**Kurukshetra University, Kurukshetra**

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**Scheme of Examination and Syllabus**

**for**

**UG Programme under Multiple Entry-Exit Internship**

**and CBCS-LOCF in accordance to NEP-2020**

**w.e.f. 2022-23 (in phased manner)**

**Course: Botany**

**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 course of UG Programme**

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.

**Kurukshetra University Kurukshetra**

**Syllabus and Scheme of Examination for UG Programme under Multiple Entry-Exit Internship and CBCS-LOCF**

**in accordance to NEP-2020 w.e.f. 2022-23 (in phased manner)**

**Course: Botany**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester** | **Course** | **Paper** | **Nomenclature of paper** | **Credits**  **(4+2)** | **Internal marks** | **External Marks** | **Total**  **Marks** | **Exam Duration** | **Hours/week** |
| 1 | CC-1  Botany | B-BOT-N101 | Biodiversity –I  (Microbes, Algae, Fungi) | 2 | 25 | 25 | 50 | 3 hrs. | 2 |
| B-BOT-N102 | Biodiversity-II (Archegoniate) | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N103 | Practical based on B-BOT-N101 and 102 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| 2 | CC-2  Botany | B-BOT-N201 | Plant Ecology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N202 | Plant Taxonomy | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N203 | Practical based on B-BOT-N201 and 202 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| 3 | CC-3  Botany | B-BOT-N301 | Plant Anatomy | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N302 | Plant Embryology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N303 | Practical based on B-BOT-N301 and 302 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| 4 | CC-4  Botany | B-BOT-N401 | Plant Physiology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N402 | Plant Metabolism | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N403 | Practical based on B-BOT-N401 and 402 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| 5  (For Honours only | CC-5  Botany | B-BOT-N501 | Plant Stress Physiology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N502 | Plant Propagation Techniques | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N503 | Practical based on B-BOT-N501 and 502 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| 5  Choose one DSE from given options of Major subjects | DSE-I  Botany | B-BOT-N504 | Economic Botany | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N505 | Plant Biotechnology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N506 | Practical based on B-BOT-N504and 505 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| DSE-II  Botany | B-BOT-N507 | Cell Biology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N508 | Molecular Biology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N509 | Practical based on B-BOT-N507 and 508 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| DSE-III  Botany | B-BOT-N510 | MOOC\*  (From Swayam Portal) | \* | \* | \* | \* | \* | \* |
| SEC\* Major-1 | SEC-1\*  Botany | B-BOT-NS1 | Biofertilizers | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-NSP1 | Practical based on B-BOT-NS1 | 4 | 50 | 50 | 100 | 6 hrs | 8 |
| 6  (For Honors only) | CC-6 | B-BOT-N601 | Natural Resources Management | 2 | 25 | 25 | 50 | 3 hrs | 2 |
|  | B-BOT-N602 | Recent Trends in  Conservation Biology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
|  | B-BOT-N603 | Practical based on B-BOT-N601 and 602 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| 6  Choose one DSE from given options of Major subjects | DSE  (Option-I) | B-BOT-N604 | Genetics | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N605 | Plant Breeding | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N606 | Practical based on B-BOT-N604 and 605 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| DSE  (Option-II) | B-BOT-N607 | Natural Plant Products | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N608 | Modern Plant Systematics | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N609 | Practical based on B-BOT-N607 and 608 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| SEC\*  Major-2 | SEC-2\*  Botany | B-BOT-NS2 | Mushroom Cultivation Technology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-NSP2 | Practical based on B-BOT-NS2 | 4 | 50 | 50 | 100 | 6 hrs | 8 |
| 7  (For Non-Honours only | CC-5  Botany | B-BOT-N501 | Plant Stress Physiology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N502 | Plant Propagation Techniques | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N503 | Practical based on B-BOT-N501 and 502 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| 7 | RAEC Botany | B-LS -N700 | Research Ethics | 4 | 50 | 50 | 100 | 3 hrs | 4 |
| B-LS-N701 | Research Methodology | 4 | 50 | 50 | 100 | 3 hrs | 4 |
| Research Progression Seminar | B-BCH-N701 | Seminar and Report | 4 | \_ | \_ | 100 | \_ | \_ |
| B-BCH-N702 | Synopsis writing and seminar | 4 | \_ | \_ | 100 | \_ | \_ |
| 8  (For Non-Honors only) | CC-6 | B-BOT-N601 | Natural Resources Management | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N602 | Recent Trends in  Conservation Biology | 2 | 25 | 25 | 50 | 3 hrs | 2 |
| B-BOT-N603 | Practical based on B-BOT-N601 and 602 | 2 | 25 | 25 | 50 | 6 hrs | 4 |
| 8 | RAEC  Botany | B-BCH-N800 | Research Dissertation/Thesis | 20 | \_ | \_ | \_ | \_ | \_ |
| B-BCH-N801 | Mid-term Seminar | 2 | \_ | \_ | 50 | \_ | \_ |
| B-BCH-N802 | Pre-submission seminar | 2 | \_ | \_ | 50 | \_ | \_ |
| **CC- Core Courses; DSE- Discipline Specific Elective; SEC- Skill Enhancement Courses; RAEC- Research ability enhancement courses**  **• Opt SEC\* Major-1 in 5th semester and Opt second SEC\* of Major-2 in 6th semester.**  **• CC-5 & CC-6 are compulsorily in semester 7 & 8, if these courses are not completed as CC-5 & CC-6 in semester 5 & 6**  **• Internal assessment (50%) shall be based on clearly defined components of class attendance and participation (10%), mid-term exam of 2 hour duration (30%) and assignments-presentations (10%) of the credit and the rest (50%) through End term Examination.**  **• Internship@10 credits (450 hours) after 2 nd semester (only for exit options) • Internship@10 credits (450 hours) after 4 th semester (compulsory for all)** | | | | | | | | | |

**BOTANY DEPARTMENT**

**KURUKSHETRA UNIVERSITY KURUKSHETRA**

**(Established by the State Legislature Act-XII of 1956)**

**(‘A+’ Grade, NAAC Accredited)**

Scheme of Examination and Syllabus

for

UG Programme

Course: Botany

Modified Common Minimum Syllabus

(As per National Education Policy-2020)

For the first three years of Higher Education (UG) w.e.f. session 2022-23 in Phased Manner

COURSE INTRODUCTION

The new curriculum of UG Programme offers essential knowledge and technical skills to study plants in a holistic manner. Students would be trained in all areas of plant biology using a unique combination of core, elective and vocational papers with significant inter-disciplinary components.

Students would be exposed to cutting-edge technologies that are currently used in the study of plant life forms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

UG Programme covers academic activities within the classroom sessions along with practical concepts at laboratory sessions. Infield, outstation activities and projects are also required to be organized for real-life experience and learning.

Candidates who have curiosity in plants kingdom, ecosystem, love exploring exotic places and wish to work as researchers or professions like Botanist, Conservationist, Ecologist, etc. can choose UG Programme with Botany.

**SEMESTER-I**

**PAPER CODE: B-BOT-N101**

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

**Internal Assessment: 25 Marks External Marks: 25 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 (05 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 and role 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 B-BOT-N101 (Biodiversity-I Microbes, Algae, Fungi)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO-N101.1 | 3 | --------- | --------- | 2 | 2 | 1 | 2 |
| CO-N101.2 | 2 | --------- | --------- | 2 | 2 | 3 | 3 |
| CO-N101.3 | 2 | --------- | --------- | 1 | 2 | 1 | 1 |
| Average | 2.33 | ---------- | --------- | 1.66 | 2.00 | 1.66 | 2.00 |

**Table -1: CO-PSO matrix for the course B-BOT-N101 (Biodiversity-I Microbes, Algae, Fungi)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO-N101.1 | 3 | 2 | 1 | -------- | 2 | 3 |
| CO-N101.2 | 1 | 3 | 3 | -------- | 2 | 3 |
| CO-N101.3 | 3 | 3 | 1 | -------- | -------- | 3 |
| Average | 2.33 | 2.66 | 1.66 | ------ | 1.33 | 3.00 |

**UNIT-I**

Bacteria: Structure, nutrition, reproduction and economic importance with reference to their role in agriculture and industry (fermentation and medicine)

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. lytic and lysogenic cycle.

Fungi: General characters,Affinities with plants and animals, 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, Mycorrhiza-Ectomycorrhiza,

Endomycorrhiza and their significance.

**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. CryptogamicBotany.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: B-BOT-N102**

**BIODIVERSITY-II (ARCHEGONIATE)**

**Internal Assessment: 25 Marks External Marks: 25 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 (05 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 B-BOT-N102 (Biodiversity-II Archegoniate)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO-N102.1 | 3 | --------- | --------- | 1 | 2 | 2 | 1 |
| CO-N102.2 | 2 | --------- | --------- | 3 | 1 | 1 | 1 |
| CO-N102.3 | 1 | --------- | --------- | ------- | 1 | 1 | 1 |
| Average | 2.00 | ------ | ------- | 1.33 | 1.33 | 1.33 | 1.00 |

**Table -2: CO-PSO matrix for the course B-BOT-N102 (Biodiversity-II Archegoniate)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO-N102.1 | 2 | 1 | -------- | ------- | 2 | 3 |
| CO-N102.2 | 2 | 1 | 2 | ------- | 2 | 3 |
| CO-N102.3 | 2 | 2 | 1 | 1 | 2 | 2 |
| Average | 2.00 | 1.33 | 1.00 | 0.33 | 2.00 | 2.66 |

**UNIT-I**

Bryophyta: General characters, Adaptations to land habit, classification upto classes (Smith, 1935), alternation of generations, structure and reproduction (excluding development) of *Marchantia* (Hepaticopsida), *Anthoceros* (Anthocerotopsida), *Funaria* (Bryopsida).Ecological and economic importance of bryophytes with special reference to *Sphagnum*.

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).Apogamy, and apospory, heterospory andseed habit, telome theory, stelar evolution; Ecological and economic importance.

Gymnosperms-General characteristics, classification up to family (Smith 1955), morphology, anatomy and reproduction of *Cycas*,*Pinus*, *Gnetum* 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: B-BOT-N103**

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

**Internal Assessment: 25 External marks: 25 Maximum Marks: 50**

**Credits: 2 Time: 6 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 temporary preparations and permanent slides.

• Fungi: Study of vegetative & reproductive structures of *Phytophthora*, *Mucor*, *Puccinia*, *Penicillium*&*Colletotrichum*: Asexual and sexual stagesthroughtemporarypreparations 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 gemmacup,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. microsporophyllandmegasporophyll, 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).

*Gnetum*- Morphology (stem, male & female cones), transverse section of stem, verticalsection of ovule (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: B-BOT-N201**

**PLANT ECOLOGY**

**Internal Assessment: 25 Marks External Marks: 25 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 (5 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 B-BOT-N201 (Plant Ecology)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO-N201.1 | 3 | 1 | 2 | ------ | 2 | 3 | 3 |
| CO-N201.2 | 3 | 1 | 1 | 1 | 3 | 3 | 2 |
| CO-N201.3 | 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 B-BOT-N201 (Plant Ecology)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO-N201.1 | \_\_ | 1 | ----- | 1 | 1 | 1 |
| CO-N201.2 | 2 | \_\_\_ | 1 | 1 | 1 | 1 |
| CO-N201.3 | 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-Definition & types. Processes and types (autogenic, allogenic, autotrophic, heterotrophic, primary & secondary), Hydrosere and Xerosere.

**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; acid rain, ozone layer depletion, 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: B-BOT-N202**

**PLANT TAXONOMY**

**Internal Assessment: 25 Marks External Marks: 25 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 (5 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 B-BOT-N202 (Plant Taxonomy)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO-N202.1 | 3 | 2 | 1 | 2 | 2 | 1 | 2 |
| CO-N202.2 | 3 | 2 | 1 | 2 | 2 | 1 | 1 |
| CO-N202.3 | 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 B-BOT-N202 (Plant Taxonomy)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO-N202.1 | 3 | \_\_ | 1 | \_\_\_ | 1 | 2 |
| CO-N202.2 | 3 | 1 | \_\_\_ | 1 | 2 | 2 |
| CO-N202.3 | 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.

TOOLS & SOFTWARES IN PLANT IDENTIFICATION-GIS (Mapping of (i) Patterns(ii) Features (iii) Quantities Free Phylogenetic Software: PAUP and MESQUITE

Digital Taxonomy (e-flora), Description Language for Taxonomy – DELTA Internet directory for Botany.

**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: B-BOT-N203**

**PLANT ECOLOGY AND PLANT TAXONOMY- PRACTICAL**

**Internal Assessment: 25 External marks: 25 Maximum Marks: 50**

**Credits: 2 Time: 6 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.

5. 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).

6. Quantitative analysis of herbaceous vegetation in the college campus or nearby fields for frequency andcomparison with Raunkiaer’s frequency distribution law.

7. 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).

8. Excursion Report: Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and specimens related to Angiosperms.Mountingof a collected, properly dried and pressed specimen of minimum 20 wild plants with herbarium label.