

Shree Warana Vibhag Shikshan Mandal's

# **WARANA UNIVERSITY, WARANANAGAR**

(A State Public University established under Section 3 (6) of MPUA, 2016)



Established: 2025

## **Structure & Syllabus For Bachelor of Science (B. Sc.) in Botany**

UNDER

**Faculty of Science & Technology**

**B. Sc. Part - I (Semester - I and II)**

**(As Per National Education Policy – 2020)**

**With Effect from Academic Year 2025-26 Onwards**

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**Abbreviations:**

|      |                              |
|------|------------------------------|
| POs  | Program Outcomes             |
| PSOs | Program Specific Outcomes    |
| COs  | Course Outcomes              |
| DSC  | Discipline Specific Core     |
| DSE  | Discipline Specific Elective |
| GE   | Generic Elective             |
| OE   | Open Elective                |
| VSC  | Vocational Skill Course      |
| SEC  | Skill Enhancement Course     |
| IKS  | Indian Knowledge System      |
| AEC  | Ability Enhancement Course   |
| VEC  | Value Education Course       |
| OJT  | On Job Training (Internship) |
| FP   | Field project                |
| CEP  | Community engagement project |
| CC   | Co-curricular Courses        |
| RM   | Research Methodology         |
| RP   | Research Project             |
| MJ   | Major Course                 |
| MN   | Minor Course                 |
|      |                              |

## **PREAMBLE**

Botany, as a core branch of life sciences, plays a vital role in understanding plant diversity, ecology, agriculture, biotechnology, and environmental sustainability. The B.Sc. Botany programme under NEP-2020 is designed to provide broad-based knowledge of plant sciences while fostering scientific temper, critical thinking, and problem-solving skills.

The curriculum emphasizes conceptual learning, laboratory and field-based training, skill development, and exposure to traditional as well as modern scientific approaches. It aims to equip students with competencies required for higher education, research, employment, and entrepreneurship in diverse sectors such as education, agriculture, forestry, pharmaceuticals, and environmental management.

This programme aspires to nurture responsible graduates who are not only academically competent but also committed to biodiversity conservation, sustainable development, and societal well-being.

## **GENERAL OBJECTIVES OF THE COURSE**

- To provide a strong foundation in plant sciences covering diversity, structure, function, physiology, genetics, ecology, and applied aspects of Botany.
- To develop scientific temper and critical thinking by encouraging observation, experimentation, and logical interpretation of biological phenomena.
- To impart practical skills in laboratory techniques, fieldwork, plant identification, herbarium preparation, data analysis, and use of modern tools in Botany.
- To integrate traditional knowledge with modern science, highlighting the importance of ethnobotany, medicinal plants, and sustainable use of biodiversity.
- To cultivate awareness of environmental issues and the role of plants in climate regulation, ecosystem services, conservation, and sustainable development.
- To prepare students for higher education and research in plant sciences, biotechnology, agriculture, forestry, and allied disciplines.
- To enhance employability and entrepreneurship skills through exposure to applied aspects of Botany such as horticulture, nursery management, mushroom cultivation, biofertilizers, and herbal industries.
- To foster values of responsibility and ethics towards nature, biodiversity, and society, preparing students as informed citizens and contributors to national development.
- To encourage teamwork, communication, and digital literacy as essential skills for 21st-century scientific and professional careers.
- To nurture lifelong learning habits and inspire curiosity about the natural world, enabling students to adapt to evolving global challenges in science and environment..

## **PROGRAMME OUTCOMES (POs) – B.Sc.**

- PO1. Knowledge and Understanding: Acquire comprehensive knowledge of plant diversity, structure, physiology, genetics, ecology, and applied aspects of Botany.
- PO2. Scientific Temper and Inquiry: Develop the ability to observe, analyse, and interpret biological phenomena using scientific reasoning and evidence-based approaches.
- PO3. Practical and Field Skills: Demonstrate competence in laboratory techniques, field methods, plant identification, herbarium preparation, and use of modern tools in plant sciences.
- PO4. Environment and Sustainability Awareness: Recognize the importance of plants in ecosystems and human welfare and apply principles of conservation and sustainable resource use.
- PO5. Problem-Solving and Critical Thinking: Apply botanical knowledge and analytical skills to address issues in agriculture, environment, biotechnology, and related fields.
- PO6. Communication and Teamwork: Communicate scientific ideas effectively in oral and written forms, and work collaboratively in laboratory, field, and community settings.
- PO7. Employability and Entrepreneurship: Gain skills relevant for careers in teaching, agriculture, forestry, pharmaceuticals, environmental consultancy, horticulture, and plant-based industries.
- PO8. Ethics and Lifelong Learning: Cultivate ethical responsibility towards nature and society, while nurturing curiosity and the ability to engage in lifelong learning in the biological sciences.

## **PROGRAMME SPECIFIC OUTCOMES (PSOs) – B.Sc. BOTANY**

After successful completion of the B.Sc. Botany course, the students will

- PSO 1. Understanding Plant Diversity and Systematics: Gain in-depth knowledge of plant diversity, taxonomy, and evolutionary relationships among algae, fungi, bryophytes, pteridophytes, gymnosperms, and angiosperms.
- PSO 2. Plant Structure and Function: Comprehend the organization, physiology, metabolism, and development of plants at cellular, tissue, organ, and whole-plant levels.
- PSO 3. Genetics, Molecular Biology, and Biotechnology: Apply principles of genetics, molecular biology, and modern biotechnological tools to understand heredity, variation, crop improvement, and plant-based innovations.
- PSO 4. Ecology and Environment: Analyse plant–environment interactions, ecological adaptations, ecosystem dynamics, and strategies for biodiversity conservation and climate resilience.
- PSO 5. Applied Botany: Acquire practical knowledge of applied aspects such as horticulture, nursery techniques, mushroom cultivation, biofertilizers, plant pathology, and herbal industries.
- PSO 6. Research and Analytical Skills: Develop the ability to design experiments, collect and analyse data, prepare herbarium specimens, and use ICT/digital tools in plant science research.

PSO 7. Traditional and Indigenous Knowledge: Appreciate the role of ethnobotany, medicinal plants, and traditional practices in healthcare and sustainable livelihoods, integrating them with modern science.

PSO 8. Contribution to Sustainable Development: Apply botanical knowledge to address agricultural, environmental, and industrial challenges while promoting conservation, sustainability, and societal well-being.

### **ELIGIBILITY FOR ADMISSION**

As per guidelines obtained from Warana University, Warananagar by following rules and regarding reservations by Govt. of Maharashtra

### **DURATION**

The course shall be a fulltime course. One Year, Semester I and II.

### **MEDIUM OF INSTRUCTION**

The medium of instruction shall be English

**MEME Instructions:** In alignment with the National Education Policy (NEP) 2020, the Bachelor of Science (B.Sc.) program adopts the Multiple Entry and Multiple Exit (ME-ME) framework. This flexible structure is designed to provide students with academic mobility, skill development, and lifelong learning opportunities. Through ME-ME framework, the program enables students to enter and exit at different stages with appropriate certifications. Information regarding different entry and exit options available to students and respective mandatory number of credits to be earned by the students are provided in the table below.

| Year | Stage of exit                             | Type of Award                        | Mandatory Credits to be earned | Minimum credits to be earned |
|------|-------------------------------------------|--------------------------------------|--------------------------------|------------------------------|
| 1    | After successful completion of One Year   | Undergraduate Certificate in Science | 44                             | 40                           |
| 2    | After successful completion of Two Year   | Undergraduate Diploma in Science     | 88                             | 80                           |
| 3    | After successful completion of Three Year | Bachelor of Science Degree           | 132                            | 120                          |

**Re-entry provision:** Students leaving after a undergraduate certificate or undergraduate diploma may re-enter the program within 5 years by earning required credits through Academic Bank of Credits.

**SCHEME OF TEACHING AND EXAMINATION:** [The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

| B.Sc.Program Structure for Level 4.5 of B.Sc.-I Semester I |                             |                 |           |       |         |                                            |     |     |                              |     |     |                                             |     |     |
|------------------------------------------------------------|-----------------------------|-----------------|-----------|-------|---------|--------------------------------------------|-----|-----|------------------------------|-----|-----|---------------------------------------------|-----|-----|
| Teaching Scheme                                            |                             |                 |           |       |         | Examination Scheme                         |     |     |                              |     |     |                                             |     |     |
| Sr. No.                                                    | Theory (TH) & Practical (P) |                 |           |       |         | Semester-end Examination (SEE)             |     |     | Internal Assessment (IA)     |     |     | Practical                                   |     |     |
|                                                            | Course Type                 | No. of Lectures | Practical | Hours | Credits | Paper Hours                                | Max | Min | Internal                     | Max | Min | Paper Hours                                 | Max | Min |
| 1.                                                         | DSC-I                       | 4               | 1         | 4 +4  | 6       | 1                                          | 30  | 12  | Assignment                   | 20  | 8   | 2                                           | 50  | 20  |
| 2.                                                         | DSC-I                       | 4               | 1         | 4 +4  | 6       | 1                                          | 30  | 12  |                              | 20  | 8   | 2                                           | 50  | 20  |
| 3.                                                         | DSC-I                       | 4               | 1         | 4 +4  | 6       | 1                                          | 30  | 12  |                              | 20  | 8   | 2                                           | 50  | 20  |
| 4.                                                         | OE -I                       | -               | 1         | 4     | 2       | -                                          | -   | -   |                              | -   | -   | 2                                           | 50  | 20  |
| 5.                                                         | VEC                         | -               | -         | -     | -       | -                                          | -   | -   |                              | -   | -   | -                                           | -   | -   |
| 6.                                                         | IKS (Generic)               | 2               | -         | 2     | 2       | 2                                          | 50  | 20  |                              | -   | -   | -                                           | -   | -   |
| Total                                                      |                             |                 |           |       | 22      | [DSC (60 X 3) + IKS 50]<br>Total SEE = 230 |     |     | DSC (40X3)<br>Total IA = 120 |     |     | Practical. = 50X4<br>Total Practical. = 200 |     |     |
|                                                            |                             |                 |           |       |         | Total Semester –I = 550                    |     |     |                              |     |     |                                             |     |     |

| B.Sc.Program Structure for Level 4.5 of B.Sc.-I Semester II |                             |                 |           |       |         |                                            |     |     |                              |     |     |                                             |     |     |
|-------------------------------------------------------------|-----------------------------|-----------------|-----------|-------|---------|--------------------------------------------|-----|-----|------------------------------|-----|-----|---------------------------------------------|-----|-----|
| Teaching Scheme                                             |                             |                 |           |       |         | Examination Scheme                         |     |     |                              |     |     |                                             |     |     |
| Sr. No.                                                     | Theory (TH) & Practical (P) |                 |           |       |         | Semester-end Examination (SEE)             |     |     | Internal Assessment (IA)     |     |     | Practical                                   |     |     |
|                                                             | Course Type                 | No. of Lectures | Practical | Hours | Credits | Paper Hours                                | Max | Min | Internal                     | Max | Min | Paper Hours                                 | Max | Min |
| 1.                                                          | DSC-II                      | 4               | 1         | 4 +4  | 6       | 1                                          | 30  | 12  | Assignment                   | 20  | 8   | 2                                           | 50  | 20  |
| 2.                                                          | DSC-II                      | 4               | 1         | 4 +4  | 6       | 1                                          | 30  | 12  |                              | 20  | 8   | 2                                           | 50  | 20  |
| 3.                                                          | DSC-II                      | 4               | 1         | 4 +4  | 6       | 1                                          | 30  | 12  |                              | 20  | 8   | 2                                           | 50  | 20  |
| 4.                                                          | OE -II                      | -               | 1         | 4     | 2       | -                                          | -   | -   |                              | -   | -   | 2                                           | 50  | 20  |
| 5.                                                          | VEC -I                      | 2               | -         | 2     | 2       | 2                                          | 50  | 20  |                              | -   | -   | -                                           | -   | -   |
| 6.                                                          | IKS (Generic)               | -               | -         | -     | -       | -                                          | -   | -   |                              | -   | -   | -                                           | -   | -   |
| Total                                                       |                             |                 |           |       | 22      | [DSC (60 X 3) + IKS 50]<br>Total SEE = 230 |     |     | DSC (40X3)<br>Total IA = 120 |     |     | Practical. = 50X4<br>Total Practical. = 200 |     |     |
|                                                             |                             |                 |           |       |         | Total Semester –I = 550                    |     |     |                              |     |     |                                             |     |     |

### **General Guidelines for the selection of subjects**

1. In first year, student has to choose three DSC subjects from the basket for faculty of Science. (The DSC Basket for faculty of Science includes Mathematics, Physics, Chemistry, Botany, Zoology, Biochemistry, Industrial Microbiology and Computer Science)
2. At the start of second year, out of these 3 DSC subjects, he/she has to opt one subject as Major subject and one as Minor subject. The remaining DSC subject will be dropped.
3. Student cannot select a subject as major or minor other than the subjects taken in first year.
4. OE is to be chosen compulsorily from faculty other than that of the major. (B.Sc. students needs to select OE from faculty of Arts or Faculty of Commerce)
5. VSC is to be selected from the basket of Skill courses approved by the university.
6. IKS (Generic) will be provided by the university separately.

**Credit Distribution Structure for B.Sc.-I in Botany with Multiple Entry and Multiple Exit Options:**

| <b>COURSE CATEGORY</b> | <b>ABBREVIATION (Only 2 Letters)</b> | <b>DESCRIPTION</b>                | <b>Sem.-I Credit</b> | <b>Sem.-II Credit</b> |
|------------------------|--------------------------------------|-----------------------------------|----------------------|-----------------------|
| DSC                    | DSC (DS)                             | Discipline Specific Course        | 6x3=18               | 6x3=18                |
| OE                     | OE(OE)                               | Open Elective                     | 2x1=02               | 2x1=02                |
| SEC                    | SEC (SE)                             | Skill Enhancement Course          | -                    | -                     |
| AEC/IKS/VEC            | AEC(AE)                              | Ability Enhancement Course        | -                    | -                     |
|                        | IKS(IK)                              | Indian Knowledge System (Generic) | 2x1=02               | -                     |
|                        | VEC(VE)                              | Value Education Course            | -                    | 2x1=02                |
| CC/CEP                 | CC (CC)                              | Co-curricular Course              | -                    | -                     |
|                        | CEP(CE)                              | Community Engagement Project      | -                    | -                     |
|                        |                                      |                                   | 22                   | 22                    |
|                        |                                      |                                   | Total 44             |                       |

**Bachelor of Science in BOTANY**  
**Credit Framework**  
**First-Year (B. Sc. I- BOTANY)**

| Level | Sem.                                                                                                                                             | Subject-1<br>(BOTANY)                                                          | Subject<br>-2          | Subject<br>-3          | IDC/MDC/O<br>E/GE                              | SE<br>C | AEC, VEC, IKS |                                                                                 |                                                                | OJT, FP, CEP, CC,<br>RP |            |                     | Total<br>Credits |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------|------------------------|------------------------------------------------|---------|---------------|---------------------------------------------------------------------------------|----------------------------------------------------------------|-------------------------|------------|---------------------|------------------|
|       |                                                                                                                                                  | DSC                                                                            | DSC                    | DSC                    | OE                                             | SE<br>C | AE<br>C       | VEC                                                                             | IKS                                                            | C<br>C                  | FP/O<br>JT | RP/<br>Disse<br>rt. |                  |
| 4.5   | I                                                                                                                                                | 2502USBOM<br>J101<br>Paper-I<br>Phycology<br>and<br>Microbiology<br>(2 Cr)     | DSC-I<br>(2 Cr)        | DSC-I<br>(2 Cr)        | 2502USBOO<br>E101<br>Practical-I<br>(2 Cr)     | --      | --            | --                                                                              | 2502USBOI<br>K101<br>IKS-I<br>(2 Cr)<br>Introduction<br>to IKS | --                      | --         | --                  | --               |
|       |                                                                                                                                                  | 2502USBOM<br>J102<br>Paper-II<br>Biomolecules<br>and Cell<br>Biology<br>(2 Cr) | DSC-<br>II (2<br>Cr)   | DSC-II<br>(2 Cr)       |                                                |         |               |                                                                                 |                                                                |                         |            |                     |                  |
|       |                                                                                                                                                  | 2502USBOM<br>J103<br>Practical-I (2<br>Cr)                                     | DSC-<br>P-I (2<br>Cr)  | DSC-<br>P-I (2<br>Cr)  |                                                |         |               |                                                                                 |                                                                |                         |            |                     |                  |
|       | Credits                                                                                                                                          | 4(T)+2(P)=6                                                                    | 4(T)+2(P)=6            | 4(T)+2(P)=6            | 2 (P)=2                                        | --      | --            | --                                                                              | 2(T)                                                           | --                      | --         | --                  | 22               |
|       | II                                                                                                                                               | 2502USBOM<br>J201 Paper-<br>III Mycology<br>and<br>Phytopathology (2 Cr)       | DSC-III<br>(2 Cr)      | DSC-I<br>(2 Cr)        | 2502USBOO<br>E201 OE<br>Practical-II<br>(2 Cr) | --      | --            | 2502USBOV<br>E201 VEC-I<br>(2 Cr)<br>Democracy,<br>Election and<br>Constitution | --                                                             | --                      | --         | --                  | --               |
|       |                                                                                                                                                  | 2502USBOM<br>J202 Paper-<br>IV<br>Archegoniate<br>(2 Cr)                       | DSC-<br>IV (2<br>Cr)   | DSC-II<br>(2 Cr)       |                                                |         |               |                                                                                 |                                                                |                         |            |                     |                  |
|       |                                                                                                                                                  | 2502USBOM<br>J203<br>Practical-II (2<br>Cr)                                    | DSC-<br>P-II (2<br>Cr) | DSC-<br>P-II (2<br>Cr) |                                                |         |               |                                                                                 |                                                                |                         |            |                     |                  |
|       | Credits                                                                                                                                          | 4(T)+2(P)=6                                                                    | 4(T)+2(P)=6            | 4(T)+2(P)=6            | 2 (P)=2                                        | --      | --            | 2(T)                                                                            | --                                                             | --                      | --         | --                  | 22               |
|       | Total Credits                                                                                                                                    | 12                                                                             | 12                     | 12                     | 4                                              | --      | --            | 2                                                                               | 2                                                              | --                      | --         | --                  | 44               |
|       | Exit Option: Award of UG Certificate in Major with 44 Credits and an additional 4 credits core NSQF course/ Internship/Skill Courses OR Continue |                                                                                |                        |                        |                                                |         |               |                                                                                 |                                                                |                         |            |                     |                  |

**Course Code Table**

**B.Sc.-I: SEMESTER-I (TOTALCREDITS-22):** (Note: Put '—' wherever 'Not Applicable')

| COURSE CATEGORY            |      | COURSE NAME                             | COURSE CODE   | CREDITS |
|----------------------------|------|-----------------------------------------|---------------|---------|
| DSC                        | DS-I | Phycology and Microbiology              | 2502USBOMJ101 | 2       |
| DSC                        | DS-I | Biomolecules and Cell Biology           | 2502USBOMJ102 | 2       |
| DSC                        | DS-I | Practical-I                             | 2502USBOMJ103 | 2       |
| OE                         | OE-I | जैविक व सेंद्रिय खतांचा परिचय           | 2502USBOOE101 | 2       |
| SEC                        | SE-I | -                                       | -             | -       |
| AEC                        | AE-I | -                                       | -             | -       |
| IKS<br>(Generic)           | IK   | Introduction to Indian Knowledge System | 2502USBOIK101 | 2       |
| CC                         | CC   | -                                       | -             | -       |
| CREDITS FOR B.Sc.-I, SEM-I |      |                                         |               | 10      |

**B.Sc.-I: SEMESTER-II (TOTALCREDITS-22):** (Note: Put '—' wherever 'Not Applicable')

| COURSE CATEGORY             |       | COURSE NAME                          | COURSE CODE   | CREDITS |
|-----------------------------|-------|--------------------------------------|---------------|---------|
| DSC                         | DS-I  | Mycology and Phytopathology          | 2502USBOMJ201 | 2       |
| DSC                         | DS-I  | Archegoniate                         | 2502USBOMJ202 | 2       |
| DSC                         | DS-I  | Practical-II                         | 2502USBOMJ203 | 2       |
| OE                          | OE-II | बागकाम तंत्रज्ञान                    | 2502USBOOE201 | 2       |
| SEC                         | SE-I  | -                                    | -             | -       |
| AEC                         | AE-I  | -                                    | -             | -       |
| VEC<br>(Generic)            | VE-I  | Democracy, Election and Constitution | 2502USBOVE201 | 2       |
| CC                          | CC    | -                                    | -             | -       |
| CREDITS FOR B.Sc.-I, SEM-II |       |                                      |               | 10      |

**NOTE REGARDING OPEN ELECTIVE:**

The OE courses offered by the Department of Botany are available for the first-year students of the faculty of Arts and Humanities or faculty of Commerce and Management. The students of science should select the open elective subject from the OE basket provided by the faculty of Arts and Humanities or the faculty of Commerce and Management. The details of OE courses available are provided in the prospectus and posted on Institutional Website.

**Semester- I****Botany Paper I: Phycology and Microbiology (2502USBOMJ101)**

## CREDIT: 2. LECTURE HOURS; 2 PER WEEK; MARKS: 50

### Course Outcomes:

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

|            |                                                                                                                                                                                                        |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | Define the general characters of algae, viruses, and bacteria and explain their structural and functional diversity using appropriate biological terminology                                           |
| <b>CO2</b> | Classify algae based on modern criteria and describe the major groups with reference to various characteristics.                                                                                       |
| <b>CO3</b> | Illustrate the life cycles of representative algal groups and demonstrate understanding of their alternation of generations through diagrams or flowcharts.                                            |
| <b>CO4</b> | Differentiate between the structure of various types of viruses.                                                                                                                                       |
| <b>CO5</b> | Compare the morphological forms and modes of reproduction in bacteria and interpret their role in ecological processes such as nitrogen fixation, decomposition, and symbiosis.                        |
| <b>CO6</b> | Evaluate the economic importance of algae, viruses, and bacteria in agriculture, industry, and human welfare, and propose practical applications or solutions based on beneficial microbial processes. |

### Syllabus

| MODULE | SUB-MODULE          | TOPICS                                                                                                                                                                                                                                                                                                                                | LECTURE PERIOD |
|--------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| M 1    | Phycology           |                                                                                                                                                                                                                                                                                                                                       |                |
|        | <b>1. Algae</b>     | i) General characteristics<br>ii) Diversity with respect to habit and habitats<br>iii) Economic importance<br>iv) Classification (as per G. M. Smith, 1955) up to classes<br>v) Life cycle (excluding developmental stages of sex organs) of the following types<br>a) Cyanophyceae: <i>Nostoc</i><br>Chlorophyceae: <i>Spirogyra</i> | 14             |
| M 2    | Microbiology        |                                                                                                                                                                                                                                                                                                                                       |                |
|        | <b>2.1 Viruses</b>  | i) Discovery and General characteristics<br>ii) General structure of viruses: Helical, Icosahedral and Complex<br>iii) Types of viruses- DNA viruses (T- Phage), RNA viruses (TMV)<br>Economic importance                                                                                                                             | 08             |
|        | <b>2.2 Bacteria</b> | i) Discovery and General characteristics<br>ii) Cell structure<br>iii) Forms of bacteria based on shapes<br>iv) Reproduction – vegetative, asexual and                                                                                                                                                                                | 08             |

|  |  |                                                        |           |
|--|--|--------------------------------------------------------|-----------|
|  |  | recombination (conjugation)<br>vi) Economic importance |           |
|  |  | <b>Total Lectures</b>                                  | <b>30</b> |

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3. Vidyarthi, Sanjeev Kumar. *Phycology and Microbiology*. P.K. Publishers & Distributors, 2024.
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6. Parker, Nina; Schneegurt, Mark; Tu, Anh-Hue Thi; Lister, Philip; Forster, Brian M. *Microbiology*. OpenStax, Houston, Texas, 2016.
7. Maheshwari, Dinesh K., editor. *Bacteria in Agrobiolgy: Plant Probiotics*. Springer, 2012.
8. Postgate, John. *Microbes and Man*. Cambridge University Press, 2000. (Classic book on ecological, environmental, and societal importance of microbes.)
9. Fogg, G. E., W. D. P. Stewart, P. Ray, and A. E. Walsby. *The Blue-Green Algae*. Academic Press, London, 1973. (For cyanobacteria/blue-green algae)
10. Bold, H. C., and M. J. Wynne. *Introduction to Algae: Structure and Reproduction*. Harper & Row (or appropriate publisher), 1978. (Classic for algal morphology, taxonomy)
11. Dubey, R. C., and D. K. Maheshwari. *Textbook of Microbiology*. S. Chand & Company, New Delhi.

## Botany Paper II: Biomolecules and Cell Biology (2502USBOMJ102)

**CREDIT: 2. LECTURE HOURS; 2 PER WEEK; MARKS: 50**

### Course Outcomes:

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

|            |                                                                                                                                                                           |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | <b>Define</b> and <b>classify</b> carbohydrates, <b>explain</b> the properties and biological significance of carbohydrate, lipids and proteins.                          |
| <b>CO2</b> | <b>Describe</b> the structural organization of DNA as proposed by Watson and Crick and <b>differentiate</b> between mRNA, rRNA, and tRNA based on structure and function. |
| <b>CO3</b> | <b>Illustrate</b> the types of cells and <b>demonstrate</b> understanding of the structure and functions of the cell wall and plasma membrane using labeled diagrams      |
| <b>CO4</b> | <b>Explain</b> the stages of the cell cycle and <b>analyze</b> the process of cell division (mitosis and meiosis) with reference to their biological significance         |
| <b>CO5</b> | <b>Describe</b> and <b>compare</b> the ultrastructure and functions of major cell organelles such as nucleus, chloroplast, mitochondria, and ribosomes                    |
| <b>CO6</b> | <b>Analyze</b> the functional roles of peroxisomes and glyoxysomes in cellular metabolism and <b>evaluate</b> their significance in plant growth and development.         |

| MODULE    | SUB-MODULE                               | TOPICS                                                                                                                                             | LECTURE PERIOD |
|-----------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>1.</b> | <b>Biomolecules</b>                      |                                                                                                                                                    |                |
|           | <b>1.1 Carbohydrates</b>                 | Introduction, Nomenclature, classification and definition of Monosaccharides, Disaccharides, Oligosaccharides and Polysaccharides with one example | <b>04</b>      |
|           | <b>1.2 Lipids</b>                        | Introduction, Definition, Properties and Significance.                                                                                             | <b>03</b>      |
|           | <b>1.3 Proteins</b>                      | Introduction, Definition, Properties and Biological role of proteins.                                                                              | <b>03</b>      |
|           | <b>1.4 Nucleic acids</b>                 | Introduction, Watson and Crick model of DNA, Types of RNA and Role of nucleic acids.                                                               | <b>05</b>      |
| <b>2.</b> | <b>The cell</b>                          |                                                                                                                                                    |                |
|           | <b>2.1 Cell</b>                          | Introduction, Structure of prokaryotic and eukaryotic cells.                                                                                       | <b>02</b>      |
|           | <b>2.2 Cell wall and plasma membrane</b> | Introduction, structure and function of Plant cell wall. Plasma membrane: fluid mosaic model.                                                      | <b>03</b>      |

|                       |                             |                                                                                                   |           |
|-----------------------|-----------------------------|---------------------------------------------------------------------------------------------------|-----------|
|                       | <b>2.3 Cell division</b>    | Cell cycle, mitosis, meiosis and significance                                                     | <b>05</b> |
|                       | <b>2.4. Cell Organelles</b> | Structure and functions of Nucleus, Chloroplast, Mitochondria, Ribosomes, Peroxisomes, Glyoxisome | <b>05</b> |
| <b>Total Lectures</b> |                             |                                                                                                   | <b>30</b> |

### **Cytology, Microbiology and Analytical Techniques-**

1. Alberts, Bruce, et al. *Molecular Biology of the Cell*. 7th ed., Garland Science, 2020. A comprehensive and authoritative textbook on cell biology, organelle structure, biomolecules, and molecular mechanisms of cells.
2. Verma, P. S., and V. K. Agarwal. *Cell Biology (Cytology, Biomolecules and Molecular Biology)*. S. Chand Publishing, 2022. A syllabus-aligned text covering biomolecules, cell structure, membranes, and molecular biology basics.
3. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. *Fundamentals of Biochemistry: Life at the Molecular Level*. 5th ed., John Wiley & Sons, 2016. A standard undergraduate biochemistry text explaining carbohydrates, lipids, proteins, and nucleic acids.
4. Nelson, David L., and Michael M. Cox. *Lehninger Principles of Biochemistry*. 5th ed., W. H. Freeman, 2008. A widely used reference for structure and function of biomolecules and metabolic principles.
5. OpenStax. *Concepts of Biology*. OpenStax, 2013, openstax.org. A freely available textbook with chapters on biological molecules, DNA structure, and cell components.
6. Cooper, Geoffrey M. *The Cell: A Molecular Approach*. 2nd ed., Sinauer Associates, 2000. Focuses on molecular aspects of cell structure and biomolecules, suitable for deeper understanding of cells.
7. Hardin, Jane, et al. *Becker's World of the Cell*. 8th ed., Pearson, 2012. A student-friendly introduction to cell biology and organelle function with clear illustrations.
8. Tymoczko, John L., Jeremy M. Berg, and Lubert Stryer. *Biochemistry: A Short Course*. 2nd ed., W. H. Freeman, 2012. A concise biochemistry text that covers biomolecules and nucleic acids in context.
9. Campbell, Neil A., et al. *Campbell Biology*. 12th ed., Pearson, 2020. A broad introductory biology text with excellent chapters on molecules of life and cellular organization

## SEMESTER – I

### Practical-I (2502USBOMJ103) based on paper I and II

**Total Marks 50**

Course Outcomes:

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

|            |                                                                                                                                                                                        |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | <b>Identify and demonstrate</b> the correct use, handling, and care of compound and dissecting microscopes for biological observations.                                                |
| <b>CO2</b> | <b>Observe, recognize, and differentiate</b> major groups of microorganisms (viruses, bacteria, cyanobacteria, algae) and plant cells using slides, microphotographs, and models.      |
| <b>CO3</b> | <b>Examine and illustrate</b> the vegetative and reproductive structures of selected organisms ( <i>Nostoc</i> , <i>Spirogyra</i> ) and stages of cell division (mitosis and meiosis). |
| <b>CO4</b> | <b>Perform and interpret</b> qualitative biochemical tests for carbohydrates, lipids, and proteins using standard laboratory procedures.                                               |
| <b>CO5</b> | <b>Analyze experimentally</b> the effect of physical and chemical factors (temperature and organic solvents) on membrane permeability and organelle activity.                          |
| <b>CO6</b> | <b>Document, correlate, and appreciate</b> plant diversity, ecological interactions, and applied botany through field exposure during botanical excursions and specimen submission.    |

#### Practical

1. Study of compound and dissecting microscope.
2. Study of T-Phage and TMV viruses with the help of Electron microphotographs/models
3. Study of Bacterial forms (Temporary / permanent slides/ photographs).
4. Study of vegetative and reproductive structures of *Nostoc* and *Spirogyra*
5. Study of Qualitative tests for carbohydrates, lipids and proteins (Any two test of each)
6. Study of plant cell structure with the help of epidermal peel
7. Study of mitosis
8. Study of meiosis
9. Study of cell organelles with the help of microphotograph/model
10. Study the effect of organic solvent on permeability of plasma membrane.
11. Study the effect of temperature on the activity of peroxisome.
12. Botanical excursion.

#### Reference Books:

1. Practical Manual for B.Sc.-I Botany Sem-I

सेमेस्टर- १

ओपन इलेक्टिव- भाग एक

जैविक व सेंद्रिय खतांचा परिचय (2502USBOOE101)

क्रेडिट: दोन

वेळ: 60 तास

मार्क्स: 50

ओपन इलेक्टिव अभ्यासक्रमाचे अपेक्षित परिणाम

विद्यार्थ्यांनी ओपन इलेक्टिव अभ्यासक्रम यशस्वीरीत्या पूर्ण केल्यानंतर त्यांना खालील गोष्टींचा फायदा होईल.

- विद्यार्थ्यांना 'जैविक शेती-शाश्वत शेती' बाबतची जागृती निर्माण होईल.
- विविध जैविक खते निर्माण करण्याचे कौशल्य प्राप्त होईल.
- काम्पोस्ट खत, गांडूळ खत आणि व्हर्मिवाश तयार करता येईल.
- जैविक खतांवर आधारित उद्योग निर्मिती करता येईल.

#### प्रात्यक्षिके

- जीवाणू वर्गीय जैविक खतांचे प्रकार आणि ओळख करून घेणे.
- बुरशी वर्गीय जैविक खतांची माहिती करून घेणे.
- शैवाल वर्गीय जैविक खतांचे प्रकार आणि ओळख करून घेणे.
- फर्न आणि सपुष्प वनस्पती वर्गीय जैविक खतांची ओळख आणि महत्व जाणून घेणे.
- जैविक खते तयार करण्यासाठी लागणाऱ्या मुलभूत घटकांची ओळख आणि माहिती करून घेणे.
- जैविक खते तयार करण्याची पद्धत अभ्यासाने.
- जैविक खतांचे पॅकिंग आणि लेबलिंग करण्याची पद्धत अभ्यासाने.
- हरित खतांचा परिचय करून घेणे.
- जैविक घटकांचे काम्पोस्टिंग करणे
- गांडूळ खतांचा परिचय व महत्व जाणून घेणे.
- गांडूळ खत आणि व्हर्मिवाश तयार करण्याची पद्धत अभ्यासाने.
- जैविक आणि अजैविक खते तयार करणाऱ्या केंद्रांना भेट देणे.

**Generic Paper: IKS**

**Title of the Course: Interdisciplinary course in Generic IKS**

**Course Code: 2502USBOIK101**

**CREDIT: 2.**

**LECTURE HOURS; 2 PER WEEK;**

**MARKS: 50**

**Course Aims-**

1. Creating awareness amongst the youths about the true history and rich culture of the country;
2. Understanding the scientific value of the traditional knowledge of Bhārata;
3. Promoting the youths to do research in the various fields of Bhāratiya knowledge system;
4. Converting the Bhāratiya wisdom into the applied aspect of the modern scientific paradigm;
5. Adding career, professional and business opportunities to the youths.

**Course learning Objectives**

1. To help to study the enriched scientific Indian heritage.
2. To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system.
3. To introduce the contribution from ancient Indian system & tradition to modern science & Technology.
4. Understanding the fundamental principles of Indian health systems such as Ayurveda and yoga which are useful in maintaining the human health.
5. Practical implementation of health principles to correct the intake of food, air, water and sunlight to achieve perfect health.
6. Understanding traditional way of cleansing the body regularly, strengthening body with Yogic exercises, maintaining the internal balance to prevent diseases.

**Course Learning Outcomes:**

1. Inculcate ayurvedic practices in health
2. Apply traditional knowledge for sustainability
3. Follow dincharya and daily regime and appropriate food for the maintenance of good health.

**SYLLABUS**

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Module 1</b> | <b>1. Introduction to Indian Knowledge System</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Lecture</b>  |
|                 | <p>1.1 Introduction to IKS</p> <ul style="list-style-type: none"> <li>• Definition, Concept and Scope of IKS</li> <li>• IKS based approaches on Knowledge Paradigms</li> <li>• IKS in ancient India and in modern India</li> </ul> <p>1.2 Importance of Health&amp; Wellness in IKS</p> <ul style="list-style-type: none"> <li>• Ayurveda -Importance of Sleep and Food,</li> <li>• Role of water in wellbeing</li> <li>• Yoga and Triguna System. Healthy regimen to maintain state of wellbeing</li> <li>• Dinacharya, the Daily regimen including Daily detoxification, exercise, Intake of Food, Water, Air and Sunlight, work and ergonomics, Rest and sleep hygiene.</li> </ul>                                                                                                                                                                                                                                                         | <b>15</b>       |
| <b>Module 2</b> | <b>2. Life sciences, Environment, and Health</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Lectures</b> |
|                 | <p>2.1 Life sciences, Environment, and Health</p> <ul style="list-style-type: none"> <li>• Life Science - Plants-Herbal medicines, Herbal preparations, modern herbal medicines, Herbal medicines from <i>Allium sativum</i>, Nutraceuticals, Traditional probiotic foods and their importance in human health</li> <li>• Ecology and Environment- Concept &amp; structure of ecosystem, kinds of ecosystem, functions of ecosystem,</li> <li>• Āyurveda, Integrated Approach to Healthcare, Medicine, Microbiology, Medicine, Surgery, and Yoga, etc.</li> </ul> <p>2.2 Basic principles of Food, Nutrition from Ayurveda</p> <ul style="list-style-type: none"> <li>• Understanding rich sources of nutrients</li> <li>• Concept of Doshas &amp; assessment</li> <li>• Ayurvedic Principles of food habits and factors determining quality of food (Ahara vidhi visheshaayatana)</li> <li>• FSSAI regulations on Ayurvedic Aahar</li> </ul> | <b>15</b>       |

### Recommended Books:

1. Ministry of Education, Government of India. *Indian Knowledge Systems: Background, Scope, and Perspectives*. AICTE–IKS Division, New Delhi, 2022.  
(Authoritative introduction to IKS: concept, scope, paradigms, ancient–modern continuity)
2. Sen, Amartya, and Bimal N. Patel, editors. *Indian Knowledge Systems: Contemporary Perspectives*. Oxford University Press India, 2023.  
(Modern academic perspectives on IKS across disciplines including health and life sciences)

3. Sharma, Ram Karan, and Vaidya Bhagwan Dash, translators. *Charaka Samhita*. Chowkhamba Sanskrit Series Office, Varanasi, 2018.  
(Foundational Ayurvedic text covering Ahara, Dinacharya, Doshas, health, and wellbeing)
4. Dash, Bhagwan, and Lalitesh Kashyap. *Basic Principles of Ayurveda*. Concept Publishing Company, New Delhi, 2014.  
(Clear explanation of Doshas, food principles, health, and integrated healthcare concepts)
5. Lad, Vasant. *Ayurveda: The Science of Self-Healing*. Motilal Banarsidass Publishers, Delhi, 2017.  
(Accessible and systematic treatment of sleep, food, nutrition, Triguna, and daily regimen)
6. Pandey, Gyanendra. *Dravyaguna Vijnana (Materia Medica of Ayurveda)*. Vols. 1–2, Chowkhamba Krishnadas Academy, Varanasi, 2019.  
(Herbal medicines, traditional preparations, medicinal plants including garlic and nutraceuticals)
7. Tiwari, Maya. *Ayurveda: A Life of Balance*. Healing Arts Press, Rochester, 2018.  
(Lifestyle, food habits, water, sleep hygiene, yoga, and holistic wellbeing)
8. Frawley, David. *Yoga and Ayurveda: Self-Healing and Self-Realization*. Motilal Banarsidass Publishers, Delhi, 2010.  
(Integrated approach to Ayurveda, Yoga, Triguna system, and health maintenance)
9. Odum, Eugene P., and Gary W. Barrett. *Fundamentals of Ecology*. 5th ed., Cengage Learning India, New Delhi, 2017.  
(Concept, structure, functions, and kinds of ecosystems—supports environment component)
10. Food Safety and Standards Authority of India (FSSAI). *Food Safety and Standards (Ayurvedic Aahar) Regulations*. Government of India, New Delhi, 2022.  
(Official reference for FSSAI regulations related to Ayurvedic food and nutrition)

## SEMESTER –II

### Botany Paper III: Mycology and Phytopathology (2502USBOMJ201)

**CREDIT: 2. LECTURE HOURS; 2 PER WEEK; MARKS: 50**

#### Course Outcomes:

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

|            |                                                                                                                                                                                                                             |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | <b>Describe</b> the general characters and <b>classify</b> fungi based on morphology, reproduction, and thallus organization, and <b>explain</b> their ecological and economic significance.                                |
| <b>CO2</b> | <b>Illustrate</b> and <b>explain</b> the life cycles of <i>Mucor</i> and <i>Penicillium</i> with reference to modes of reproduction and adaptive significance.                                                              |
| <b>CO3</b> | <b>Differentiate</b> the types of lichens based on growth forms and internal structure and <b>analyze</b> their general characters and ecological importance as pioneer species and bioindicators.                          |
| <b>CO4</b> | <b>Explain</b> the concept of the plant disease triangle and <b>define</b> key terminologies used in plant pathology for effective disease diagnosis and management.                                                        |
| <b>CO5</b> | <b>Identify</b> and <b>interpret</b> general symptoms of plant diseases and <b>analyze</b> their association with causal agents such as fungi, bacteria, viruses, and phytoplasmas.                                         |
| <b>CO6</b> | <b>Analyze</b> the etiology, symptoms, mode of transmission, and management strategies of major plant diseases—yellow vein mosaic of bhendi, citrus canker, white rust of crucifers, and grassy shoot disease of sugarcane. |

## SYLLABUS

| MODULE    | SUB-MODULE           | TOPICS                                                                                                                                                    | LECTURE PERIOD |
|-----------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>1.</b> | <b>Mycology</b>      |                                                                                                                                                           |                |
|           | <b>1.1Fungi – A)</b> | i) General characters of fungi<br>ii) Classification of fungi up to class as per Ainsworth (1973).<br>iii) Economic importance                            | <b>05</b>      |
|           | <b>B)</b>            | Life cycle (excluding developmental stages of sex organs) of the following types-<br>a) Zygomycotina: <i>Mucor</i><br>b) Ascomycotina: <i>Penicillium</i> | <b>10</b>      |
|           | <b>1.2Lichens</b>    | i) Occurrence and General characters<br>ii) Nature of association<br>iii) Types of lichens (Crustose, Foliose and Fruticose)<br>iv) Economic importance   | <b>04</b>      |

|                       |                                       |                                                                                                                                                                                                                                                                                                                                                                                        |           |
|-----------------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 2                     | <b>Phytopathology</b>                 |                                                                                                                                                                                                                                                                                                                                                                                        |           |
|                       | <b>2.1 Concepts in Phytopathology</b> | i) Introduction to phytopathology<br>ii) Plant disease triangle components.<br>iii) Koch's postulate<br>iv) Terminology of plant Diseases - Localized, Systemic, Soil borne, Air borne, Seed borne, Endemic, Epidemic, Sporadic diseases.<br>v) General symptoms of plant diseases- (Leaf spot, Blight, damping off, wilting, Dieback, Cankers, Chlorosis, Smut, Rust, Powdery mildew. | <b>06</b> |
|                       | <b>2.2 Plant diseases</b>             | i) Study of following plant diseases with respect to symptoms and control measures-<br><b>a) Viral</b> – Yellow vein mosaic of Bhendi<br><b>b) Bacterial</b> – Citrus Canker<br><b>c) Fungal</b> – White rust of crucifers<br><b>d) Mycoplasma (MLO)</b> - Grassy shoot of sugarcane                                                                                                   | <b>05</b> |
| <b>Total Lectures</b> |                                       |                                                                                                                                                                                                                                                                                                                                                                                        | <b>30</b> |

### **Fungi and Phytopathology –**

1. Agrios, George N. Plant Pathology. 6th ed., Academic Press, 2024. A widely used and authoritative textbook covering plant disease concepts, plant disease triangle, symptomology, and major diseases including citrus canker and white rust.
2. Alexopoulos, Constantine J., Charles W. Mims, and Michael Blackwell. Introductory Mycology. 4th ed., John Wiley & Sons, 1996. A classic reference on fungal biology, classification, and life cycles, ideal for studying general characters of fungi such as Mucor and Penicillium.
3. Sharma, O. P. Textbook of Fungi. 2nd ed., Rastogi Publications, 1999. A student-friendly text that introduces major fungal groups, morphology, and significance.
4. Mukherji, K. G., B. P. Chamola, D. K. Upreti, and R. K. Upadhyay. Biology of Lichen. Aravalli Books International, 1999. Focused on the biology, types, and ecological significance of lichens.
5. Harshberger, John W. A Text-Book of Mycology and Plant Pathology. P. Blakiston's Son & Company, 1917. A historical yet foundational book combining mycology and plant disease studies, useful for understanding early concepts in plant pathology.
6. Dubey, R. C., and D. K. Maheshwari. Practical Mycology. S. Chand & Company, 2000. A practical guide to fungal morphology and reproduction, helpful for lab and field studies.
7. Arumugam, N., Annie Ragland, and V. Kumaresan. Mycology, Plant Pathology and Lichenology. Saras Publication, 2024. A concise overview tailored to botany students, integrating fungi, lichens, and plant

disease topics.

8. Bendre, A. M., and Ashok Kumar. A Textbook of Practical Botany 1. Rastogi Publications, 1984. Includes practical methods and symptom identification for plant diseases such as citrus canker and grassy shoot disease of sugarcane.

## SEMESTER –II

### Botany Paper IV: Archegoniate (2502USBOMJ202)

**CREDIT: 2. LECTURE HOURS; 2 PER WEEK; MARKS: 50**

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

|            |                                                                                                                                                                             |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | <b>Describe</b> the general characters and <b>explain</b> the ecological and economic importance of Bryophytes, Pteridophytes, and Gymnosperms.                             |
| <b>CO2</b> | <b>Classify</b> Bryophytes and Pteridophytes according to <b>G. M. Smith (1955)</b> up to the level of classes and <b>explain</b> their diversity with respect to habitats. |
| <b>CO3</b> | <b>Illustrate</b> the external and internal structure of <i>Funaria</i> and <i>Pteris</i> and <b>demonstrate</b> understanding of their life cycles using labeled diagrams. |
| <b>CO4</b> | <b>Compare</b> the morphological and reproductive features of Bryophytes and Pteridophytes and <b>analyze</b> their evolutionary significance in the plant kingdom.         |
| <b>CO5</b> | <b>Describe</b> and <b>classify</b> Gymnosperms according to <b>Sporne (1965)</b> and <b>explain</b> their adaptive features and economic importance.                       |
| <b>CO6</b> | <b>Analyze</b> the structure, reproduction, and life cycle of <i>Cycas</i> and <b>evaluate</b> its significance as a connecting link in plant evolution.                    |

| MODULE    | SUB-MODULE               | TOPICS                                                                                                                                                                                                                                     | LECTURE PERIOD |
|-----------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>1.</b> | <b>Archegoniate</b>      |                                                                                                                                                                                                                                            |                |
|           | <b>1.1 Bryophytes</b>    | i) General characters and importance<br>ii) Diversity with respect to habitats<br>iii) Classification as per G.M. Smith (1955) up to classes<br>iv) Important features and life history (excluding developmental stages) of <i>Funaria</i> | <b>10</b>      |
|           | <b>1.2 Pteridophytes</b> | i) General characters and importance<br>ii) Classification as per G.M. Smith (1955) up to classes<br>Morphology, anatomy (leaf and stem) and life cycle (excluding developmental stages sex organs) of <i>Pteris</i>                       | <b>10</b>      |

|                       |                        |                                                                                                                                                                                       |           |
|-----------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                       | <b>1.3 Gymnosperms</b> | i) General characters and importance<br>ii) Classification as per Sporne (1965) up to classes<br>Important features and life history (excluding developmental stages) of <i>Cycas</i> | <b>10</b> |
| <b>Total Lectures</b> |                        |                                                                                                                                                                                       | <b>30</b> |

### References:

#### Module 1 – Bryophytes & Pteridophytes

1. Sambamurty, A. V. S. S. *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. I.K. International Publishing, 2005. A comprehensive Indian text covering bryophyte and pteridophyte general characters, classification, and study of *Funaria* and *Pteris*.
2. Arumugam, N., Annie Ragland, and V. Kumaresan. *College Botany – Volume 3: Bryophytes, Pteridophytes, Gymnosperms, Palaeobotany*. Saras Publication, 2024. A syllabus-oriented book with details on bryophyte and pteridophyte diversity and classifications.
3. Smith, Gilbert M. *Cryptogamic Botany, Vol. II: Bryophytes and Pteridophytes*. 2nd ed., Tata McGraw Hill Publishing Co., New Delhi, 1971. A classic reference for bryophyte and fern taxonomy, relevant to Smith's classification (1955).
4. Rashid, A. *An Introduction to Bryophyta*. Vikas Publishing House, New Delhi, 2004. A student-friendly Indian text on bryophyte structure, life history, and diversity.
5. Sharma, O. P. *Text Book of Pteridophyta*. McMillan India Ltd., New Delhi, 1990. A text covering general characters and evolution of ferns and allied pteridophytes.
6. Parihar, N. S. *An Introduction to Embryophyta – Vol. II: Bryophyta & Pteridophyta*. Central Book Depot, Allahabad. A classic Indian reference for plant kingdom lower groups.

#### Module 2 – Gymnosperms (including *Cycas*)

1. Sporne, K. R. *The Morphology of Gymnosperms*. Hutchinson & Co. Ltd., London, 1965. A foundational work—required reading for understanding gymnosperm characters and classification according to Sporne.
2. Datta, Subhash Chandra. *An Introduction to Gymnosperms*. Kalyani Publishers, New Delhi, 1984. An India-centric book suitable for conceptual study of gymnosperm morphology and importance.
3. Bhatnagar, S. P., and A. Moitra. *Gymnosperms*. New Age International (Pvt.) Ltd., New Delhi, 1996. A useful reference for gymnosperm general characters, classification, and economic significance.
4. Purohit, S. S., and R. Vyas. *A Text Book of Gymnosperms*. Ramesh Book Depot, Jaipur, 1997. A concise Indian text useful for B.Sc. level study of gymnosperm structure and life histories.
5. Vasishtha, P. C. *Gymnosperms, Vol. V*. S. Chand & Co., Delhi, 2004. A detailed Indian reference covering classification and characteristics of major gymnosperm groups.
6. Chamberlain, C. J. *Gymnosperms: Structure and Evolution*. CBS Publishers & Distributors, New Delhi. A balanced text blending structure and evolution of gymnosperms, suitable for deeper study.

**SEMESTER – II**  
**Practical -II (2502USBOMJ203)**  
**based on paper III and IV (DSC-P II)**  
**Total Marks 50**

**Course Outcomes:**

|            |                                                                                                                                                                                                                                                        |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CO1</b> | <b>Identify</b> and <b>describe</b> the diagnostic morphological and reproductive features of representative fungi ( <i>Mucor</i> and <i>Penicillium</i> ) and <b>classify</b> them based on observable characters.                                    |
| <b>CO2</b> | <b>Recognize, classify,</b> and <b>demonstrate</b> the structural diversity of different types of lichens using preserved specimens, charts, or microscopic observations.                                                                              |
| <b>CO3</b> | <b>Observe, record,</b> and <b>interpret</b> general symptoms of plant diseases and <b>differentiate</b> between bacterial, viral, fungal, and mycoplasmal diseases using standard pathological criteria.                                              |
| <b>CO4</b> | <b>Examine</b> and <b>analyze</b> the etiology, symptoms, and causal organisms of major plant diseases—citrus canker, yellow vein mosaic of bhendi, grassy shoot of sugarcane, and white rust of crucifers—through specimen study and disease reports. |
| <b>CO5</b> | <b>Prepare, label,</b> and <b>illustrate</b> the vegetative and reproductive structures of <i>Funaria</i> , <i>Pteris</i> , and <i>Cycas</i> using temporary mounts, permanent slides, or diagrams.                                                    |
| <b>CO6</b> | <b>Document, evaluate,</b> and <b>present</b> plant disease specimens and practical records following standard laboratory practices, demonstrating skills in scientific reporting and specimen submission.                                             |

**Practical:**

1. Study of *Mucor*
2. Study of *Penicillium*
3. Study of types of Lichens
4. Study of any four general symptoms on plant diseases (As per theory)
5. Study of bacterial plant disease – Citrus canker
6. Study of Viral plant disease – Yellow vein mosaic of Bhendi
7. Study of Mycoplasmal plant disease – Grassy Shoot of Sugarcane
8. Study of fungal plant disease – White rust of Crucifers
9. Study of vegetative and reproductive structures of *Funaria*
10. Study of vegetative and reproductive structures of *Pteris*
11. Study of vegetative and reproductive structures of *Cycas*
12. Submission of plant diseases.

**References:**

Practical handbook for B.Sc.-I Sem-II botany.

सेमेस्टर- २

ओपन इलेक्टिव- भाग दोन

बागकाम तंत्रज्ञान (2502USBOOE201)

क्रेडिट: दोन

वेळ: 60 तास

माक्स: 50

ओपन इलेक्टिव अभ्यासक्रमाचे अपेक्षित परिणाम

विद्यार्थ्यांनी ओपन इलेक्टिव अभ्यासक्रम यशस्वीरीत्या पूर्ण केल्यानंतर त्यांना खालील गोष्टींचा फायदा होईल.

- विद्यार्थ्यांना बागेची प्रकार, गरज, फायदे बाबतची जागृती निर्माण होईल.
- बागेमध्ये वापरल्या जाणाऱ्या विविध उपयुक्त वनस्पती आणि त्यांची वैशिष्ट्ये ओळखता येतील.
- कुंडी लागवड आणि लॉन साठी माती व खते यांचे मिश्रण तयार करता येईल
- बागेचे पाणी, तणे आणि रोग नियंत्रण करता येईल.
- शोभेच्या वनस्पतींचे संवर्धन आणि त्यावर आधारित उद्योग निर्मिती करता येईल.

#### प्रात्यक्षिके

- बागेचे प्रकार अभ्यासाने आणि बागेचा नकाशा तयार करणे.
- लॉनचे प्रकार आणि लॉन तयार करण्याची पद्धत अभ्यासाने.
- रोप लागवडीसाठी खत माती आणि इतर घटक यांचे मिश्रण तयार करणे व कुंडी भरणे.
- अंतर्गत गृह सजावटीसाठी टेरायम, बॉटल गार्डन सारखे बागेचे प्रकार अभ्यासाने.
- बागेतील वनस्पतींच्या गतिमान वाढीसाठी विविध वाढ संप्रेरकांच्या परिणामाचा अभ्यास करणे.
- गुटी कलम, डोळा कलम आणि पाचर कलम यांचा अभ्यास करणे
- जैविक कुंपणासाठी वापरल्या जाणाऱ्या वनस्पतींचा अभ्यास करणे.
- बागेसाठी उपयुक्त शोभिवंत वनस्पतींचा अभ्यास करणे.
- बागेमधील सिंचन व्यवस्था आणि तण व्यवस्थापन यांचा अभ्यास करणे.
- बागेमधील वनस्पतींवर आढळणाऱ्या बुरशीजन्य रोगांचा अभ्यास करणे.
- बागेमधील वनस्पतींवर आढळणाऱ्या मावा वर्गीय किडींचा अभ्यास करणे.
- तणनाशक, कीटक नाशक, आणि संप्रेरके यांचे प्रमाणित मिश्रण तयार करणे.
- महाविद्यालयाच्या नजीकच्या नावाजलेल्या बागेला भेट देऊन अहवाल तयार करणे.

## Generic Paper: Value Education Course (VEC-I)

### Title of the Course: Democracy, Election and Constitution

Course Code: 2502USBOVE201

CREDIT: 2.

LECTURE HOURS; 2 PER WEEK;

MARKS: 50

#### Course Outcomes:

|     |                                                                                                                                                                                                                   |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | <b>Explain</b> the concept of democracy and democratic values and <b>interpret</b> the universal values enshrined in the Preamble of the Indian Constitution.                                                     |
| CO2 | <b>Describe</b> the salient features of the Indian Constitution and <b>analyze</b> the role of Fundamental Rights and Duties in promoting responsible citizenship.                                                |
| CO3 | <b>Examine</b> India's social, cultural, and religious diversity and <b>analyze</b> how tolerance, beauty, and harmony in diversity contribute to national integration.                                           |
| CO4 | <b>Explain</b> the structure and functions of the Election Commission of India and <b>analyze</b> the electoral process as a mechanism for strengthening democratic governance.                                   |
| CO5 | <b>Apply</b> constitutional and democratic values such as acceptance, appreciation, gratitude, truthfulness, and will power in personal and social life through reflective and participatory activities.          |
| CO6 | <b>Evaluate</b> the significance of unity in diversity and <b>design</b> reflective strategies for shaping a common future based on introspection, visualization, communal harmony, and shared national identity. |

#### SYLLABUS

| Module          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Lecture Hrs |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Module 1</b> | a. Introduction and course mind map<br>b. Meaning of Democracy and democratic values<br>c. Universal Values in the preamble of Indian Constitution<br>d. Our commonalities<br>e. Our constitutional values binding us together as one people<br>f. Our true identity binds us together<br>g. Our two-fold purpose<br>h. Shaping together our common future based on unity in diversity<br>i. Accept, appreciate and Gratitude<br>j. Will power<br>k. Truth and investigation of truth<br>l. Introspection and visualization | 15          |
| <b>Module 2</b> | a. Salient features of the Indian constitution<br>b. Fundamental rights of the citizens<br>c. Duties of the citizen                                                                                                                                                                                                                                                                                                                                                                                                         | 15          |

|  |                                                                                                                                                      |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | d. Diversity in India<br>e. Tolerance<br>f. Beauty and Harmony in diversity<br>g. Communal Harmony<br>h. Election commission<br>i. Electoral process |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------|--|

## References:

1. Basu, Durga Das. Introduction to the Constitution of India. 8th ed., LexisNexis Butterworths Wadhwa, Nagpur, 2015. A definitive text on salient features of the Indian Constitution and Fundamental Rights/Duties.
2. Austin, Granville. The Indian Constitution: Cornerstone of a Nation. Oxford University Press, 2019. Examines the philosophical foundations and democratic character of the Constitution.
3. Palekar, Suhas, and Smita Narula. Democracy and Governance in India: A Student Text. Orient BlackSwan, Hyderabad, 2022. Clear explanation of democratic values, processes, and institutions.
4. Keerthika, R., and S. Uma. Value Education and Human Rights. Neelkamal Publications, Hyderabad, 2021. Focuses on universal values, tolerance, and ethical development in students.
5. Rajeev, Gopal. Indian Political System and Governance. S. Chand Publishing, New Delhi, 2023. Provides comprehensive discussion on democracy, election commission, and electoral process in India.
6. Jha, Shefali, and Maheshwari, S. Modern India and the Indian Constitution. VK Global Publications, Delhi, 2020. Useful for understanding constitutional values and India's diversity.
7. Chandra, Bipan, et al. India Since Independence. Penguin Books India, 2008. Contextualizes democratic evolution and unity in diversity in a socio-historical framework.
8. Singh, M. P., and Rekha Saxena. Indian Government and Politics. 11th ed., Pearson Education India, 2017. Standard undergraduate text on democratic institutions and citizen rights/duties.
9. Nussbaum, Martha C. The Clash Within: Democracy, Religious Violence, and India's Future. Harvard University Press, 2007. A philosophical exploration of tolerance, identity, and constitutional democracy.
10. Sharma, R. K., and S. Chand. Value Education: Theory and Practice. Ramesh Publishing House, Jaipur, 2019. Covers personal values, introspection, truth, will power, and moral development in education.

### SCHEME OF EXAMINATION:

- The examination shall be conducted at the end of each term for semester pattern.
- The theory paper shall carry 30 marks.
- The evaluation of the performance of the students in theory papers shall be on the basis of Semester Examination of 30 marks.
- The internal evaluation for each paper shall carry 10 marks. (Semester I and II: Home assignment, class assignment, unit test a and midterm test)
- Question paper will be set in the view of the /in accordance with the entire syllabus and preferably covering each unit of syllabi.

**STANDARD OF PASSING:** As prescribed under rules and regulation for each degree.

### SPECIAL INSTRUCTIONS, IF ANY

#### Determination of CZPA, Grading and Declaration of result

University has adopted 10-point Grading System as follows: **In each semester, marks obtained in each course (Paper) are converted to grade points:** If the total marks of course are 100 and passing criteria is 40%, then use the following Table for the conversion.

#### Gradation Chart:

Table

| Marks Obtained | Numerical Grade (Grade Point) | CGPA      | Letter Grade     |
|----------------|-------------------------------|-----------|------------------|
| Absent         | 0 (zero)                      | -         | Ab: Absent       |
| 0–39           | 0 to 4                        | 0.0–4.99  | F: Fail          |
| 40–49          | 5                             | 5.00–5.49 | C: Average       |
| 50–54          | 6                             | 5.50–6.49 | B: Above Average |
| 55–64          | 7                             | 6.50–7.49 | B+: Good         |
| 65–74          | 8                             | 7.50–8.49 | A: Very Good     |
| 75–84          | 9                             | 8.50–9.49 | A+: Excellent    |
| 85–100         | 10                            | 9.50–10.0 | O: Outstanding   |

#### Note:

1. Marks obtained  $\geq 0.5$  shall be rounded off to next higher digit.
2. The SGPA & CGPA shall be rounded off to 2 decimal points.
3. Marks obtained in 50 marks or 200 marks paper shall be converted to 100 marks.

## **Calculation of SGPA & CGPA**

### 1. Semester Grade Point Average (**SGPA**)

$$\text{SGPA} = \frac{\sum (\text{Course credits} \times \text{Grade points obtained}) \text{ of a semester}}{\sum (\text{Course credits}) \text{ of respective semester}}$$

### 2. Cumulative Grade Point Average (**CGPA**)

$$\text{CGPA} = \frac{\sum (\text{Total credits of a semester} \times \text{SGPA of respective semester}) \text{ of all semesters}}{\sum (\text{Total course credits}) \text{ of all semesters}}$$

## **NATURE OF THEORY QUESTION PAPER AND SCHEME OF MARKING:**

Duration of question paper: As per University rule:

- |      |                                       |           |         |
|------|---------------------------------------|-----------|---------|
| i.   | Duration of Examination for           | 60 marks- | 2 Hours |
| ii.  | Duration of Examination for           | 30 marks- | 1 Hours |
| iii. | Duration of Practical Examination for | 50 marks- | 2 Hours |

### **Assessment pattern**

For 4 Credits 60:40 (SSE : CIE)

For 2 Credits 30:20 (SSE : CIE)

**ESE Question paper pattern for theory**  
**(Botany Paper-I, II, III and IV)**

**Duration: 1 Hr**

**Total Marks: 30**

Q. 1. Multiple choices questions (6-questions)

6 Marks

*(It may include Wh que., match the pairs, true/false, multiple correct options MCQ etc.)*

i)

ii)

iii)

iv)

v)

vi)

Q. 2. Attempt any two of the following

12 Marks

A. or B.

C. or D.

Q. 3. Short answer questions (any three) (out of five).

12 Marks

*(It may include short notes, label the diagram, compare between, distinguish between etc.)*

a.

b.

c.

d.

e.

**SSE Question paper pattern for Practical  
(Botany Practical I and II)**

**Duration: 2 Hr**

**Total Marks: 30**

|                      |          |
|----------------------|----------|
| Q. 1. Specimen A -   | 5 Marks  |
| Q. 2. Specimen B -   | 5 Marks  |
| Q. 3. Specimen C -   | 5 Marks  |
| Q. 4. Specimen D -   | 5 Marks  |
| Q. 5. Identification | 10 Marks |
| a.                   |          |
| b.                   |          |
| c.                   |          |
| d.                   |          |
| e.                   |          |

**Internal Evaluation**

**(20)**

|                                   |   |
|-----------------------------------|---|
| Journal                           | 5 |
| Practical Note Book               | 5 |
| Oral based on practical           | 5 |
| Tour report / Project/ Model etc. | 5 |

सेमेस्टर- १  
ओपन इलेक्टिव- भाग एक  
प्रात्यक्षिक परीक्षेचे स्वरूप  
जैविक व सेंद्रिय खतांचा परिचय (BOOEPR-101)

वेळ: ३ तास

एकूण गुण: ५०

- प्रश्न. १. दिलेली जैविक खते (अ) आणि (ब) ओळखा आणि त्यांचे गुणधर्म आणि उपयोग लिहा [१०]
- प्रश्न. २. जैविक खते तयार करण्याच्या कायमपद्धतीची मांडणी करा. [१०]
- प्रश्न. ३. कांपोस्ट तयार करण्याच्या पद्धतीचे प्रात्यक्षिक सादरीकरण करा . [१०]
- प्रश्न. ४) ओळख पटविणे [१०]
- अ. ओळख पटवून माहिती लिहा.
- ब. ओळख पटवून माहिती लिहा.
- प्रश्न. ५. अ. विभागप्रमुखांच्या सहीने प्रमाणित प्रयोगवही [०५]
- ब. जैविक खते तयार करणाऱ्या कारखानाला भेट अहवाल [०५]

सेमेस्टर- २  
ओपन इलेक्टिव- भाग दोन  
प्रात्यक्षिक परीक्षेचे स्वरूप  
बागकाम तंत्रज्ञान (BOOEPR-201)

वेळ: ३ तास

एकूण गुण: ५०

- प्रश्न. १. बागेचे प्रकार लिहा आणि बागेचा नकाशा तयार करा [१०]
- प्रश्न. २. रोप लागवडीसाठी खत, माती आणि इतर घटकांचे मिश्रण तयार करून कुंडी भरण्याचे तंत्र/ पद्धत वर्णन करा. [१०]
- प्रश्न. ३. गुटी कलम/ डोळा कलम / पाचर कलम करण्याचे तंत्र/ पद्धत वर्णन करा. [१०]
- प्रश्न. ४) ओळख आणि माहिती लिहा [१०]
- अ. जैविक कुंपणासाठी वापरल्या जाणाऱ्या वनस्पती (कोणतीही एक).
- ब. बागेमध्ये वापरल्या जाणाऱ्या शोभिवंत वनस्पती (कोणतीही एक).
- क. लॉन / टेरायम, / बॉटल गार्डन (कोणतीही एक).
- ड. बागेतील वनस्पती वरील बुरशी / मावा वर्गीय किड (कोणतीही एक).
- इ. बागेमधील सिंचन व्यवस्था / तण निर्मुलन/ वाढ सम्प्रेषके (कोणतीही एक).
- प्रश्न. ५. अ. विभागप्रमुखांच्या सहीने प्रमाणित प्रयोगवही [०५]  
ब. क्षेत्रिय बागेला भेट अहवाल [०५]

Nature of Question Paper  
Programme: B.Sc. (Part I) (Level 4.5) (Semester – I) (NEP-2020)  
**Course Title: Interdisciplinary course in Generic IKS**  
**Course Code: 2502USBOIK101**

**SSE 30 Marks**

**Question paper pattern**

Q. 1. Multiple choices questions (6-questions) 6 Marks  
(It may include Wh que., match the pairs, true/false, multiple correct options MCQ etc.)

- i)
- ii)
- iii)
- iv)
- v)
- vi)

Q. 2. Write short notes on (Any three) 12 Marks

- A.
- B.
- C.
- D.
- E.

Q. 3. Answer the following (any two) 12 Marks

- a.
- b.
- c.

**Internal Assessment**

**20 Marks**

Nature of Question Paper  
**Course Title: Democracy, Election and Constitution**  
**Course Code: 2502USBOVE201**

**SSE 50 Marks**

**Question paper pattern**

Q. 1. Multiple choices questions (25questions)

50 Marks

25 MCQ questions each with 4 options

A)                      B)                      C)                      D)