D., 2010 Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
	+ Singh, J.S., Singh, S.P. and Gupta, S.R. 2006. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
	+ Smith, R.L. 1996, Ecology and Field Biology, Harper Collins, New York.

# SEMESTER-II

**PAPER: BOT- 202 PLANT TAXONOMY**

**Internal Assessment: 15 Marks External Marks:60 Maximum Total Marks: 75 Credits: 3 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (12 marks each).**

**Objectives**: The objective of the course is to make the students aware of various components and concepts of plant taxonomy.

**Learning Outcomes:** Upon completion, the students will be able to comprehend

**CO1** the botanical description of plants;

**CO2** discuss the essentials of plant taxonomy and taxonomic hierarchy;

**CO3** the classification system of Bentham and Hooker;

**CO4** explain the concepts of numerical taxonomy and cladistics.

# Table -4: CO-PO matrix for the course Botany -202(Plant Taxonomy)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 202.1 | 3 | 2 | 1 | 2 | 2 | 1 | 2 |
| BOT 202.2 | 3 | 2 | 1 | 2 | 2 | 1 | 1 |
| BOT 202.3 | 3 | 3 | ------ | 1 | 1 | 1 | 2 |
| Average | 3.00 | 2.33 | 0.66 | 1.66 | 1.66 | 1.00 | 1.66 |

**Table -4: CO-PSO matrix for the course Botany -202(Plant Taxonomy)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 202.1 | 3 |   | 1 |   | 1 | 2 |
| BOT 202.2 | 3 | 1 |   | 1 | 2 | 2 |
| BOT 202.3 | 3 | 2 | ------ | ------- | 2 | 2 |
| Average | 3.00 | 1.00 | 0.33 | 0.33 | 1.66 | 2.00 |

**UNIT-I**

Taxonomy and systematics, fundamental components of taxonomy (identification, classification, description, nomenclature and phylogeny).

Role of chemotaxonomy, cytotaxonomy and taximetrics in relation to taxonomy.

Botanical nomenclature, principles and rules, principle of priority.Type concept, author citation, taxonomic ranks.

Keys to identification of plants.

**Herbarium:** General introduction and importance of herbaria. Botanical gardens and their importance.

**Documentation of Floristic Diversity:**Brief idea about floras, monograph and journals. Flower and types of inflorescence.

# UNIT-II

**Types of classification:**Artificial, natural and phylogenetic.

Bentham and Hooker system of classification (upto series), Angiosperm Phylogeny Group (APG)- general introduction.

**Diversity of Flowering Plants:** Diagnostic features and economic importance of the following families: Ranunculaceae, Brassicaceae, Malvaceae, Euphorbiaceae, Rutaceae, Leguminosae, Apiaceae, Apocynaceae, Lamiaceae, Solanaceae, Asteraceae, Liliaceae and Poaceae.

# Suggested Readings

* + B.P. Pandey. 2001. A Textbook of Botany: Angiosperms - Taxonomy, Anatomy, Embryology and Economic Botany. S Chand and Co Delhi
	+ Chopra, GL. 1984. Angiosperms: Systematic & Life-Cycle. Pradeep Publications
	+ Davis, P.H. and Heywood, V.H. 1963. Principles of Angiosperm Taxonomy, Oliver and Boyd,London.
	+ Gifford, E.M. and Foster, A.S. 1988. Morphology and Evolution of Vascular Plants, W.H. Freeman &Company, New York.
	+ Heywood, V.H. and Moore, D.M. (Eds.) 1984.Current Concepts in Plant Taxonomy. Academic Press,London.
	+ Jeifrey, C. 1982. An introduction to Plant Taxonomy. Cambridge University Press, Cambridge,London.
	+ Jones, S.B., Jr. Luchsinger, A.E. 1986. Plant Systematics (2nd edition).McGraw Hill Book Co.
	+ Radford, A.E. 1986. Fundamentals of Plant Systematics.Harper and Row, New York.
	+ Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
	+ Singh and Jain, 2015. Taxonomy of Angiosperms 10 Edition. Rastogi Publication Meerut.
	+ Singh, G. 2017. Plant Systematics Theory And Practice 3rd Edition, Oxford & IBH Publishing
	+ Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold, London.

# SEMESTER-II PAPER CODE: BOT- 203

**PLANT ECOLOGY AND PLANT TAXONOMY- PRACTICAL**

**Maximum Marks: 50 External marks: 40 Internal Assessment: 10**

**Credits: 2 Time: 4 Hours**

1. Ecological experiment A & B (as per the list) 8
2. Write Ecological notes on the specimens C and D 6
3. Describe/compare the given flowers A and B in semi-technical language giving V.S. of flowers, T.S. of ovaries, Floral Diagrams and Floral Formulae. Identify and assign them to their respective families giving reasons. 10
4. Identify spots 1 and 2 from the point of view of morphology of the plant part given. 4
5. Note-book 4
6. Collection and Collection Report. 4
7. Viva-voce. 4

**List of Practicals**

1. Study of instruments used to measure microclimatic variables: Soil thermometer,maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gaugeand lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides and sulphatesby rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of threehabitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).

(b)Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite(*Orobanche*), Epiphytes(Orchid) and Predation (Insectivorous plants) using museum specimens/ live plants.

1. Determination of minimal quadrat size for the study of herbaceous vegetation in thecollege campus or nearby fields by species area curve method (species to be listed).
2. Quantitative analysis of herbaceous vegetation in the college campus or nearby fields for frequency andcomparison with Raunkiaer’s frequency distribution law.
3. Study of vegetative and floral characters of the one or two member of each family/sub-family mentioned in theory syllabus (Description, V.S.flower, section of ovary, floral diagram/s, floral formula/e and systematic positionaccording to Bentham & Hooker’s system of classification).
4. Excursion Report: Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and specimens related to Angiosperms.Mounting of a collected, properly dried and pressed specimen of minimum 20 wild plants with herbarium label.

# SEMESTER- III PAPER CODE: BOT- 301

**PLANT ANATOMY**

**Internal Assessment: 15 Marks External Marks: 60 Maximum Total Marks: 75 Credits: 3 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (12 marks each).**

**Objectives:** The objective of this course is to familiarize the students with internal organization of plants, which plays important roles in plant sciences.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** identify, describe and differentiate plant cells, cell organelles and their functions; **CO2** apply plant anatomical features for correct identification and its role in taxonomy; **CO3** analyze and comprehend wood structure.

# Table -5: CO-PO matrix for the course Botany -301(Plant Anatomy)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 301.1 | 3 | ---- | ----- | 2 | 1 | ----- | 2 |
| BOT301.2 | 3 | 2 | ----- | 2 | 1 | ------ | 2 |
| BOT 301.3 | 2 | 3 | 1 | 1 | 2 | 1 | 2 |
| Average | 2.66 | 1.66 | 0.33 | 1.66 | 1.33 | 0.33 | 2.00 |

**Table -5: CO-PSO matrix for the course Botany -301(Plant Anatomy)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 301.1 | 2 | 2 | 2 | ------- | 2 | 2 |
| BOT301.2 | 2 | 2 | ------ | ------- | 2 | 1 |
| BOT 301.3 | 2 | --------- | 2 | ------- | 2 | 3 |
| Average | 2.00 | 1.33 | 1.33 | -------- | 2.00 | 2.00 |

**UNIT-I**

**Diversity in plant forms:** Annuals, biennials and perennials.

**Tissues:** Meristematic and permanent (simple and complex).

**Leaf:** Types of leaves (simple and compound); phyllotaxy.

**Epidermis:**Uniseriate and multiseriate, epidermal appendages and their morphological types. Anatomy of typical monocot and dicot leaf and cell inclusions in leaves;

Leaf abscission.

Stomatal apparatus and their morphological types.

# UNIT-II

**Shoot system:** Shoot apical meristem and its histological organizations (monocot and dicot stem); **Cambium:** Structure and functions; secondary growth in dicot stem; characteristics of growth rings; sap wood and heart wood, periderm.

Anomalous secondary growth (*Achyranthes*&*Boerhaavia*)

**Root system:**Root apical meristem; histological organization of monocot and dicot roots. Secondary growth in dicot root.

**Structural modifications in roots:**Storage (*Beta*), respiratory (*Rhizophora*), epihytic (*Vanda*). Anatomical aspects of adaptations in xerophytes, hydrophytes, halophytes.

# Suggested Readings

* + Bryan G. Bowes 1999. A Colour Atlas of Plant Structure. Manson Publishing
	+ Cutter, E.G. 1969. Plant Anatomy Part-I, Cells and Tissues, Edward Arnold, London.
	+ Cutter, E.G. 1971. Plant Anatomy:Experiment and Interpretation. Part-II Organs, Edward Arnold London.
	+ Esau, K. 1977. Anatomy of Seed Plants, 2nd Edition. John Wiley & Sons, New York.
	+ Fahn, A. 1974. Plant Anatomy, 2nd Edition. Pergamon Press, Oxford.
	+ Hartmann, H.T. and Kestler, D.E. 1976. Plant Propagation; Principles and Practices. 3rdEdition.Prentice Hall of India Pvt. Ltd. New Delhi.
	+ King. J. 1997. Reaching for the Sun: How Plants Work. Cambridge University Press, Cambridge,U.K.
	+ Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Company Inc.,Menlo Park, California, USA.
	+ Pandey, B.P 2012. Plant Anatomy. S. Chand & Co. Publisher
	+ Raven, P.H. Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants.5th edition.W.R.Freeman and Co., Worth Publishers, New York.
	+ Sharma MK. Plant Structure (An Introduction To Plant Anatomy) JBC Press
	+ William C. Dickison 2015. Integrative Plant Anatomy. Academic Press

# SEMESTER- III

**PAPER CODE: BOT- 302 PLANT EMBRYOLOGY**

**Internal Assessment: 15 Marks External Marks: 60 Maximum Total Marks: 75**

**Credits: 3 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (12 marks each).**

**Objectives:** Embryological studies play important role in plant breeding and crop improvements, this course is designed to make them aware of some important aspects of embryology.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1:** explain the developmental patterns of both vegetative and reproductive organs of plants; **CO2:** apply knowledge about embryological characters in explaining plant reproductivebiology. **Table -6: CO-PO matrix for the course Botany -302 (Plant Embryology)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 302.1 | 3 | 1 | ----- | 1 | 1 | ------ | 2 |
| BOT 302.2 | 3 | 2 | 1 | 2 | 1 | ------ | 2 |
| Average | 3.00 | 1.50 | 0.50 | 1.50 | 1.00 | ------ | 2.00 |

# Table -6: CO-PSO matrix for the course Botany -302 (Plant Embryology)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 302.1 | 3 | 2 | 3 | ----- | 2 | 2 |
| BOT 302.2 | 2 | 1 | 2 | 1 | 2 | 2 |
| Average | 2.50 | 1.50 | 2.50 | 0.50 | 2.00 | 2.00 |

**UNIT-I**

Flower-a modified shoot; functions of various floral parts.

Microsporangium, its wall and dehiscence mechanism.Microsporogenesis, pollen grains and its structure (pollen wall).

Pollination (types and agencies); pollen germination (microgametogenesis). Pollen-pistil interaction; self-incompatibility.

Male gametophyte.

Structure of megasporangium (ovule), its curvatures.

Megasporogenesis and megagametogenesis.

# UNIT-II

Female gametophyte (monosporic, bisporic and tetrasporic)- organization and ultrastructure of mature embryo sac.

Double fertilization.

Endosperm types and their biological importance. Embryogenesis in dicot and monocot; Polyembryony and apomixis.

Structure of dicot and monocot seed.

Fruit types; dispersal mechanisms in fruits and seeds.

# Suggested Readings

* + B.M. Johri Editor (1984) Embryology of Angiosperms Springer Verlag
	+ Bhojwani, S.S. &Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
	+ Fageri, K. and Van der Pijl1979.The Principles of Pollination Ecology.Pergamon Press, Oxford.
	+ Hartmann, H.T. and Kestler, D.E. 1976. Plant Propagation; Principles and Practices. 3rdEdition.Prentice Hall of India Pvt. Ltd. New Delhi.
	+ King. J. 1997. Reaching for the Sun: How Plants Work. Cambridge University Press, Cambridge,U.K.
	+ P. Maheshwari (1950) An Introduction to the Embryology of Angiosperms McGraw Hill
	+ Proctor, M. and Yeo, P. 1973. The Pollination of Flowers.William Collins Sons, London.
	+ Raven, P.H. Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants.5th edition.W.R.Freeman and Co., Worth Publishers, New York.
	+ Thomas, P. 2000. Trees: Their Natural History. Cambridge University Press, Cambridge.

# SEMESTER- III PAPER CODE: BOT- 303

**PLANT ANATOMY AND PLANT EMBRYOLOGY- PRACTICAL**

**Maximum Marks: 50 External marks: 40 Internal Assessment: 10**

**Credits: 2 Time- 4 Hrs.**

1. Cut Transverse Section and prepare a double-stained permanent mount of the given material A and B (from angiosperms). Identify giving reasons and show it to the examiner. 14
2. Identify, giving the important characters of identification, the spots 1, 2, 3 and 4 (one material/photograph/ slide from embryology of angiosperms). 16
3. Dissect out the globular/heart-shaped embryo from the given material. 5
4. Note-book and Collection permanent prepared slides 10
5. Viva-voce 5

**List of Practicals**

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (Permanent slides preparation).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (Permanent slides preparation).
5. Leaf: Dicot and Monocot leaf (Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory)(Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/campylotropous (Permanent Slides).
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril,caruncle)(Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.

# SEMESTER IV PAPER CODE: BOT- 401 PLANT PHYSIOLOGY

**Internal Assessment: 15 Marks External Marks: 60 Maximum Total Marks: 75 Credits: 3 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (12 marks each).**

**Objectives:**This course will make students aware of very important aspects of plant growth, and will also enhance their understanding of their cultivation requirements.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** explain plant water relations and elucidate mineral nutrients that plants require, how they are obtained, metabolized and transported.

**CO2** describe physiological details of photosynthesis and respiration in plants.

**CO3** describe enzymes, hormones, environmental responses and nitrogen metabolism required for plant growth and development.

# Table -7: CO-PO matrix for the course Botany -401(Plant Physiology)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 401.1 | 3 | 3 | 1 | 2 | 2 | ------ | 3 |
| BOT 401.2 | 3 | 3 | 1 | 1 | 1 | 1 | 2 |
| BOT401.3 | 3 | 1 | 1 | 1 | 2 | 1 | 2 |
| Average | 3.00 | 2.33 | 1.00 | 1.33 | 1.66 | 0.66 | 2.33 |

**Table -7: CO-PSO matrix for the course Botany -401(Plant Physiology)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 401.1 | 2 | 2 | 3 | 1 | 3 | 2 |
| BOT 401.2 | 2 | 2 | 3 | 1 | 3 | 2 |
| BOT401.3 | 1 | 3 | 2 | 1 | 1 | 2 |
| Average | 1.66 | 2.33 | 2.66 | 1.00 | 2.33 | 2.00 |

**UNIT-I**

**Plant-water Relations:** Importance of water to plant life; physical properties of water; Imbibition, Diffusion, Osmosis and Plasmolysis; absorption and transport of water; transpiration-types, physiology of stomata, factors affecting transpiration, importance of transpiration.

**Mineral Nutrition:** Essential macro and micro elements; criteria of essentiality of elements; Role of essential elements; mineral uptake; deficiency symptoms.

**Transport of Organic Substances:** Mechanism of phloem transport; source-sink relationship; factors affecting translocation

# UNIT-II

Seed dormancy; Plant movements; Concept of photoperiodism; Physiology of flowering; Florigen concept; Physiology of senescence; Fruit ripening.

**Growth and Development:** Definitions; phases of growth and development.

**Plant Hormones:**Auxins, Gibberellins, Cytokinins, Abscissic acid and Ethylene, history of their discovery, mechanism of action.

**Photo-morphogenesis:**phytochromes and their discovery, physiological role and mechanism of action.

# Suggested Readings

* Dennis,D.T., Turpin, D.H., Lefebvre,D.D. and Layzell (eds.). 1997: Plant Metabolism (2nd Edition), Longman, Essex, England.
* Galston, A.W. 1989: Life Processes in Plants, Scientific American Library, Springer-Verlag, NewYork, USA.
* Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
* Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology.John Wiley and Sons.U.S.A.4th edition.
* Hopkins, W.G., 1995: Introduction to Plant Physiology, John Wiley & Sons, Inc., New York, USA.
* Mohr, H. and Schopfer, P. 1995: Plant Physiology. Springer-Verlag, Berlin Germany.
* Pandey, S.N &Sinha BK. 2018. Plant Physiology 4/Ed .Vikas Publishing House Pvt Ltd
* Salisbury, F.B. and Ross, C.W. 1986: Plant Physiology. CBS Publishers and Distributors, New Delhi.
* Taiz, L. and Zeiger, E. 2003: Plant Physiology. Panima Publishing Corporation, New Delhi.
* Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
* Verma, V. 2015. Plant Physiology 2nd Ed. Athena Academic

# SEMESTER- IV PAPER CODE: BOT- 402 PLANT METABOLISM

**Internal Assessment: 15 Marks External Marks: 60 Maximum Total Marks: 75 Credits: 3 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is**

**compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (12 marks each).**

**Objectives: Objectives:** This course will make students aware of very important life processes of plants which are very vital for all the ecosystems.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** Explain the most important metabolic processes of this planet, i.e. photosynthesis and respiration;

**CO2** understand the basics of enzymology and metabolism of nitrogen and lipid.

# Table -8: CO-PO matrix for the course Botany -402(Plant Metabolism)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 402.1 | 3 | 2 | 1 | 1 | 2 | 1 | 2 |
| BOT 402.2 | 3 | 3 | 2 | 3 | 2 | ---- | 3 |
| Average | 3.00 | 2.50 | 1.50 | 2.00 | 2.00 | 0.50 | 1.50 |

**Table -8: CO-PSO matrix for the course Botany -402(Plant Metabolism)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 402.1 | 1 | 3 | 3 | 1 | 2 | 2 |
| BOT 402.2 | ------ | ------- | 2 | 1 | 3 | 2 |
| Average | 0.50 | 1.50 | 2.50 | 1.00 | 2.50 | 2.00 |

**UNIT-I**

**Photosynthesis:** Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photo-phosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration.

**Respiration:** ATP–the biological energy currency; aerobic and anaerobic respiration; Krebs cycle; electron transport mechanism (chemi-osmotic theory); redox -potential; oxidative phosphorylation; pentose phosphate pathway.

# UNIT-II

**Nitrogen metabolism:** Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation.

**Lipid metabolism:** Structure and functions of lipids; fatty acid biosynthesis; B-oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids

**Basics of Enzymology:** Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and co-factors; regulation of enzyme activity; mechanism of action.

# Suggested Readings:

* Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology.John Wiley and Sons.U.S.A.4th edition.
* Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. (2015). Plant Physiology and Development.Sinauer Associates Inc. USA.6th edition.
* Harborne, J.B. (1973). Phytochemical Methods.John Wiley & Sons. New York.
* Dennis,D.T., Turpin, D.H., Lefebvre,D.D. and Layzell (eds.). 1997: Plant Metabolism (2nd Edition), Longman, Essex, England.
* Galston, A.W. 1989: Life Processes in Plants, Scientific American Library, Springer-Verlag, NewYork, USA.
* Hopkins, W.G., 1995: Introduction to Plant Physiology, John Wiley & Sons, Inc., New York, USA.
* Mohr, H. and Schopfer, P. 1995: Plant Physiology. Springer-Verlag, Berlin Germany.
* Salisbury, F.B. and Ross, C.W. 1986: Plant Physiology. CBS Publishers and Distributors, New Delhi.
* Taiz, L. and Zeiger, E. 2003: Plant Physiology. Panima Publishing Corporation, New Delhi.

# SEMESTER-IV PAPER CODE: BOT- 403

**Plant Physiology and Plant Metabolism- Practical**

**Maximum Marks: 50 External marks: 40 Internal Assessment: 10**

**Credits: 2 Time: 4 Hours**

1. Devise experiments A and B to demonstrate the physiological process (as per the list). Perform it and show it to the examiners. 14
2. Comment on the physiologicalexperiment C and D (Specimen/ set-up / Model / Chart). 8
3. Test for carbohydrates / Proteins / Fats / Peroxidase activity. 6
4. Note Book and Report 8
5. Viva-voce. 4

**List of Practicals**

* + Demonstration of imbibition by plaster of Paris method.
	+ Demonstration of Osmosis by potato osmoscope method.
	+ To study the Osmotic pressure of onion scale/ Rhoeo leaf peel by plasmolytic method.
	+ Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte. Demonstration of transpiration by Ganong’s/ Farmer’s potometer.
	+ To separate of photosynthetic pigments by thin layer/paper chromatography.
	+ Demonstration of Ascent of sap/Transpiration pull
	+ To study the rate of photosynthesis under varying CO2 concentration using Wilmott’s bubbler.
	+ To study the effect of light intensity on oxygen evolution during photosynthesis
	+ UsingWilmott’s bubbler.
	+ Demonstration of aerobic respiration.
	+ Demonstration of anaerobic respiration.
	+ To study the evolution of heat during respiration
	+ Demonstration of manometric determination of R. Q.
	+ Demonstration of phototropism, geotropism and hydrotropism.
	+ Determination of peroxidase activity.
	+ Simple tests for the detection of carbohydrates(monosaccharides,disaccharides and starch); Proteins and Fats.
	+ Preparation of report on use of plant hormones in vegetative reproduction, seed germination etc.

# SEMESTER- V DISCIPLINE SPECIFIC ELECTIVE- I

**PAPER CODE: BOT- 501 (Option-I) ECONOMIC BOTANY**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To highlight the role and significance of cultivated plants.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** enumerate various services and benefits provided by the plants like food, medicines, timber etc.;

**CO2** know the practical methods to cultivate and harvest various important plants and their parts.

# Table -9: CO-PO matrix for the course Botany -501(Economic Botany)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 501.1 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| BOT 501.2 | 3 | 1 | 2 | 2 | 3 | 3 | 3 |
| Average | 3.00 | 1.50 | 2.50 | 2.00 | 3.00 | 2.50 | 3.00 |

**Table -9: CO-PSO matrix for the course Botany -501(Economic Botany)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 501.1 | 3 | 2 | 1 | 2 | 1 | 3 |
| BOT 501.2 | 3 | 1 | 2 | 2 | 1 | 3 |
| Average | 3.00 | 1.50 | 1.50 | 2.00 | 1.00 | 3.00 |

**UNIT-I**

Origin, distribution, botanical description, brief idea of cultivation and uses of the following:

**Food plants:** Cereals (Rice, Wheat and Maize).

**Pulses:** Gram, Arhar and Pea. **Vegetables:**Potato, Tomato and Onion. **Fibers:** Cotton, Jute and Flax.

**Oils:** Groundnut, Mustard and Coconut.

# UNIT-II

Morphology of plant part used, brief idea of cultivation and uses of the following:

**Spices:** Coriander, *Ferula*, Ginger, Turmeric, Cloves.

**Medicinal Plants:***Cinchona*, *Rauwolfia*, *Atropa*, Opium, *Cannabis*, Neem, *Withania*

Botanical description and processing of:

**Beverages:** Tea and Coffee; **Rubber:***Hevea*; **Sugar:** Sugarcane. General account and sources of timber.

Energy plantations and bio-fuels.

# Suggested Readings:

* + Kocchar, S.L. 1998: Economic Botany in Tropics, 2nd edition, MacMillan India Ltd., New Delhi.
	+ Kocchar, S.L. 2016. Economic Botany: A Comprehensive Study, 5 Ed, Cambridge India.
	+ Sambammurthy, A.V.S.S. And Subramanyam, N.S. 1989: A Textbook of Economic Botany, Wiley Eastern Ltd., New Delhi.
	+ Sharma, O.P. 1996: Hills Economic Botany (Late Dr. A.F. Hill adapted by O.P. Sharma), Tata McGraw Hill Co. Ltd., New Delhi.
	+ Simpson, B.B. and Conner-Ogorzaly, M. 1986: Economic Botany- Plants in our World, McGraw Hill,New York.

# SEMESTER- V DISCIPLINE SPECIFIC ELECTIVE-I PAPER CODE: BOT- 502 (Option-I)

**PLANT BIOTECHNOLOGY**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To study material, methods and applications of plant biotechnology. **Learning Outcomes:** After completion of the course the learners will be able to: **CO1** understand the concepts and fundamentals of plant biotechnology.

**CO2** develop their competency on different types of plant tissue culture methods

**CO3** examine gene cloning and evaluate different methods of gene transfer

**CO4** critically analyze the major concerns and applications of transgenic technology

# Table -10: CO-PO matrix for the course Botany -502(Plant Biotechnology)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 502.1 | 3 | 2 | 3 | 1 | 3 | 2 | 2 |
| BOT 502.2 | 3 | 1 | 3 | 2 | 2 | 1 | 1 |
| BOT502.3 | 3 | 2 | 3 | 2 | 2 | ----- | 1 |
| BOT 502.4 | 3 | 2 | 3 | 1 | 2 | ------ | 1 |
| Average | 3.00 | 1.75 | 3.00 | 1.50 | 2.25 | 0.75 | 1.25 |

**Table -10: CO-PSO matrix for the course Botany -502(Plant Biotechnology)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 502.1 | 1 | 3 | 3 | 1 | 1 | 1 |
| BOT 502.2 | 1 | 3 | 3 | 2 | 1 | 3 |
| BOT 502.3 | --------- | 3 | 3 | 2 | 1 | 2 |
| BOT502.4 | 1 | 2 | 2 | 2 | 2 | 2 |
| Average | 0.75 | 2.75 | 2.75 | 1.75 | 1.25 | 2.00 |

**Unit I**

Historical perspective of plant tissue culture; Composition of media; Nutrient and hormone requirements; Totipotency; Organogenesis; Embryogenesis; Protoplast culture; Plant tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production; Cryopreservation. Restriction Endonucleases- types and role. Brief idea about cloning vectors- Ti plasmid, BAC, Lambda phage, M13phagemid, cosmid, shuttle vector; eukaryotic vectors (YAC).

Recombinant DNA, bacterial transformation and selection of recombinant clones, PCR mediated gene cloning; Genomic and cDNA libraries

# UNIT II

Methods of gene transfer- Agrobacteriummediated, electroporation, microinjection,microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Applications of biotechnology-pest resistant (Bt-cotton); herbicide resistant plants (Round-Upready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines;

Industrial enzymes (aspergillase, protease, lipase); Biosafety concerns.

# Suggested Readings

* + BD Singh. Biotechnology. Kalyani Publications
	+ Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam.The Netherlands.
	+ Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
	+ Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
	+ Trehan, K. 1990. Biotechnology, New Age Int. Pvt. Ltrd. New Delhi India.

# SEMESTER-V DISCIPLINE SPECIFIC ELECTIVE-I PAPER CODE –BOT- 503 (Option-I)

**ECONOMIC BOTANY AND PLANT BIOTECHNOLOGY- PRACTICAL**

**Maximum Marks: 50 External marks: 40 Internal Assessment: 10**

**Credits: 2 Time: 4 Hours**

1. Identify and Classify spots 1, 2, 3, and 4 from the point of view of economic importance and morphology of the plant part used. 14
2. Perform the Applied Botany experiment (as per the list). 8
3. Comment on the specimen A and B (Chart/ Model /Photograph from Biotechnology) 6
4. Note Book, Collection and field report. 8
5. Viva-voce. 4

**List of Practicals**

* + Study of economically important plants : Wheat, Rice, Gram, Pea, Arhar, Soybean, Black pepper, Ginger, Clove, Turmeric, Tea, Coffee, Cocoa, Cotton, Jute, Coir, Groundnut, Coconut and Mustard
	+ Collection and preparation of report on various crops and economically important plants being cultivated/wildly available in your area.
	+ Brief introduction to the components and working of the instruments- oven, autoclave, incubator, centrifuge, laminar air flow and spectrophotometer)Familiarization with basic equipments in tissue culture
	+ Preparation of MS medium.
	+ To prepare the slants and petri plates for plant tissue culture.
	+ Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
	+ Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
	+ Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
	+ Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.
	+ Isolation and quantification of genomic DNA from bacteria (E. coli) or Plants
	+ Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
	+ To separate proteins using PAGE.

# SEMESTER- V DISCIPLINE SPECIFIC ELECTIVE-I PAPER CODE: BOT- 501 (Option-II)

**CELL BIOLOGY**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 4 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To familiarize with structure and components of cell

**Learning Outcomes:** After completion of the course, the learners will be able to: **CO1** explain the chemical composition and structure of cell wall and cell membrane **CO2** compare the structure and functions of organelles of a plant cell.

**CO3** describe the structure and organization of a chromosome

# Table -11: CO-PO matrix for the course Botany -503(Cell Biology)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 503.1 | 3 |   |   | 1 | 1 |  |  |
| BOT503.2 | 3 | 1 |   | 1 | 1 |   | 1 |
| BOT 503.3 | 3 | 1 | 1 | 1 | 1 |   | 1 |
| Average | 3.00 | 0.66 | 0.33 | 1.00 | 1.00 |  | 0.66 |

**Table -11: CO-PSO matrix for the course Botany -503(Cell Biology)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 503.1 | 3 | 2 | 2 | 1 | 2 | 2 |
| BOT503.2 | 2 | 3 | 2 | 1 | 2 | 2 |
| BOT 503.3 | 2 | 3 | 2 | 1 | 2 | 2 |
| Average | 2.33 | 2.66 | 2.00 | 1.00 | 2.00 | 2.00 |

**UNIT-I**

Cell as a unit of Life; The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components

**The Cell Envelopes:** Structure and functions of Cell Wall and Plasma Membrane. Ultrastructure and function of nucleus, Nuclear Envelope- structure of nuclear pore complex

Ultrastructure and function of following cell organelles: Golgi Apparatus, Endoplasmic Reticulum, Chloroplast,Mitochondria, Lysosomes, Peroxisomes and Vacuoles.

# UNIT-II

**Cell Division:** Mitosis and Meiosis.

**Chromosome:**Morphology, organization, ultrastructure of Centromere and Telomere; Chromosomalalterations- deletions, duplications, translocations, inversions; Variations in chromosome number- aneuploidy, polyploidy; sex chromosomes and sex determination.

# SUGGESTED READINGS

* + Alberts, B.Bray, D.Lewis, J., Raff, M.., Roberts, K. and Watson J.D. 1999. Molecular Biology of Cell. Garland Publishing Co., Inc., New York, USA.
	+ Atherly, A.G. Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics, Saunders College Publising, Fort Worth, USA.
	+ Gupta, P.K. 1999. A text book of Cell and MolelcularBiology.Rastogi Publications, Meerut, India.
	+ Kleinsmith, L. J and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd edition) Harper Collins College Publishers, New York, USA.
	+ Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimoe, D. and Darnell, J. 2000. Molecular, Cell Biology, W.H. Freeman and Co., New York., USA.
	+ Russel, P.J. 1998. Genetics, The Benjamin/Cummings Publishing Co. Inc., USA.
	+ Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics. John Wiley and Sons, Inc. USA.

# SEMESTER- V DISCIPLINE SPECIFIC ELECTIVE-I

**PAPER CODE: BOT- 502 (Option-II) MOLECULAR BIOLOGY**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To understand structure and function of genetic material.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** analyze the structures and chemical properties of DNA and RNA

**CO2** gain an understanding of various steps of transcription, translation, protein modifications and gene regulation.

# Table -12: CO-PO matrix for the course Botany -504(Molecular Biology)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 504.1 | 3 | 3 | 2 | 2 | 1 | 1 | 2 |
| BOT504.2 | 3 | 3 | 2 | 1 | 3 | 1 | 1 |
| Average | 3.00 | 3.00 | 2.00 | 1.50 | 2.00 | 1.00 | 1.50 |

**Table -12: CO-PSO matrix for the course Botany -504(Molecular Biology)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 504.1 | 3 | 3 | 2 | 1 | 2 | 2 |
| BOT 504.2 | 2 | 3 | 2 | 1 | 2 | 3 |
| Average | 2.50 | 3.00 | 2.00 | 1.00 | 2.00 | 2.50 |

**Unit I**

**Genetic material DNA**: Miescher to Watson and Crick- historic perspective,

Griffith’s and Avery’s transformation experiments, Hershey-Chase bacteriophage experiment. DNA structure, types of DNA, types of genetic material.

**DNA Replication:** Prokaryotes and eukaryotes; bidirectional replication, semi–conservative, semi discontinuous RNA priming, Ǿ (theta) mode of replication, replication of linear, dsDNA, replicating the 5 ́end of linear chromosome including replication enzymes.

# Unit II

**Transcription**: Prokaryotes and Eukaryotes.

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types;

**Translation:** Prokaryotes and eukaryotes, genetic code.

**Regulation of gene Expression** in Prokaryotes: Lac operon and Tryptophan operon; regulation of gene expression in Eukaryotes.

# Suggested Readings

* + Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of theCell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
	+ Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th Ed. Sinauer Associates, Inc. • Publishers Sunderland, Massachusetts U.S.A.
	+ De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8thedition. Lippincott Williams and Wilkins, Philadelphia
	+ Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley &Sons.Inc.
	+ Lewin, B. 2018. Genes XII,Osford University Press, Oxford, UK

# SEMESTER-V DISCIPLINE SPECIFIC ELECTIVE-I PAPER CODE: BOT- 503 (Option-II)

**CELL BIOLOGY AND MOLECULAR BIOLOGY- PRACTICAL**

**Maximum Marks: 50 External marks: 40 Internal Assessment: 10**

**Credits: 2 Time: 3 Hours**

1. Prepare the root smear and find out two different stages of Mitosis. Identify and show it to the examiners. Also give characters of identification. 8
2. Identify the two stages of Meiosis from given permanent slide and write notes on it 4
3. Identify and comment on the specimen A, B, C and D (Chart/ Model /Photograph from Cell organelles, other molecular biology phenomenon) 16
4. Note Book, and Model on any DNA/Molecular Biology Phenomenon. 8
5. Viva-voce. 4

**List of Practicals**

* + To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
	+ Study of the photomicrographs of cell organelles
	+ To study the structure of plant cell through temporary mounts.
	+ Study of mitosis and meiosis (temporary mounts and permanent slides).
	+ Demonstration of dialysis of starch and simple sugar.
	+ Study of plasmolysis and deplasmolysis on Rhoeo leaf.
	+ Measure the cell size (either length or breadth/diameter) by micrometry.
	+ Study the structure of nuclear pore complex by photograph.
	+ Study of special chromosomes (polytene&lampbrush) either by slides or photographs.
	+ Study DNA packaging by micrographs.
	+ Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

# SEMESTER VI

**DISCIPLINE SPECIFIC ELECTIVE-II PAPER CODE: BOT- 601 (Option-I) GENETICS**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To enhance knowledge of the concept of Heredity, structure and functioning of Gene and chromosome

**Learning Outcomes: After completion of the course, the learners will be able to: CO1** have the conceptual understanding of the laws of inheritance and gene interaction. **CO2** comprehend the chromosomal abnormalities that lead to genetic disorders.

**CO3** analyze the effect of mutations on gene functions and dosage.

# Table -13: CO-PO matrix for the course Botany -601(Genetics)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 601.1 | 3 | 2 | 1 | 1 | 1 |   | 1 |
| BOT 601.2 | 3 | 3 | 3 | 1 | 2 |   | 2 |
| BOT601.3 | 3 | 3 | 3 | 1 | 2 |   | 2 |
| Average | 3.00 | 2.66 | 2.33 | 1.00 | 1.68 | ------- | 1.68 |

**Table -13: CO-PSO matrix for the course Botany -601(Genetics)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 601.1 | 3 | 1 | -------- | 1 | 1 | 1 |
| BOT601.2 | 1 | 2 | 3 | 2 | 2 | 2 |
| BOT 601.3 | 1 | 3 | 3 | 2 | 2 | 2 |
| Average | 1.66 | 2.00 | 2.00 | 1.66 | 1.66 | 1.66 |

**Unit I**

**Heredity:** Brief life history of Mendel; Terminologies; Laws of Inheritance.

**Modified Mandelian Ratios:**Lethal Genes; Co-dominance, incompletedominance; Gene interaction (9:7; 9:4:3; 13:3; 12:3:1, 15:1); Chi Square test; Pedigree Analysis.

**Cytoplasmic Inheritance:** Kappa particles in Paramecium, leafvariegation in *Mirabilis jalapa*

Male sterility; Multipleallelism;Pleiotropism;

Chromosome theory of Inheritance.Sex-determination and Sex-linked Inheritance.

# Unit II

**Linkage:**Concept & history, complete & incomplete linkage, bridges experiment, coupling &repulsion, recombination frequency, linkage maps based on two and three factor crosses

**Crossing over:** concept and significance, cytological proof of crossing over.

Mutations and Chromosomal Aberrations; Types of mutations, effects of physical & chemical mutagens.

**Numerical chromosomalchanges:** Euploidy, Polyploidy and Aneuploidy.

**Structural chromosomal changes:**Deletions, Duplications, Inversions & Translocations.

# Suggested Readings

* Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley India.
* 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.

* Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
* Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
* Singh, BD. Genetics. Kalyani Publishers Delhi
* Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.

# SEMESTER- VI

**DISCIPLINE SPECIFIC ELECTIVE-II PAPER CODE: BOT- 602 (Option-I) PLANT BREEDING**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To enhance the skill in the field of crop improvement.

**Learning Outcomes:** After completion of the course the learners will be able to: **CO1** develop conceptual understanding of plant genetic resources and plant breeding, **CO2** know the various methods of plant propagation.

**CO3** explain the monogenic and polygenic inheritance

**CO4** understand the various methods used in crop improvement.

# Table -14: CO-PO matrix for the course Botany -602(Plant Breeding)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 602.1 | 3 | 3 | 2 | 1 | 3 | 2 | 2 |
| BOT 602.2 | 3 | 2 | 1 | 1 | 3 | 2 | 1 |
| BOT 602.3 | 3 | 1 | 2 | 1 | 1 |   | 1 |
| BOT602.4 | 3 | 3 | 2 | 1 | 2 | 2 | 2 |
| Average | 3.00 | 2.25 | 1.75 | 1.00 | 2.25 | 1.50 | 1.50 |

**Table -14: CO-PSO matrix for the course Botany -602(Plant Breeding)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 602.1 | 3 | 1 | 2 | 2 | 2 | 3 |
| BOT 602.2 | 1 | 1 | 3 | 1 | 2 | 2 |
| BOT602.3 | 1 | 1 | 3 | 1 | 3 | 2 |
| BOT 602.4 | 1 | 1 | 3 | 1 | 2 | 3 |
| Average | 1.50 | 1.00 | 2.75 | 1.25 | 2.25 | 2.50 |

**Unit- I**

**Introduction and objectives of Plant Breeding:** Breeding systems; modes of reproduction in crop plants; Important achievements and undesirable consequences of plant breeding.

**Methods of crop improvement:** Introduction;Centers of origin and domestication of crop plants; plant genetic resources;Acclimatization.

**Selection methods:** For self-pollinated, cross pollinated and vegetativelypropagated plants;

**Hybridization:** For self, cross and vegetatively propagated plants–Procedure, advantages and limitations.

# Unit II

**Quantitative inheritance**: Concept, mechanism, examples.Monogenic vs polygenic Inheritance. **Inbreeding depression and heterosis**: History, genetic basis of inbreeding depression and heterosis; applications; Crop improvement and breeding.

Role of mutations, polyploidy, distant hybridization and role of biotechnology incropimprovement.

# Suggested Readings

* Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.
* Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
* 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.

* Poehlman JM and Sleper DA (1995) Breeding Field Crops, AVI. Publ., U.S.A.
* Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.

# SEMESTER-VI DISCIPLINE SPECIFIC ELECTIVE-II

**PAPER CODE: BOT- 603 (Option-I) GENETICS AND PLANT BREEDING- PRACTICAL**

**Maximum Marks: 50 External marks: 40 Internal Assessment: 10**

**Credits: 2 Time: 4 Hours**

|  |  |
| --- | --- |
| 1. Numerical regarding Genetics (Mendelian Inheritance or Gene Interaction) as per syllabus. | 10 |
| 2.Identify and comment on the specimen A, B, C and D (Chart/ Model /Photograph) | 12 |
| 3. Preparation of Idiogram from a given karyotype photograph | 6 |
| 4. Note Book and Chart/Model/Report on any Genetics/Plant Breeding Phenomenon. | 8 |
| 5. Viva-voce. | 4 |

**List of Practicals**

* + Mendel’s laws through seed ratios. Laboratory exercises in probability and chi-square.
	+ Chromosome mapping using point test cross data.
	+ Pedigree analysis for dominant and recessive autosomal and sex linked traits.
	+ Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3,15:1, 12:3:1, 9:3:4).
	+ Photographs/Permanent Slides showing Translocation Ring, Laggards and InversionBridge.
	+ Hybridization techniques - Emasculation, Bagging & Cross Pollination(For demonstration only).
	+ Induction of polyploidy conditions in plants (For demonstration only).

# SEMESTER- VI

**DISCIPLINE SPECIFIC ELECTIVE-II PAPER CODE: BOT- 601 (Option-II) RESEARCH METHODOLOGY-I**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To understand some basic concepts of research and its methodologies. **Learning Outcomes:** After completion of the course the learners will be able to: **CO1** select and define appropriate research problem and its parameters

**CO2** prepare and undertake a project

**CO3** organize and conduct research (advanced project) in a more appropriate manner

# Table -15: CO-PO matrix for the course Botany -603(Research Methodology-I)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 603.1 | 2 | 3 |   | 1 |   |   | 1 |
| BOT 603.2 | 1 | 3 |   | 1 |   |   | 1 |
| BOT603.3 | 1 | 3 | 3 | 2 | 2 |   | 2 |
| Average | 1.33 | 3.00 | 1.00 | 1.33 | 0.66 |  | 1.33 |

**Table -15: CO-PSO matrix for the course Botany -603(Research Methodology-I)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 603.1 | --------- | 2 | 3 | 3 | 3 | 2 |
| BOT603.2 | --------- | 2 | 3 | 3 | 3 | 3 |
| BOT 603.3 | 1 | 3 | 3 | 2 | 3 | 2 |
| Average | 0.33 | 2.33 | 3.00 | 2.66 | 3.00 | 2.33 |

**Unit I**

Basic concepts of Research**:** Research-definition and types of research (Descriptive versus analytical; applied versus fundamental;quantitative versus qualitative; conceptual versusemperical). Research methods versus methodology.

Literature-review and its consolidation; Library research; field research; laboratory research.

General laboratory practices- Common calculations in botany laboratories.Understanding the details on the label ofreagent bottles.Molarity and normality of common acids and bases.

# Unit II

Preparation of solutions.Dilutions.Percentage solutions.Molar, molal and normal solutions.Technique of handlingmicropipettes; Knowledge about common toxic chemicals and safety measures in theirhandling. Data collection and documentation of observations.Maintaining a laboratory record; Tabulation and generation of graphs.

Imaging oftissuespecimens and application of scale bars. The art of field photography.

# Suggested Readings

* + Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
	+ 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.

# SEMESTER- VI DISCIPLINE SPECIFIC ELECTIVE-II PAPER CODE: BOT- 602 (Option-II)

**RESEARCH METHODOLOGY- II**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** Tounderstand some basic concepts of research and its methodologies. **Learning Outcomes:** After completion of the course the learners will be able to: **CO1** select and define appropriate research problem in biological sciences.

**CO2** understand basic techniques used in biological research.

**CO3** learn various micro techniques in plant sciences.

# Table -16: CO-PO matrix for the course Botany -604(Research Methodology-II)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT 604.1 | 1 | 3 |   | 1 |   |   | 2 |
| BOT604.2 | 2 | 3 | 2 | 2 | 2 |   | 2 |
| BOT 604.3 | 2 | 3 | 1 | 1 | 2 |   | 2 |
| Average | 1.66 | 3.00 | 1.00 | 1.33 | 1.33 |  | 2.00 |

**Table -16: CO-PSO matrix for the course Botany -604(Research Methodology-II)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT 604.1 | ------- | 2 | 3 | 2 | 3 | 3 |
| BOT604.2 | ------- | 2 | 3 | 2 | 3 | 2 |
| BOT 604.3 | -------- | 2 | 3 | 1 | 3 | 1 |
| Average | -------- | 2.00 | 3.00 | 1.66 | 3.00 | 2.00 |

**Unit I**

**Overview of Biological Problems:**History; Key biology research areas,

**Model organisms in biology (A brief overview):**Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics,Proteomics-Transcriptional regulatory network.

**Methods to study plant cell/tissue structure:**Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning.

**Tissue preparation:** Living versus fixed, physical versus chemical fixation, coagulating fixatives, noncoagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plasticinfiltration; Preparation of thin and ultrathin sections.

# Unit II

**Plant microtechniques**:Staining procedures, classification and chemistry of stains. Staining equipment.Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP andother tags).Cytogenetic techniques with squashed plant materials.

The art of scientific writing and its presentation**,** Numbers, units, abbreviations and nomenclature used in scientific writing.

Writingreferences.Powerpoint presentations.Poster presentations.

Scientific writing and ethics,Introduction to copyright-academic misconduct/plagiarism.

# Suggested Readings

* + Dawson, C. (2002). Practical research methods.UBS Publishers, New Delhi.
	+ Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writingfor agricultural research scientists – a training reference manual. West Africa RiceDevelopment Association, Hong Kong.

# SEMESTER-VI DISCIPLINE SPECIFIC ELECTIVE-II

**PAPER CODE: BOT-603 (Option-II)**

**RESEARCH METHODOLOGY-I AND RESEARCH METHODOLOGY-II : PRACTICAL**

**Maximum Marks: 50 External marks: 40 Internal Assessment: 10**

**Credits: 2 Time: 4 Hours**

1. Prepare whole mount of given material. 6
2. Calculate amount of salt (CaNO3, KNO3, MgSO4, K2SO4, ZnSO4, FeCl3 etc.) in gms need to prepare molar, molal and normal solutions (any 2 salts) 10
3. Explain picture of given symbols on reagent bottle(3 symbols) 6
4. Prepare a bar graph from given data 6
5. Note Book and technical writing of at least 5000 words on any defined topic 8
6. Viva-voce. 4

**List of Practicals**

* + Calculation for making molar, molal and normal solution for common salts (CaNO3, KNO3, MgSO4, K2SO4, ZnSO4, FeCl3etc) used in biological experiments.
	+ Study of symbols and signs printed on common reagents used in biological experiments
	+ Study of making simple graphs from given data
	+ Preparation of Whole mount squash preparation of biological samples
	+ Fixation of onion root tips in fixative for mitosis studies
	+ To study methods of staining for studying Anatomy, chromosomal studies
	+ Preparation of Poster presentation on defined topics.
	+ Technical writing on topics assigned.

# SEMESTER IV-VI

**SKILL ENHANCEMENT COURSE-III PAPER CODE: BOT- S1**

**NURSERY AND GARDENING**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credit:2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives**: To sharpen the skills of learners about this self-employing discipline. **Learning Outcomes:** After completion of the course, the learners will be able to: **CO1** practically execute basic skills of gardening and landscaping;

**CO2** apply the knowledge gained in raising small scale nursery or kitchen gardens.

# Table -17: CO-PO matrix for the course Botany –SEC 01 (Nursery and Gardening)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT SEC-1.1 | 3 | 2 | 1 | 1 | 2 | 3 | 2 |
| BOT SEC-1.2 | 2 | 1 | ------- | 2 | 2 | 2 | 2 |
| Average | 2.50 | 1.50 | 0.50 | 1.50 | 2.00 | 2.50 | 2.00 |

**Table -17: CO-PSO matrix for the course Botany –SEC 01 (Nursery and Gardening)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT SEC-1.1 | 3 | 2 | 3 | -------- | 1 | 3 |
| BOT SEC-1.2 | 1 | 2 | 2 | -------- | 1 | 3 |
| Average | 2.00 | 2.00 | 2.50 | ------- | 1.00 | 3.00 |

**Unit I**

**Nursery:**Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities – planting, direct seeding and transplants.

**Seed:** Structure and types -Seed dormancy; causes and methods of breaking dormancy

**Seed storage:** Seed banks, factors affecting seed viability, genetic erosion.

**Seed production technology:** Seed testing and certification.

**Gardening operations:**Soil laying, manuring, watering, management of pests and diseases and harvesting, sowing/raising of seeds and seedlings, transplanting of seedlings.

# Unit II

**Vegetative propagation**: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings.

**Hardening of plants** - green house - mist chamber, shed root, shade house and glass house. **Gardening**: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design

Computer applications in landscaping.

**Cultivation of different vegetables**: Cabbage, Brinjal, Lady’s finger, Onion, Tomatoes and carrots **Cultivation of different flowers**: Marigold, *Lilium*, Rose, *Gerbera*, *Gladiolus*, *Chrysanthemum* and Carnation

Storage and marketing procedures.

# Suggested Readings

* + Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
	+ Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
	+ Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
	+ Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.
	+ Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
	+ Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
	+ Singh B, Singh N. and Kumar K. 2015. Common Garden Plants. Unique Publications,Panipat

# SEMESTER IV-VI

**SKILL ENHANCEMENT COURSE-III PAPER CODE: BOT- S2**

**BIO-FERTILIZERS**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To familiarize the students about important aspects of sustainable bio-fertilizers.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** elucidate different types of fertilizers using biological organisms;

**CO2** apply the knowledge gained in utilization of bio-fertilizers in organic farming.

**CO3** isolate, identify and mass multiply the microbes used as bio-fertilisers.

# Table -18: CO-PO matrix for the course Botany –SEC 02 (Bio-Fertilizers)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT SEC-2.1 | 3 | 2 | 1 | 2 | 2 | 3 | 1 |
| BOT SEC-2.2 | 3 | 1 | ------------ | 2 | 1 | 2 | 1 |
| Average | 3.00 | 1.50 | 0.50 | 2.00 | 1.50 | 2.50 | 1.00 |

**Table -18: CO-PSO matrix for the course Botany –SEC 02 (Bio-Fertilizers)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT SEC-2.1 | 1 | 1 | 2 | ------- | 1 | 2 |
| BOT SEC-2.2 | -------- | 2 | 3 | -------- | --------- | 3 |
| Average | 0.50 | 1.50 | 2.50 | --------- | 0.50 | 2.50 |

**Unit I**

General account about the microbes used as bio-fertilizers:

*Rhizobium*-isolation,identification, mass multiplication and carrier based inoculants, Actinorrhizal symbiosis.

*Azospirillum*: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.

*Azotobacter*: classification, characteristics-crop response to *Azotobacter* inoculum, maintenance and mass multiplication.

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogenfixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

# Unit II

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence anddistribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation andinoculum production of VAM, and its influence on growth and yield of crop plants.

Organic farming: Green manuring and organic fertilizers.

Recycling of biodegradable municipal, agricultural and Industrial wastes- bio-compost making methods. Types and method of vermicomposting – field application.

Antagonistic bacteria and fungi- role in agriculture

# Suggested Readings

* + - Dubey, R.C., 2005 A Text book of Biotechnology S. Chand & Co, New Delhi.
		- Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
		- John JothiPrakash, E. 2004. Outlines of Plant Biotechnology.EmkayPublication, New Delhi.
		- Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.
		- SubhaRao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
		- Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming AktaPrakashan, Nadiad

# SEMESTER IV-VI

**SKILL ENHANCEMENT COURSE-III PAPER CODE: BOT- S3**

**INTELLECTUAL PROPERTY RIGHTS**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To make aware students about legal aspects of Intellectual property.

**Learning Outcomes:** After completion of the course, the learners will be able to:

**CO1** understand the concept of IPR and differentiate between various agreements of IPR.

**CO2** compare copyrights, patents and geographical Indicators.

**CO3** examine various legal issues related to IPR.

# Table -19: CO-PO matrix for the course Botany –SEC 03 (Intellectual Property Rights)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT SEC-3.1 | 2 | 2 | 3 | 2 | 1 | ------ | 2 |
| BOT SEC-3.2 | 2 | 2 | 3 | 1 | 1 | --------- | 1 |
| BOTSEC-3.3 | 1 | 2 | 3 | 1 | 1 | 1 | ------- |
| Average | 1.66 | 2.00 | 3.00 | 1.33 | 1.00 | 0.33 | 1.00 |

**Table -19: CO-PSO matrix for the course Botany –SEC 03 (Intellectual Property Rights)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT SEC-3.1 | 1 | 1 | -------- | 3 | 2 | 1 |
| BOT SEC-3.2 | 1 | 1 | -------- | 3 | 3 | 2 |
| BOTSEC-3.3 | 1 | 1 | --------- | 3 | 2 | 1 |
| Average | 1.00 | 1.00 | ---------- | 3.00 | 2.33 | 1.33 |

**Unit I**

**Introduction to intellectual property rights (IPR)**: Concept and kinds, economic importance.

**IPR in India and world:** Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

**Patents:** Objectives, rights, patent act 1970 and its amendments. Procedure of obtaining patents, working of patents, infringement.

**Copyrights:** Introduction, works protected under copyright law, rights, transfer of copyright, infringement.

**Trademarks:** Objectives, types, rights, protection of goodwill, infringement, passing off, defenses, domain name.

**Geographical indications:** Objectives, justification, international position, multilateral treaties, national level, Indian position.

**Protection of traditional knowledge**: Objective, concept of traditional knowledge, holders, issues concerning, Bio-prospectingand Bio-piracy, alternative ways, protectability, needfor a *Sui-Generis* regime, Traditional knowledge on the international arena, at WTO, at National level, traditional knowledge digital library.

# Unit II

**Industrial designs:**Objectives, rights, assignments, infringements, defences of design infringement **Protection of plant varieties:**Objectives, justification, international position, plant varieties protection in India. Rights of farmers, breeders and researchers.

National gene bank, benefitsharing.

Protection of plant varieties and farmers’ rights act, 2001.

**Information technology related intellectual property rights**- Computer software and intellectual property, database and data protection, protection of semi-conductor chips, domain name protection **Biotechnology and Intellectual Property Rights**- Patenting biotech inventions: objective, applications, concept of novelty, Concept ofinventive step, Microorganisms,

Moral issues in patenting biotechnological inventions.

# Suggested Readings:

* + - Arthur Raphael Miller, MichealH.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
		- JayashreeWatal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.
		- Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
		- N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
		- P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).

# SEMESTER IV-VI

**SKILL ENHANCEMENT COURSE-III**

**PAPER CODE: BOT- S4 FLORICULTURE**

**Internal Assessment: 10 Marks External Marks: 40 Total Marks: 50 Credits: 2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two from each unit. Question no.1 is compulsory (Short answer type). Nine questions are to be set spread over entire syllabus. All questions carry equal marks (8 each).**

**Objectives:** To sharpen the skills of learners about this self-employing discipline. **Learning Outcome:** After completion of the course, the learner will be able to: **CO1** practically execute basic skills of designing of gardens and landscaping.

**CO2** apply the knowledge gained for commercial floriculture.

# Table -20: CO-PO matrix for the course Botany –SEC 04 (Floriculture)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT SEC-4.1 | 3 | 2 | 1 | 1 | 3 | 3 | 3 |
| BOT SEC-4.2 | 3 | 2 | 1 | 2 | 2 | 3 | 2 |
| Average | 3.00 | 2.00 | 1.00 | 1.50 | 2.50 | 3.00 | 2.50 |

**Table -20: CO-PSO matrix for the course Botany –SEC 04 (Floriculture)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT SEC- 4.1 | 2 | 2 | 2 | --------- | 2 | 3 |
| BOT SEC- 4.2 | 2 | 2 | 1 | ------ | 3 | 3 |
| Average | 2.00 | 2.00 | 1.50 | ------ | 2.5 | 3.00 |

**Unit I**

**Introduction**: History, importance and scope of floriculture and landscape gardening.

**Nursery management and routine garden operations**: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators

**Ornamental Plants**: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

# Unit II

**Principles of Garden Designs**: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (garden wall, fencing, steps, hedge, edging, lawn, flower beds, shrubbery, borders, water garden. Some famous gardens of India.

**Landscaping ofplaces of public importance**: Landscaping highways and educational institutions. **Commercial floriculture**: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life.

**Cultivation of Important cut flowers**- Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Lilium).

Diseases and Pests of Ornamental Plants.

# Suggested Readings

* + - Allan M. Armitage and Judy M. Laushman. 2008. Speciality Cut Flowers: The Production of Annuals, Perennials, Bulbs and Woody Plants for Fresh and Dried Cut Flowers. Timber Press; REV
		- Christopher Brickell. Royla Horticulture Society. Encyclopedia of Plants and Flowers (Rhs).
		- D. Ravinath. 2007. Floriculture: A Viable Business. Excel Books.
		- D.G. Hessayon. 2005. The House Plant Expert. Expert; 2nd edition.
		- Desh Raj 2019. Floriculture At A Glance. KALYANI PUBLISHER, Delhi
		- Floriculture, Vols. I and II Aavishkar Pub., Second Revised and Enlarged Edition, 798.
		- Griner, C. 2020. Floriculture Deigning And Merchandising (4th Edition) CENGAGE LEARNING.
		- J.S. Arora.2007. Introductory ornamental horticulture. Kalyani Publications.
		- John M. Dole and Harold F. Wilkins. 2004. Floriculture: Principles and Secies : Prentice Hall; 2 edition (2nd Edition)
		- Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.
		- S. Prasad, U. Kumar. 2010. A Handbook of Floriculture). Agrobios (India)
		- S.K. Bhattacharjee and LakshmanChandran De. 2010. Advanced Commercial.
		- Sathyanarayana,E.2019.A competitive book on Floriculture and Landscaping. Jain Brothers.
		- Singh B, Singh N. and Kumar K. 2015. Common Garden Plants. Unique Publications, Panipat

# SEMESTER IV-VI

**SKILL ENHANCEMENTCOURSE- III PAPER CODE: BOT- S5 ORGANIC FARMING**

**Internal Assessment: 10 Marks External Marks: 40 Maximum Total Marks: 50 Credits:2 Time: 3 Hours**

**Note: Attempt five questions in all, selecting two questions from each unit. Question No. 1 is compulsory (short answer type). Nine questions are to be set spread over the entire syllabus. All questions carry equal marks (8 marks each).**

**Objectives:** To familiarize the students about important aspects & benefits of Organic Farming.

**Learning Outcomes:** After completion of the course, the learners will be able to: **CO1** differentiate the different types of farming system and their important features. **CO2** apply the knowledge gained in carrying out organic farming practices.

# Table -21: CO-PO matrix for the course Botany –SEC 05 (Organic Farming)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| BOT SEC-5.1 | 3 | 1 | 1 | 1 | 2 | 3 | 2 |
| BOT SEC-5.2 | 3 | 2 | 1 | 1 | 1 | 3 | 3 |
| Average | 3.00 | 1.50 | 1.00 | 1.00 | 1.50 | 3.0 | 2.50 |

**Table -21: CO-PSO matrix for the course Botany –SEC 05 (Organic Farming)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| BOT SEC-5.1 | 1 | 1 | 3 | --------- | 2 | 3 |
| BOT SEC-5.2 | 1 | 2 | 3 | ---------- | 3 | 3 |
| Average | 1.00 | 1.50 | 3.00 | -------- | 2.50 | 3.00 |

**Unit I**

**Basics of organic farming** – Concept and components of organic farming, aims and objectives; Need of organic farming; Historical development of organic farming in India; Status of organic farming in India; Advantages and disadvantages of organic farming

**Organic farming process**- Concept of farming system, Developing organic farms, Important steps & methods; Pure organic farming and integrated farming system (combination of organic and inorganic), **Plant nutrients**: Essential plant nutrients, their role in plant growth and development, Nutrient uptake and utilization by plant.

**Nutrient management in organic farming**: Balanced nutrients supply for organic farming system using nutrients from organic sources. Preparation, nutrient content and methods of use of following- FYM/Rural compost, mulching, city compost, oil cakes, animal wastes, vermicomposts, vermiwash, jeevamrit, beejamrit, green manures, biofertilizers.

# Unit II

**Bio fertilizers and their method of use** – Nitrogenous, Phosphatic, Potassic, availability of nutrients from above sources.

**Recycling of organic matter in organic agriculture** - Transformation of organic substances in soil **Disease and pest management in organic farming**- Integrated pest & disease managements; Organic pesticides, bio-pesticides; Inorganic pesticides, disadvantages of their use; Seed, seedling and soil treatment measures; Feasibility of complete dependence on organic sources. Weed management in organic farming

Use of Neem and other plant products in organic farming; Organic agri-horticulture in urban &semi urban areas.

**Certification, Standardization, Marketing** - Quality control and certification procedures of organic products.Organic standards In India. Govt. schemes related to organic farming in India. Potential demand and Marketing of organic products.Organic farming and food security in India.

# Suggested Readings

1. P K Shetty Claude Alvares Ashok Kumar Yadav (Eds), 2014. Organic Farming And Sustainability. National Institute of Advanced Studies Bangalore, India.
2. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya Publishers.
3. SubhaRao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
4. Vayas,S.C, Vayas, S. And Modi, H.A. 1998 Bio-Fertilizers And Organic Farming AktaPrakashan, Nadiad.
5. Narayanan S., 2005. Organic Farming in India: Relevance, Problems and Constraints. National Bank for Agriculture and Rural Development, 2005
6. Krishan Chandra, 2005. Organic Manures. Regional Centre of Organic Farming, Banglaore-24
7. Mohan S. etal Pest and Disease Management: Organic Ecosystem. TNAU Publication
8. S.R. Reddy, 2017. Principles of Organic Farming.Kalyani Publishers New Delhi
9. S.R. Reddy, 2017, Farming System and Sustainable Agriculture. Kalyani Publishers New Delhi
10. MamtaBansal . 2017. Basics of Organic Farming, CBS PUBLICATION.
11. K. Annadurai, SP. Palaniappan, 2018. Organic Farming: Theory And Practice. Scientific Publishers (India)

# CO-PO-PSO mapping matrix for all the courses of B.Sc. Medical

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cours e code** | **PO 1** | **PO 2** | **PO3** | **PO 4** | **PO 5** | **PO6** | **PO 7** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO4** | **PSO 5** | **PSO 6** |
| **B 101** | 2.33 | ------ | ------ | 1.66 | 2.00 | 1.66 | 2.00 | 2.33 | 2.66 | 1.66 | ------ | 1.33 | 3.00 |
| **B 102** | 2.00 | ------ | ------- | 1.33 | 1.33 | 1.33 | 1.00 | 2.00 | 1.33 | 1.00 | 0.33 | 2.00 | 2.66 |
| **B 201** | 3.00 | 1.00 | 1.66 | 0.33 | 2.33 | 2.66 | 2.66 | 1.66 | 0.66 | 0.33 | 1.66 | 1.00 | 1.33 |
| **B 202** | 3.00 | 2.33 | 0.66 | 1.66 | 1.66 | 1.00 | 1.66 | 3.00 | 1.00 | 0.33 | 0.33 | 1.66 | 2.00 |
| **B 301** | 2.66 | 1.66 | 0.33 | 1.66 | 1.33 | 0.33 | 2.00 | 2.00 | 1.33 | 1.33 | -------- | 2.00 | 2.00 |
| **B 302** | 3.00 | 1.50 | 0.50 | 1.50 | 1.00 | ------ | 2.00 | 2.50 | 1.50 | 2.50 | 0.50 | 2.00 | 2.00 |
| **B 401** | 3.00 | 2.33 | 1.00 | 1.33 | 1.66 | 0.66 | 2.33 | 1.66 | 2.33 | 2.66 | 1.00 | 2.33 | 2.00 |
| **B 402** | 3.00 | 2.50 | 1.50 | 2.00 | 2.00 | 0.50 | 1.50 | 0.50 | 1.50 | 2.50 | 1.00 | 2.50 | 2.00 |
| **B 501** | 3.00 | 1.50 | 2.50 | 2.00 | 3.00 | 2.50 | 3.00 | 3.00 | 1.50 | 1.50 | 2.00 | 1.00 | 3.00 |
| **B 502** | 3.00 | 1.75 | 3.00 | 1.50 | 2.25 | 0.75 | 1.25 | 0.75 | 2.75 | 2.75 | 1.75 | 1.25 | 2.00 |
| **B 503** | 3.00 | 0.66 | 0.33 | 1.00 | 1.00 |  | 0.66 | 2.33 | 2.66 | 2.00 | 1.00 | 2.00 | 2.00 |
| **B 504** | 3.00 | 3.00 | 2.00 | 1.50 | 2.00 | 1.00 | 1.50 | 2.50 | 3.00 | 2.00 | 1.00 | 2.00 | 2.50 |
| **B 601** | 3.00 | 2.66 | 2.33 | 1.00 | 1.68 | ------- | 1.68 | 1.66 | 2.00 | 2.00 | 1.66 | 1.66 | 1.66 |
| **B 602** | 3.00 | 2.25 | 1.75 | 1.00 | 2.25 | 1.50 | 1.50 | 1.50 | 1.00 | 2.75 | 1.25 | 2.25 | 2.50 |
| **B 603** | 1.33 | 3.00 | 1.00 | 1.33 | 0.66 |  | 1.33 | 0.33 | 2.33 | 3.00 | 2.66 | 3.00 | 2.33 |
| **B 604** | 1.66 | 3.00 | 1.00 | 1.33 | 1.33 |  | 2.00 | ---- | 2.00 | 3.00 | 1.66 | 3.00 | 2.00 |
| **SEC****01** | 2.50 | 1.50 | 0.50 | 1.50 | 2.00 | 2.50 | 2.00 | 2.00 | 2.00 | 2.50 | ------- | 1.00 | 3.00 |
| **SEC 02** | 3.00 | 1.50 | 0.50 | 2.00 | 1.50 | 2.50 | 1.00 | 0.50 | 1.50 | 2.50 | ----- | 0.50 | 2.50 |
| **SEC 03** | 1.66 | 2.00 | 3.00 | 1.33 | 1.00 | 0.33 | 1.00 | 1.00 | 1.00 | ---- | 3.00 | 2.33 | 1.33 |
| **SEC****04** | 3.00 | 2.00 | 1.00 | 1.50 | 2.50 | 3.00 | 2.50 | 2.00 | 2.00 | 1.50 | ------ | 2.5 | 3.00 |
| **SEC 05** | 3.00 | 1.50 | 1.00 | 1.00 | 1.50 | 3.0 | 2.50 | 1.00 | 1.50 | 3.00 | -------- | 2.50 | 3.00 |