Appendix- B

 AC –

 Item No. –

As per NEP 2020

**S. R. D. S. P. Mandal’s**

**SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA,**

**SAWANTWADI**



Title of the Programme: Science

**B.Sc. (Botany)**

 A: Certificate in Botany: 2023-2024

 B: Diploma in Botany: 2024-2025

 **C: Degree in Botany: 2025-2026**

Syllabus for

**Sem-V and Sem-VI**

Reference GR dated 16th May 2023 for Credit structure

**S. R. D. S. P. Mandal’s**

**SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA,**

**SAWANTWADI**



###  (As per NEP 2020)

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Headings** | **Particulars** |
| 1 | Title of the Program | Science- Botany |
| 2  | Eligibility  | H.S.C. Science |
|  | Duration of the Programme | 1. Certificate
2. Diploma
3. Advance Diploma
4. Research Degree
 |
|  | Scheme of Examination | External : 60Internal: 40Separate passing in External and Internal examination  |
|  | Standard of Passing | 40.00% |
|  | Program Academic Level | * 1. Certificate
1. Diploma

5.5 Advance Diploma6.0 Research Degree |
|  | Pattern | Semester Pattern |
|  | Status | New  |
|  | To Be Implemented from the academic year | * 1. Certificate 2023-2024
1. Diploma 2024-2025

**5.5 Advance Diploma 2025-2026**6.0 Research Degree 2026-2027 |

**Preamble**

Shri Pancham Khemaraj Mahavidyalaya, Sawantwadi (Autonomous) is committed to the implementation of various measures that align with the guidelines established by the University Grants Commission (UGC) in order to promote excellence, efficacy, and equity in the higher education system. To attain these objectives, diligent attempts are undertaken to guarantee superior educational standards through the implementation of various measures aimed at improving the teaching-learning process, assessment and evaluation methodologies, and the comprehensive development of students.

The B.Sc. Botany program is a four-year program with a progressive and innovative curriculum that prepares students for the challenges that higher education will provide in the future. The first to last semester of B.Sc. Botany at S. P. K. Mahavidyalaya, Sawantwadi (Autonomous) has a curriculum that transcends traditional academic boundaries, developed by the Board of Studies in Botany at S. P. K. Mahavidyalaya, Sawantwadi (Autonomous) in response to the rapid advancements in science and technology and the evolving approaches in various domains of Botany and related subjects. In order to guarantee that students receive an education that equips them for the opportunities and challenges of the twenty-first century, the syllabus has been linked with the NEP 2020 principles. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report and Government of Maharashtra's General Resolution dated 20th April and 16th May 2023.

A postgraduate degree in Botany provides students with the requisite knowledge and abilities need for a wide array of rewarding professional trajectories. Postgraduates in the discipline of Botany are presented with a wide range of prospects across several domains, encompassing urban planning, pedagogy, environmental science, plant sciences, organic agriculture, nursery management, and entrepreneurship. The disciplines encompassed include mushroom cultivation, medicinal plant cultivation, floriculture, horticulture, propagation methods, and plant tissue culture method, among others. During the course of their three-year academic program, students delve into the profound importance of plants in the existence of all living organisms on our planet. Students acquire the necessary knowledge and skills to establish various agencies involved in the production of pickles, jam, jelly, medicinal plants, fruit processing, vegetable processing, organic products, organic fertilizers, and pesticides. Additionally, they gain the ability to develop knowledge in the production of natural remedies for a wide range of diseases. They acquired expertise in the identification and advancement of numerous novel medicinal compounds that are currently employed in the pharmaceutical, herbal cosmetics, and other ingredient-based sectors.

A comprehensive, up-to-date education that prepares pupils to thrive in today's fast-paced, globally interconnected world is assured by revising Botany curricula to meet the requirements of NEP 2020. As a result, students are better prepared to succeed academically and professionally in today's dynamic world and to make meaningful contributions to society as a whole.

**Aims and Objective**

* To recognize the principles behind and importance of many botanical trends.
* To conduct experiments to understand the plants and environment correlations.
* To use the knowledge and abilities gained to solve nutrition related real time problems.
* To develop and use a broad view for conservational problem-solving abilities.

**Program Outcomes**

After Completing the Programme, Students will be able to,

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| --- | --- | --- |
| PO1 | Demonstrate comprehensive knowledge and grasp of science that form a component of an undergraduate plan of study. | Disciplinary knowledge |
| PO2 | Exhibit the ability to read and write critically, listen intently, use appropriate media, confidently express oneself, communicate scientific knowledge, concepts, and ideas both orally and in writing, and explain difficult material to a variety of audiences. | Communication Skills |
| PO3 | Apply analytical thinking to a corpus of information; identify relevant presumptions or implications; study and evaluate arguments, evidence, claims, and opinions in light of empirical evidence. Develop logical arguments. Analyze theories, policies, and practices critically while using a scientific approach to information collection. | Critical thinking |
| PO4 | Extrapolate from what one has learned and apply their competencies to solve other types of non-familiar challenges, rather than duplicating curricular core knowledge; and apply one’s learning to real world scenarios. | Problem solving |
| PO5 | Evaluate the dependability and relevance of evidence; uncover logical errors and holes in the arguments of others; evaluate and synthesise data from a range of sources; draw valid results and back them with facts and examples, and addressing opposing perspectives. | Analytical reasoning |
| PO6 | Enquire, ask appropriate questions, to recognise cause and effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; Plan, execute and report the results of an experiment or investigation. | Research-related skills |
| PO7 | Work successfully and respectfully with multiple teams; create cooperative or coordinated group effort; operate as a group or team in the interests of a common cause; and work efficiently as a team member. | Cooperation/Team work |
| PO8 | Analyse, interpret and derive conclusions from Quantitative/Qualitative data; and critically assess ideas, evidence and experiences from a open-minded and reasoned perspective. | Scientific reasoning |
| PO9 | Examine and evaluate one's own sensitivity to life experiences, as well as one's own and society's reflexivity. | Reflective thinking |
| PO10 | Use ICT in a variety of learning scenarios; exhibit, access, evaluate, and apply a variety of relevant information sources; and analyze data using appropriate tools. | Information/digitalliteracy |
| PO11 | Work autonomously, identify the resources needed for a project, and see it through to completion. | Self-directed learning |
| PO12 | Maintain comprehension of other cultures' values and beliefs, as well as a global worldview. Participate in a multicultural culture and engage politely with different groups. | Multicultural competence |
| PO13 | Adopt moral and ethical values in your life, take a position on moral matters and give reasons from multiple angles, and incorporate morality into all you do.Recognize moral issues, refrain from unethical behavior such as fabricating, falsifying, or misrepresenting that plagiarism has occurred, respect intellectual property rights, and recognize environmental and sustainability issues; and act impartially, objectively, and truthfully in all aspects of work. | Moral and ethical awareness/reasoning |
| PO14 | Map out the tasks that a team or organization must complete, establish direction, develop an inspiring vision, assemble a team to help achieve the vision, encourage and inspire team members to participate in that vision, and use management techniques to lead people effectively and efficiently. | Leadership readiness/qualities |
| PO15 | Acquire knowledge and skills, including 'learning how to learn', that are required for participating in learning activities throughout life through self-paced and self-directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing trades and workplace demands through knowledge/skill development/reskilling.  | Lifelong learning |

**Program Specific Outcome:** After successful completion of this programme (Botany) learners are able to

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| PSO1 | Describe the various tasks that plants do at the gene, cell, tissue, organ, and organism levels. |
| PSO2 | Sort and contrast the characteristics of different plant groups. Identify and categorize plants up to the class level using your understanding of plant morphology, anatomy, and other fundamental concepts from observation in the wild. |
| PSO3 | When addressing botany-related problems, apply scientific procedures by formulating testable hypotheses, gathering information to support these assumptions, and assessing the information to determine the extent to which the research supports the hypotheses. |
| PSO4 | Show mastery of the analytical and experimental techniques used in a variety of domains, as well as the most recent advancements in plant science. |

Proposed Third Year Credit Structure as per NEP 2020

**Department of Botany**

**Proposed Structure for Major / Minor/OE/VSE/SEC/VEC/IKS/VEC**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Semester** | **Paper Code** | **PAPER TITLE** | **Type** | **Credits** |
| **V****(Level 5.5)** | S301BOT (Major) | PLANT DIVERSITY III | **Theory** | **2** |
| S302BOT (Major) | ANGIOSPERM & PALEOBOTANY | **Theory** | **2** |
| S303BOT (Major) | PLANT PHYSIOLOGY | **Theory** | **2** |
| S304BOT (Major) | ETHANOBOTANY AND PHARMACOGNOSY  | **Theory** | **2** |
| S305BOP (Major) | PRACTICAL I BASED ON S301BOT & S302BOT | **Practical** | **3** |
| S306BOP (Major) | PRACTICAL II BASED ON S303BOT & S304BOT | **Practical** | **3** |
| S307BOT (Minor) | PLANT DIVERSITY III | **Theory** | **2** |
| BOTE05(Major) (Elective) | BIOSTAT AND BIOINFORMATICSOR PLANT TISSU CULTURE AND ENVIRONNMENTAL BOTANY | **Theory** | **2** |
| BOPE05(Major) (Elective) | PRACTICAL BASED ON BOTE05(MAJOR) (Elective) | **Practical** | **2** |
| **BOTFP01(FP)** |  **FIELD PROJECTS** | **FP** | **2** |
| **OR** |
| **BOTCEP01(CEP)** | **COMMUNITY ENGAGEMENT PROGRAM** | **CEP** | **2** |
| **VI****(Level 5.5)** | S308BOT (Major) | PLANT DIVERSITY IV | **Theory** | **2** |
| S309BOT (Major) | ANGIOSPERM & EEMBRYOLOGY | **Theory** | **2** |
| S310BOT (Major) | PLANT BIOTECHNOLOGY | **Theory** | **2** |
| S311BOT (Major) | PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY  | **Theory** | **2** |
| S312BOP (Major) | PRACTICAL I BASED ON S308BOT & S309BOT | **Practical** | **3** |
| S313BOP (Major) | PRACTICAL II BASED ON S310BOT & S311BOT | **Practical** | **3** |
| BOTE06(Major) (Elective) | GENETICS AND INSTRUMENTATIONORANATOMY AND PALYNOLOGY | **Theory** | **2** |
| BOPE06(Major) (Elective) | PRACTICAL BASED ON BOTE06(MAJOR) (Elective) | **Practical** | **2** |
| BOTVEC03(VSC) | EXPERIMENTAL BOTANY | **Practical** | **2** |
| **BOTFP02(FP)** |  **FIELD PROJECTS: REPORT SUBMISSION** | **FP** | **2** |
|  | **OR** |
|  | **BOTCEP02(CEP)** | **COMMUNITY ENGAGEMENT PROGRAM** | **CEP** | **2** |

## **MAJOR SUBJECTS**

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| --- | --- | --- | --- | --- | --- |
| Paper No. | Semester | Paper Code | Title of Paper | No of Credits | No of LecturesIn Hours |
| I | V | S301BOT (Major) | PLANT DIVERSITY III | **2** | 30 |
| II | S302BOT (Major) | ANGIOSPERM & PALEOBOTANY | **2** | 30 |
| III | S303BOT (Major) | PLANT PHYSIOLOGY | **2** | 30 |
| IV | S304BOT (Major) | ETHANOBOTANY AND PHARMACOGNOSY  | **2** | 30 |
| V |  | S305BOP (Major) | PRACTICAL I BASED ON S301BOT & S302BOT | **3** | 90 |
| VI |  | S306BOP (Major) | PRACTICAL II BASED ON S303BOT & S304BOT | **3** | 90 |

Committee for creation of Syllabus

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Name**  | **College Name** | **Designation** | **Signature** |
| 1. | Prof. (Dr.) Dethe U. L | Head, P.G. Department of BotanyShri Pancham Khemraj Mahavidyalaya, Sawantwadi | Chairman, BOS |  |
| 2. | Dr. Aparadh V.T | Shri Pancham Khemraj Mahavidyalaya, Sawantwadi | Member |  |
| 3. | Dr. Pawar U.R. | Shri Pancham Khemraj Mahavidyalaya, Sawantwadi | Member |  |
| 4. | Mrs. Sawant S. S. | Shri Pancham Khemraj Mahavidyalaya, Sawantwadi | Member |  |
| 5 | Dr. Pawar Nilesh .V | Assistant Professor,The New College KolhapurPhone: 9860282394Email: nileshsu@gmail.com | Subject experts from outside the university are to be nominated by the Academic Council |  |
| 6 | Dr. Patil M.S. | Assistant Professor,S. G.M. College, KaradPhone: 9226824947Email: manasipatil202@gmail.com  | Subject experts from outside the university are to be nominated by the Academic Council |  |
| 7 | Dr. Kashetti Ramesh P. | Anandibai Raorane Arts, Commerce, and Science College VaibhavwadiPhone: 9730460853Email: kashettiramesh@gmail.com | Expert nominated by the VC |  |
| 8 | Dr. Naik Vinayak R. | Vardanjali Herbals, Goregaon (E), MumbaiMobile: 8928207443Email: drvinayaknaik01@gmail.com  | Representative from Industry/corporate sector/allied areas nominated by the Principal |  |
| 9 | Dr, Naikwade Pratap V. | Assistant professorAthalye Sapre Pitre College, DevrukhMobile:9595821891naikwade.pratap@gmail.com  | Experts from outside the Autonomous college whenever special courses of studies are to be formulated to be nominated by the Principal |  |
| 10 | Mr. Ghaware Pandurang Prabhakar | Botany ExecutiveShree Swami Samarth Enterprises, Thane7588451052pandurangghaware75@gmail.com | Post Graduate Meritorius Alumni |  |

Letter Grades and Grade points

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| --- | --- | --- |
| **Semester GPA/Program CGPA/Semester Program** | **Percentage of Marks** | **Alpha- sign / letter grade result** |
| 9.00-10.00 | 90.00-100 | O (Outstanding) |
| 8.00-9.00≥ | 80.0-90.0 | A+ (Excellent) |
| 7.00-8.00 | 70.0-80.0 | A(Very Gppd) |
| 6.00-7.00 | 60.0-70.0 | B+(Good) |
| 5.50-6.00 | 55.0-60.0 | B(Above Average) |
| 5.00-5.50 | 50.0-55.0 | C(Average) |
| 4.00-5.00 | 40.0-50.0 | P(Pass) |
| Below 4.00 | Below 40.0 | F(Fail) |
| AB (absent) |  | Absent |

**Course Code and Title: S301BOT (MAJOR): PLANT DIVERSITY III**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-V** |

**Learning Objectives:**

The students would be able :

* To gain knowledge about microbial diversity and techniques for culturing and visualization.
* To understand the salient features of three major groups of algae, their life cycle patterns with a suitable example; to be able to identify them.
* To learn the general characteristics and classification of two major groups of fungi along with life cycles of each group; to be able to identify them.
* To understand the scope and importance of Plant Pathology and apply the concepts of various control measures of commonly widespread plant diseases.

**Learning Outcomes:**

After Completing the course, Student will be able to

* Identify and classify Algae on basis of general characters and principles of taxonomy.
* Differentiate modes of nutrition in fungi
* Evaluate economic importance of algae.
* Justify the scope and importance of Plant Pathology and apply the concepts of various control measures of commonly widespread plant diseases.

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| **Unit - I ALGAE** (G.M. Smith Classification System to be followed) **15 Lectures** |
|  | * Division Rhodophyta: Classification and General Characters: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, Alternation of Generations, Economic Importance. Structure, life cycle and systematic position of *Polysiphonia* and *Batrachospermum*.
 |  |
| * Classification and General Characters of Xanthophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. Structure, life cycle and systematic position of *Vaucheria*.
 |
|  | * Classification and General Characters of Bacillariophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. Structure, life cycle and systematic position of *Pinnularia*.
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| **Unit – II Fungi and Plant Pathology 15 Lectures** |
|  | * Basidiomycetes: Classification and General characters. Life cycle of *Agaricus* and *Puccinia*
 |  |
| * Study of plant diseases: Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following.

 Tikka disease of ground nut: *Cercospora* Damping off disease: *Pythium* Citrus canker –*Xanthomonas axonopodis* pv. *citri* |
|  | * Study of Physical, chemical and biological control methods of plant diseases.
 |  |

**References:**

|  |  |
| --- | --- |
| 1 | College Botany Volume I and II by Gangulee, Das and Dutta. Central Education Enterprises. |
| 2 | Cryptogamic Botany Volume I and II by G M Smith, McGraw Hill. |
| 3 | Introductory Phycology by Kumar, H. D. 1988, Affiliated East-West Press Ltd., New York. |
| 4 | Cryptogamic Botany Vol. I & II (2nd Edition) by Gilbert, M. S., Tata McGraw Hill Publishing Co., Ltd New Delhi. |
| 5 | Plant pathology by G.N.Agrios. |
| 6 | Plant diseases by R.S.Singh. |
| 7 | Modern plant pathology by H.C.Dube. |
| 8 | Diseases of field crops and their management by Chaube and Pumdhir. |

**Course Code and Title: S302BOT (MAJOR): ANGIOSPERM AND PALEOBOTANY**

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| **Level: 5.5**  | **Credits: 02** | **Number of Lectures: 30** | **Semester-V** |

**Learning Objectives:**

* Knowledge of different fossil forms and understand their role in evolution.
* Provide plant description, describe the morphological and reproductive structures of seven families and also identify and classify according to Bentham and Hooker’s system.
* Proficiency in the use of keys and identification manuals for identifying any unknown plants to species level.

**Learning Outcomes:**

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

* To acquire knowledge of different fossil forms and understand their role in evolution.
* To provide plant description, describe the morphological and reproductive structures of seven families and also identify and classify according to Bentham and Hooker’s system.
* To gain proficiency in the use of keys and identification manuals for identifying any unknown plants to species level.

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| **Unit – I ANGIOSPERMS I 15 Lectures** |
|  | * Morphology of flower – All Parts of Flower.
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| * Complete classification of Bentham and Hooker (only for prescribed families), Merits and demerits.
 |
| * Bentham and Hooker’s system of classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of the families. (Special stress on fruit morphology to be given)
* Capparidaceae
* Umbelliferae (Apiaceae)
* Cucurbitaceae
* Rubiaceae
* Solanaceae
* Commelinaceae
* Graminae (Poaceae)
 |
| **Unit - II PALEOBOTANY 15 Lectures** |
|  | * *Lepidodendron*– All form genera root, stem, bark, leaf, male and female fructification.
* *Lyginopteris*– All form genera root, stem, leaf, male and female fructification.
* *Pentoxylon*– All form genera.
* Contribution of Birbal Sahni, Birbal Sahni Institute of Paleobotany, Lucknow
 |  |

**References:**

|  |  |
| --- | --- |
| 1 | Taxonomy of Angiosperms - Pandey B.P. |
| 2 | Plant Systematics - 1st Edition - Arun K. Pandey. |
| 3 | Plant Systematics Third Edition An Intergrated Approach: Gurcharan Singh |

**Course Code and Title: S303BOT (MAJOR): PLANT PHYSIOLOGY**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-V** |

**Learning Objectives:**

* Know Phytochemistry of these drugs.
* Explain the mechanisms of water uptake by roots.
* Describe the process of transpiration and its role in water transport through the plant.
* Analyze factors affecting water potential and its impact on plant physiology.
* Know Nitrogen and plant hormone metabolism
* Identify essential mineral nutrients for plant growth.
* Explain the mechanisms of mineral uptake and transport within the plant.
* Describe the symptoms of mineral deficiencies and toxicities.

**Learning Outcomes:**

The students would be able :

* Describe the mechanisms of water uptake, transport, and regulation in plants (transpiration, osmosis, water potential).
* Detail the mechanisms of nutrient uptake and transport within plants, including mineral nutrition.
* Design experiments to investigate plant physiological processes using appropriate techniques (e.g., leaf gas exchange measurements, solute potential determination)
* To gain insight into the Nitrogen and plant hormone metabolism with applications of the same in agriculture and horticulture.

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| **Unit - I PLANT PHYSIOLOGY-I 15 Lectures** |
|  | **Water relations:** Potential, osmosis, transpiration, imbibition,**Solute transport:** Transport of ions across cell membranes, activeand passive transport, carriers, channels and pumps.**Translocation of solutes:** Composition of phloem sap, girdlingexperiment.**Pressure flow model (Munch’s hypothesis):**Phloem loading andunloading, anatomy of sieve tube elements and mechanisms ofsieve tube translocation.**Mineral Nutrition:** Role of Macro and Micro nutrients, physiological functions and deficiency symptoms. Criteria for essentiality of minerals |  |
| **Unit II PLANT PHYSIOLOGY II 15 Lectures** |
|  | **Nitrogen Metabolism:** Nitrogen cycle, root nodule formation,and leghaemoglobin, nitrogenase activity, assimilation of nitrates,(NR, NiR activity), assimilation of ammonia, (amination andtransamination reactions), nitrogen assimilation and carbohydrateutilization.**Plant growth regulators:**Physiological effects and commercial applications of Auxins, Gibberillins, Cytokinins and Abscisic acid. |  |

**Reference books:**

|  |
| --- |
| * Fundamentals of Plant Physiology V.K. Jain.
 |
| * Plant Physiology S.N. Pandey.
 |
| * Plant Physiology and Biochemistry by H.S. Srivastava N. Shankar
 |
| * Modern Plant Physiology by R.K. Sinha
 |
| * Plant Physiology and Development by Lincoln Taiz Eduardo Zeiger Ian M. Mller Angus Murphy Lincoln Taiz;Eduardo Zeiger;Ian Max Moller;Angus Murphy.
 |

**Course Code and Title: S304BOT (MAJOR): ETHANOBOTANY AND PHARMACONOSY**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-V** |

**Learning Objectives:**

* Know Phytochemistry of these drugs.
* Discuss phytopharmacology of these drugs.
* Know the cultural significance of plants, including their symbolic meaning, spiritual associations, and traditional beliefs surrounding their use.

**Learning Outcomes:**

 The students would be able:

* Understanding the concept of Ethnobotany across different cultures.
* Identifying and classifying plants.
* Exploring diverse plants are utilized by different cultures, including food, medicine, clothing, shelter, tools, and ceremonial purposes.
* Understanding the cultural significance of plants, including their symbolic meaning, spiritual associations, and traditional beliefs surrounding their use.
* Analyzing the role of Ethnobotany in plant conservation efforts, including the potential for sustainable utilization of traditional knowledge.
* To learn ethnobotanical principles, applications and utilize indigenous plant knowledge for the cure of common human diseases and improvement of agriculture.

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| **Unit - I ETHNOBOTANY AND MUSHROOM INDUSTRY 15 Lectures** |
|  | **Ethnobotany**- Definition, history, sources of data and methods ofstudy.**Traditional medicines** used by tribals in Maharashtra towardsSkin ailments: *Rubia cordfolia, Sandalwood*Liver ailments: *Phyllanthus, Andrographis*Wound healing and ageing: *Centella, Typha, Terminalia, Tridax.*Fever: *Vitex negundo, Tinospora cordifolia* leaves Diabetes: *Momordica charantia, Syzygium cuminii***Mushroom industry:**Detail general account of production of mushrooms with respectto methods of Composting, spawning, casing, harvesting of mushroom. Cultivation of *Pleurotus* mushroom.General account of mushrooms: Nutritional value, picking and packaging, economic importance. |  |
| **Unit II PHARMACOGNOSY AND MEDICINAL BOTANY 15 Lectures** |
|  | Monographs of drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants- *Strychnos* seeds, *Senna* leaves, Clove buds, *Allium sativum, Acorus calamus* and *Curcuma longa* |  |

**Reference books:**

|  |
| --- |
| * ETHANOBOTANY by Shimi K. S.
 |
| * Textbook of Pharmacognosy and Phytochemistry 2nd Edition by Biren Shah and A.K. Seth
 |
| * Practical Pharmacognosy by K R Khandelwal
 |
| * Ethnobotany of India, Volume 1 to 5 by T. Pullaiah, K. V. Krishnamurthy, Bir Bahadur
 |

**Course Code and Title: S305BOP (MAJOR): PRACTICAL I BOTANY**

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| **Level: 5.5**  | **Credits: 03** | **Number of Lectures: 90** | **Semester-V** |

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| **A. EXTERNAL experiments** |
| 1-4 | **Algae** Study of stages in the life cycle of the following Algae from fresh /preserved material and permanent slides.*Polysiphonia**Batrachospermum**Vaucheria**Pinnularia* |
| 5-6 | **Fungi** Study of stages in the life cycle of the following Fungi from fresh / preserved material.*Agaricus**Puccinia* |
| 7-9 | **Plant Pathology**Study of the following plant diseases:Tikka disease in GroundnutDamping off diseaseCitrus canker |
| 10-15 | Study of one plant from each of the following Angiosperm families as perBentham and Hooker’s system of classification.CapparidaceaeUmbelliferaeCucurbitaceaeRubiaceaeSolanaceaeCommelinaceaeGraminae |
| **B. INTERNAL experiments** |
| 1-3 | **Paleobotany**Study of the following form genera with the help of permanent slides/photomicrographs.*Lepidodendron**Lyginopteris**Pentoxylon* |
| 4 | Identifying the genus and species of a plant with the help of Flora |
| 5 | Study of stages in the life cycle of *Agaricus* and *Puccinia*from permanent slides. |
| 6 | Morphology of Flower – All Parts of Flower |
| 7-12 | Morphological peculiarities and economic importance of the members ofthe above-mentioned Angiosperm families |

**Course Code and Title: S306BOP (MAJOR): PRACTICAL II BOTANY**

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| **Level: 5.5**  | **Credits: 03** | **Number of Lectures: 90** | **Semester-V** |

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| **A. EXTERNAL experiments** |
| 1 | Estimation of Phosphate phosphorus (Plant acid extract) |
| 2 | Estimation of Iron (Plant acid extract) |
| 3 | Estimation of proteins by Biuret method |
| 4-6 | Effect of temperature on the activity of amylase. Effect of pH on the activity of amylase.Effect of substrate variation on the activity of amylase |
| 7 | Determination of alpha-amino nitrogen |
| 8 | Effect of GA on seed germination |
| 9 | Estimation of reducing sugars by DNSA method |
| 10 | Study of plants mentioned in theory for Ethnobotany |
| **B. INTERNAL experiments** |
| 1 | Identification of various stages involved in mushroom cultivation – spawn,pin head stage, mature/ harvest stage of *Agaricus.* |
| 2 | Mushroom cultivation (To be demonstrated) |
| 3-8 | Macroscopic/ Microscopic characters and Chemical tests for active constituents of the following plants.*Allium sativum**Acorus calamus**Curcuma longa**Senna angustifolia**Strychnos nux-vomica**Eugenia caryophyllata* |

**Course Code and Title: S307BOT (MINOR): PLANT DIVERSITY III**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-V** |

**Learning Objectives:**

The students would be able :

* To gain knowledge about microbial diversity and techniques for culturing and visualization.
* To understand the salient features of three major groups of algae, their life cycle patterns with a suitable example; to be able to identify them.
* To learn the general characteristics and classification of two major groups of fungi along with life cycles of each group; to be able to identify them.
* To understand the scope and importance of Plant Pathology and apply the concepts of various control measures of commonly widespread plant diseases.

**Learning Outcomes:**

After Completing the course, Student will be able to

* Identify and classify Algae on basis of general characters and principles of taxonomy.
* Differentiate modes of nutrition in fungi
* Evaluate economic importance of algae.
* Justify the scope and importance of Plant Pathology and apply the concepts of various control measures of commonly widespread plant diseases.

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| **Unit - I ALGAE** (G.M. Smith Classification System to be followed) **15 Lectures** |
|  | * Division Rhodophyta: Classification and General Characters: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, Alternation of Generations, Economic Importance. Structure, life cycle and systematic position of *Polysiphonia* and *Batrachospermum*.
 |  |
| * Classification and General Characters of Xanthophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. Structure, life cycle and systematic position of *Vaucheria*.
 |
|  | * Classification and General Characters of Bacillariophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. Structure, life cycle and systematic position of *Pinnularia*.
 |  |
|  |  |  |
| **Unit – II Fungi and Plant Pathology 15 Lectures** |
|  | * Basidiomycetes: Classification and General characters. Life cycle of Agaricus and Puccinia
 |  |
| * Study of plant diseases: Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following.

 Tikka disease of ground nut: *Cercospora* Damping off disease: *Pythium* Citrus canker –*Xanthomonas axonopodis* pv. *citri* |
|  | * Study of Physical, chemical and biological control methods of plant diseases.
 |  |

**References:**

|  |  |
| --- | --- |
| 1 | College Botany Volume I and II by Gangulee, Das and Dutta. Central Education Enterprises. |
| 2 | Cryptogamic Botany Volume I and II by G M Smith, McGraw Hill. |
| 3 | Introductory Phycology by Kumar, H. D. 1988, Affiliated East-West Press Ltd., New York. |
| 4 | Cryptogamic Botany Vol. I & II (2nd Edition) by Gilbert, M. S., Tata McGraw Hill Publishing Co., Ltd New Delhi. |

**Course Code and Title: BOTE05 (MAJOR): BIOSTATS AND BIOINFORMATICS.**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-V** |

**Learning Objectives:**

The students would be able to:

* Gain knowledge about generate and test hypotheses, make observations, collect data, analyse and interpret results, derive conclusions, and evaluate their significance within a broad scientific context, using suitable statistical techniques.
* Learn the general tools of Bioinformatics for data retrieval and phylogenetic analysis.
* Understand the scope and importance of Bioinformatics.

**Learning Outcomes:**

After Completing the course, Student will be able

* To generate and test hypotheses, make observations, collect data, analyse and interpret results, derive conclusions, and evaluate their significance within a broad scientific context, using suitable statistical techniques.
* To understand and apply tools of Bioinformatics for data retrieval and phylogenetic analysis.

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| **Unit - I BIOINFORMATICS 15 Lectures** |
|  | Organization of biological data, databasesExploration of data bases, retrieval of desired data, BLAST.Protein structure analysis and applicationMultiple sequence analysis and phylogenetic analysis |  |
|  |  |  |
| **Unit – II BIOSTATISTICS (SOLVE 5 EXAMPLE OF EACH) 15 Lectures** |
|  | Test of significance student’s *t*-test – Paired and Unpaired.Regression.ANOVA (one way). |  |
|  |  |  |

**References:**

|  |  |
| --- | --- |
| 1 | BIOINFORMATICS: PRINCIPLES AND APPLICATIONS by Zhumur Ghosh and Bibekanand Mallick |
| 2 | Bioinformatics by R. Sundaralingam and V. Kumaresan |
| 3 | Textbook of Bioinformatics by Sharma V |
| 4 | Rastogi Publications BIOINFORMATICS (BC-53) by Dr. Vinay Sharma, Dr. Ashok Munjal, et al. |
| 5 | Biostatistics by P.N. Arora, P.K. Malhan |
| 6 | Biostatistics : a computing approach by Stewart Anderson. |
| 7 | Introductory biostatistics by Chap T. Le, Lynn E. Eberly. |
| 8 | Biostatistics by Alvin E. Lewis. |

**Course Code and Title: BOPE05 (MAJOR): PRACTICAL BASED ON BOTE05**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 60** | **Semester-V** |

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| **A. EXTERNAL experiments** |
| 1-3 | **Biostatistics:** *t*-test (paired)Solve 3 Examples. |
| 4-6 | **Biostatistics:** *t*-test (unpaired)Solve 3 Examples |
| 7-8 | **Biostatistics:** ANOVA (One Way)Solve 3 Examples |
| 9 | **Bioinformatics**Multiple sequence alignment |
| 10 | **Bioinformatics**Phylogenetic analysis using MEGA software |
| **B. INTERNAL experiments** |
| 1-2 | BLAST: nBLAST, pBLAST |
| 3 | RASMOL |
| 4 | SPDBV |
| 5-9 | **Biostatistics:** Problems based on regression analysisSolve 5 Examples |

**Or**

**Course Code and Title:**

**BOTE05 (MAJOR): PLANT TISSU CULTURE AND ENVIRONNMENTAL BOTANY.**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-V** |

**Learning Objectives:**

The students would be able:

* To gain knowledge about bioremediation techniques.
* To learn the general tools of micropropagation.
* To understand the scope and importance of plant tissue culture.

**Learning Outcomes:**

After Completing the course, Student will be able to

* To understand succession in plant communities and study remediation technologies in order to apply knowledge acquired for cleanup of polluted sites.
* To get exposure to principles and techniques of plant tissue culture and apply these studies for improving agriculture and horticulture and to become an entrepreneur.

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| **Unit - I PLANT TISSUE CULTURE 15 Lectures** |
|  | * Aspects of Micro-propagation.
* Plant cell suspension cultures for the production of secondary metabolites: With special reference to Shikonin production.
* Somatic Embryogenesis and Artificial Seeds.
* Protoplast Fusion and Somatic Hybridization:
1. Concept, Definition, and various methods of Protoplast Fusion.
2. Applications of Somatic Hybridization in Agriculture.
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| **Unit – II ENVIRONNMENTAL BOTANY 15 Lectures** |
|  | * Bioremediation: Principles, factors responsible and microbial population in bioremediation.
* Phytoremediation: Metals, Organic pollutants
* Plant succession: Hydrosere and Xerosere – Formation of Barren Space, Succession on the Land Citing Different Seres leading up to the Climax, Succession in Water, Ecesis, Poly and Mono-climax theories
 |  |
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**References:**

|  |  |
| --- | --- |
| 1 | A Text Book of Plant Tissue Culture by Seema Sambrani. |
| 2 | Introduction to Plant Tissue Culture by Razdan M K. |
| 3 | Plants from Test Tubes: An Introduction to Micropropagation by Lydiane Kyte, John Kleyn, and Holly Scoggins. |
| 4 | Plant Tissue Culture: Techniques and Experiments by Roberta H. Smith. |

**Course Code and Title: BOPE05 (MAJOR): PRACTICAL BASED ON BOTE05**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 60** | **Semester-V** |

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| **Experiments** |
| 1-4 | Micropropogation • Plant tissue culture technique identification –* Multiple shoot culture,
* hairy root culture,
* somatic embryogenesis

• Preparation of stock solutions for preparation of MS medium.(Note: Concept of preparation of specified molar solutions should be taught and problems based on preparation of stock solutions for tissue culture media will be given). |
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| 5-9 | **Environmental Botany** Estimation of the following in given water sample * Dissolved oxygen demand
* Biological oxygen demand
* Hardness
* Salinity
* Chlorinity
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**Course Code and Title: BOTFP01**

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| **Level: 5.5** | **Credits: 02** | **Number of Hrs. spend: 60** | **Semester-V** |

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| **Any project related to subject (field work) as IKS related projects, Ayurveda** |

**Or**

**Course Code and Title: BOTCEP01**

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| **Level: 5.5** | **Credits: 02** | **Number of Hrs. spend: 60** | **Semester-V** |

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| **Any project related to subject (Social awareness work) as Integrated pest Management** |

 ==========================SEM-V END=================================

## **MAJOR SUBJECTS**

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| --- | --- | --- | --- | --- | --- |
| Paper No. | Semester | Paper Code | Title of Paper | No of Credits | No of LecturesIn Hours |
| I | VI | S308BOT (Major) | PLANT DIVERSITY IV | **2** | 30 |
| II | S309BOT (Major) | ANGIOSPERM & EEMBRYOLOGY | **2** | 30 |
| III | S310BOT (Major) | PLANT BIOTECHNOLOGY | **2** | 30 |
| IV | S311BOT (Major) | PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY  | **2** | 30 |
| V |  | S312BOP (Major) | PRACTICAL I BASED ON S308BOT & S309BOT | **3** | 90 |
| VI |  | S313BOP (Major) | PRACTICAL II BASED ON S310BOT & S311BOT | **3** | 90 |

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| **SEM -VI** |
| S308BOT (Major) | PLANT DIVERSITY IV | **Theory** | **2** |
| S309BOT (Major) | ANGIOSPERM & EEMBRYOLOGY | **Theory** | **2** |
| S310BOT (Major) | PLANT BIOTECHNOLOGY | **Theory** | **2** |
| S311BOT (Major) | PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY  | **Theory** | **2** |
| S312BOP (Major) | PRACTICAL I BASED ON S308BOT & S309BOT | **Practical** | **3** |
| S313BOP (Major) | PRACTICAL II BASED ON S310BOT & S311BOT | **Practical** | **3** |
| BOTE06(Major) (Elective) | GENETICS AND INSTRUMENTATIONORANATOMY AND PALYNOLOGY | **Theory** | **2** |
| BOPE06(Major) (Elective) | PRACTICAL BASED ON BOTE06(MAJOR) (Elective) | **Practical** | **2** |
| BOTVSC03(VSC) | EXPERIMENTAL BOTANY III | **Practical** | **2** |
| **BOTFP02(FP)** |  **FIELD PROJECTS: REPORT SUBMISSION** | **FP** | **2** |
| **OR** |
| **BOTCEP02(CEP)** | **COMMUNITY ENGAGEMENT PROGRAM** | **CEP** | **2** |

**Course Code and Title: S308BOT (MAJOR): PLANT DIVERSITY IV**

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| **Level: 5.5**  | **Credits: 02** | **Number of Lectures: 30** | **Semester-VI** |

**Learning Objectives:**

* To know the basics of vascular cryptogramic plants.
* To understand the plant diversity with special reference to phanerogams diversity.
* To give knowledge of identification of gymnosperms.

**Learning Outcomes:**

After Completing the course, Student will be able to

* Identify and classify bryophyta and gymnosperms on basis of general characters and principles of taxonomy
* Understand basic terminology regarding plant diseases and their control measures.
* Understand basic importance of gymnosperms.

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| **Unit - I Bryophyta (G. M. Smith Classification system to be followed) 15 Lectures**  |
|  | Life cycle of *Marchantia*Life cycle of *Pelia*Life cycle of *Sphagnum** Economic importance of Bryophytes.

Bryophytes as Indicators.Evolution of Sporophyte and Gametophyte in Bryophytes. |  |
| **Unit- II Gymnosperms (Chamberlain’s Classification System to be followed) 15 Lectures** |
|  | Life cycle of *Thuja*,Life cycle of *Gnetum*Life cycle of *Ephedra.*Economic importance of Gymnosperms |  |

**References:**

|  |  |
| --- | --- |
| 1 | College Botany Volume I and II by Gangulee, Das and Dutta. Central Education Enterprises. |
| 2 | Eames, A. J. 1936. Morphology of vascular plants. Lower groups. New York London: MacGraw-Hill. |
| 3 | Cryptogamic Botany Volume I and II by G M Smith, McGraw Hill. |
| 4 | Cryptogamic Botany Vol. I & II (2nd Edition) by Gilbert, M. S., Tata McGraw Hill Publishing Co., Ltd New Delhi. |
| 5 | "Pteridophytes, Gymnosperms and Palaeobotany" by V Kumaresan and Annie Ragland |
| 6 | "Diversity of Pteridophytes, Gymnosperms and Elementary Palaeobotany" by SATISH KUMAR |

**Course Code and Title: S309 BOT (MAJOR): ANGIOSPERM AND EMBRYOLOGY**

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| --- | --- | --- | --- |
| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-VI** |

**Learning Objectives:**

* Provide plant description, describe the morphological and reproductive structures of some families and also identify and classify according to Bentham and Hooker’s system.
* Botanical gardens.
* Explain the megasporogenesis process within the ovule, leading to the development of the female gametophyte.
* Discuss different types of endosperm based on its cellular structure and function.

 **Learning Outcomes:**

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

* Provide plant description, describe the morphological and reproductive structures of some families and Botanical gardens.
* Explain the megasporogenesis process of development of embryo sac.
* Differentiate between the development of monocot and dicot embryos.
* Describe the process of endosperm formation after fertilization, including its role in providing nutrition to the developing embryo.

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| **Unit - I Angiosperms II 15 Lectures** |
|  | **Major Botanic gardens of India**– Indian Botanic Garden,Howrah; National Botanic Garden (NBRI) Lucknow; LloydBotanic Garden, Darjeeling; Lalbaugh Botanic Garden, Bangaluru.Botanical survey of IndiaBentham and Hooker’s system of classification for floweringplants up to family with respect to the following prescribedfamilies and economic importance, medicinal importance and fruitmorphology for members of the familiesRhamnaceaeCombretaceaeAsclepiadaceaeLabiataeEuphorbiaceaeCannaceaeHutchinson’s classification system of Angiosperms BriefIntroduction, Merits and Demerits of Hutchinson’s ClassificationSystem |  |
| **Unit II : Embryology** |  **10 Lectures** |
|  | **Microsporogenesis****Megasporogenesis**- Development of monosporic type, examplesof all embryo sacsTypes of ovulesDouble fertilizationDevelopment of embryo–*Capsella* |  |

**References:**

|  |  |
| --- | --- |
| 1 | Flowering Plant Embryology by Nels R Lersten. |
| 2 | Taxonomy of Angiosperms - Pandey B.P. |
| 3 | Plant Systematics - 1st Edition - Arun K. Pandey. |
| 4 | Plant Systematics Third Edition An Intergrated Approach: Gurcharan Singh |
| 5 | Embryology of Flowering Plants: Terminology and Concepts, Vol. 2: The Seed 1st Edition Edited By T B Batygina |
| 6 | The Embryology of Angiosperms, 6th Edition by Bhojwani S.S, Bhatnagar S.P. & Dantu P.K. |

**Course Code and Title: S310 BOT (MAJOR): PLANT BIOTECHNOLOGY**

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| **Level: 5.0**  | **Credits: 02** | **Number of Lectures: 30** | **Semester-IV** |

**Learning Objectives:**

* Knowledge about recent molecular biology techniques
* Identify techniques for isolation and characterization of genes.
* Knowledge about DNA analysis and amplification.
* To give knowledge DNA Barcoding techniques and applications

**Learning Outcomes:**

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

* To gain knowledge about the latest molecular biology techniques for isolation and characterization of genes.
* To gain insight into recent molecular biology techniques for DNA analysis and amplification and Barcoding techniques and applications therein.

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| **UNIT I PLANT BIOTECHNOLOGY I 15 Lectures** |
|  | Construction of genomic DNA libraries, and c- DNA libraries.Identification of specific cloned sequences in c-DNA libraries and Genomic libraries.**Analysis of genes and gene transcripts –**Restriction enzyme, analysis of cloned DNA sequences. Hybridization (SouthernHybridization). |  |
| **Unit II PLANT BIOTECHNOLOGY II** |  **15 Lectures** |
|  | **DNA sequence analysis**– Maxam – Gilbert Method and Sanger’smethod, Pyro Sequencing.Polymerase Chain Reaction (PCR).**DNA barcoding:** Basic features, nuclear genome sequence,chloroplast genome sequence, *rbc*L gene sequence, *mat* K genesequence, present status of barcoding in plants. |  |

**References:**

|  |  |
| --- | --- |
| 1 | "Plant Biotechnology and Genetics: Principles, Techniques, and Applications" by C. Neal Stewart Jr. |
| 2 | Plant Biotechnology: The Genetic Manipulation of Plants by Adrian Slater, Nigel W. Scott, and Mark R. Fowler. |
| 2 | Textbook of Microbiology by Tortora |
| 3 | Lehninger Principles of Biochemistry by Albert L Lehninger |
| 4 | [Molecular Biology of the Cell (Hardcover](https://www.goodreads.com/book/show/13400.Molecular_Biology_of_the_Cell)) by Bruce Albert |

**Course Code and Title: S311 BOT (MAJOR): PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY**

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| **Level: 5.0**  | **Credits: 02** | **Number of Lectures: 30** | **Semester-IV** |

**Learning Objectives:**

* Knowledge about recent molecular biology techniques
* Identify techniques for isolation and characterization of genes.
* Understanding fundamental concepts of a plant cell, including chloroplasts, cell walls, and vacuoles, and their roles in various biochemical processes.
* Plant hormone signaling: auxin, cytokinin, gibberellin, ethylene, abscisic acid and their roles in regulating growth, development, and stress responses.
* Applying knowledge of plant biochemistry and molecular biology to develop strategies for enhancing crop yield, nutritional value, and stress tolerance.

**Learning Outcomes:**

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

* To gain knowledge about the latest molecular biology techniques for isolation and characterization of genes.
* To gain applied knowledge of plant biochemistry and molecular biology to develop strategies for enhancing crop yield, nutritional value, and stress tolerance.
* To gain knowledge about plant hormone and their roles in regulating growth, development, and stress responses.

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| **UNIT I PLANT BIOCHEMISTRY 15 Lectures** |
|  | **Structure of biomolecules:** Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids)**Enzymes:** Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis-Menten equation, competitive, non-competitive and un-competitive inhibitors. |  |
| **Unit II MOLECULAR BIOLOGY** |  **15 Lectures** |
|  | Structure and function of nucleusStructure and function of vacuoleStructure and function of giant chromosomesThe genetic code: Characteristics of the genetic codeTranslation in Prokaryotes and Eukaryotes. |  |

**References:**

1. Practical Biochemistry by J. Jayraman.
2. Practical biochemistry principles and techniques by Wilson and Walker.
3. Outline of Biochemistry By Cohn and Stump.
4. Analytical Biochemistry by Holme
5. Biochemistry by Lubert Stryer
6. Biochemistry by Zubay

**Course Code and Title: S312BOP (MAJOR): PRACTICAL BOTANY I**

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| **Level: 5.5**  | **Credits: 03** | **Number of Lectures: 90** | **Semester-VI** |

**Instructions:**

* All the observations and readings after calculation should be written with proper units in conclusion.
* After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and Produce the certified journal at the time of practical examination.
* While evaluating practical, weightage should be given to sketch diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
* Skill of doing the experiments and understanding botanical concepts should be more important.

For practical examinations, the learner will be examined in two experiments (one from each group).

* Each experiment will be of three lecture hours' duration.
* A Minimum 4 from each group and in all minimum 8 experiments must be reported in journal.
* All the skill experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments. A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Botany having a certificate that the learner has completed the practical course of Botany Semester VI as per the minimum requirements.

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| **A. EXTERNAL experiments** |
| 1-3 | **Bryophyta (G.M. Smith Classification System to be followed)**Study of stages in the life cycle of the following Bryophyta from fresh / preserved material.*Marchantia**Pelia**Sphagnum* |
| 4 | Types of Sporophytes in Bryophyta (from Permanent slides) |
| 5-7 | **Gymnosperms (Chamberlain’s Classification System to be followed)**Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides*Thuja**Gnetum**Ephedra* |
| 8 | Economic importance of Gymnosperms |
| 9-14 | Study of one plant from each of the following Angiosperm families asper Bentham and Hooker’s system of classification.RhamnaceaeCombretaceaeAsclepiadaceaeLabiataeEuphorbiaceaeCannaceae |
| 15 | Identify the genus and species with the help of flora. |
| 16 | *In vivo* growth of pollen tube in *Portulaca /Vinca* |
| 17 | Mounting of Monocot (Maize) and Dicot (Castor and Gram) embryo. |
| **B. INTERNAL experiments** |
| 1-3 | Study of Bryophytes from permanent slides*Marchantia**Pelia**Sphagnum* |
| 4 | Economic importance of Bryophyta |
| 5-7 | Study of Gymnosperms from permanent slides*Thuja**Gnetum**Ephedra* |
| 8 | Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families. |
| 9 | Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides / Photomicrographs. |
| 10 | Field Visit: Botanical outing. |

**Note**: Certified Journal is a must, to be eligible to appear for the semester end practical examination.

**Course Code and Title: S313BOP (MAJOR): PRACTICAL BOTANY II**

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| **Level: 5.5**  | **Credits: 03** | **Number of Lectures: 90** | **Semester-VI** |

For practical examinations, the learner will be examined in two experiments (one from each group).

* Each experiment will be of three lecture hours' duration.
* A Minimum 4 from each group and in all minimum 8 experiments must be reported in journal.
* All the skill experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments. A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Botany having a certificate that the learner has completed the practical course of Botany Semester VI as per the minimum requirements.

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| **A. EXTERNAL experiments** |
| 1-4 | **Biotechnology**  |
|  | Growth curve of E. coli |
|  | Plasmid DNA isolation and Separation of DNA using AGE |
|  | Restriction mapping (problems), Southern blotting |
|  | DNA barcoding of plant material by using suitable data |
| 5-8 | **Plant Biochemistry** |
|  | Estimation of proteins by Biuret method |
|  | Effect of temperature on the activity of amylase |
|  | Effect of pH on the activity of amylase |
|  | Effect of substrate variation on the activity of amylase |
| 9 | Smear preparation from *Tradescantia* buds |
|  |  |
| **B. INTERNAL experiments** |
| 1 | DNA sequencing by Sanger’s Method and Pyro Sequencing Method |
| 2 | Predicting the sequence of amino acids in the polypeptide chain that willbe formed following translation(Eukaryotic) |
| 3 | Meiosis |
| 4  | Biochemical Tests:-Carbohydrate, Protein, Alkaloid, Tannins, Glycosides. |
|  |  |

**Note**: Certified Journal is a must, to be eligible to appear for the semester end practical examination.

**Course Code and Title: BOTE06 (MAJOR): GENETICS AND INSTRUMENTATION**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-VI** |

**Learning Objectives:**

The students would be able :

* To gain knowledge about genes locus, genes control, genetic diseases.
* Understand genetic event based on a lineage.
* Understand the mode of inheritance based on a pedigree.

 **Learning Outcomes:**

After Completing the course, Student will be able to

* Understand how genes are located in chromosomes.
* Understand how genes control the production of proteins.
* Understand how to categorize diagnosis procedures for genetic diseases.
* Understand how to calculate the likelihood of a genetic event based on a lineage.
* Understand how to determine the mode of inheritance based on a pedigree.

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| **Unit - I GENETICS 15 Lectures** |
|  | **Genetic mapping in eukaryotes:** discovery of genetic linkage, gene recombination, construction of genetic maps, three- point crosses and mapping chromosomes, problems based on the same**Gene mutations:** definition, types of mutations, causes of mutations, induced mutations, the Ame’s test**Metabolic disorders**– enzymatic and non-enzymatic: Gene control of enzyme structure Garrod’s hypothesis of inborn errors of metabolism, Phenyl ketone urea. |  |
|  |  |  |
| **Unit – II INSTRUMENTATION 15 Lectures** |
|  | **Instrumentation****Colorimetry and Spectrophotometry** (Visible, UV and IR) – Instrumentation, principle, working and applications.**Chromatography:** General account of Column chromatography. Principle and bedding material involved in adsorption and partition chromatography, ion exchange chromatography, molecular sievechromatography. |  |
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**References:**

|  |  |
| --- | --- |
| 1 | Genetics and Molecular Biology - Robert Schleif |
| 2 | Practical biochemistry principles and techniques by Wilson and Walker. |
| 3 | Concepts of Genetics by William S. Klug, Michael R. Cummings, & Charlotte A. Spencer |

**Course Code and Title: BOPE05 (MAJOR): PRACTICAL BASED ON BOTOE05**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-VI** |

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| **Experiments** |
| 1-5 | **Genetics** |
|  | Problems based on three-point crosses, construction of chromosome Maps (ANY 5 examples) |
| 6 | Study of mitosis using pre-treated root tips of *Allium* |
| 7 | Identification of types of mutations from given DNA sequences |
| 8 | Demonstration of Beer Lambert’s Law |
| 9 | Experiment based on ion exchange chromatography for demonstration |
| 10 | Experiment based on separation of dyes/ plant pigments using silica gelcolumn. |

OR

**Course Code and Title: BOTE07 (MAJOR): ANATOMY AND PALYNOLOGY**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-VI** |

**Learning Objectives:**

The students would be able :

* To gain knowledge about distinguish between different types of plant cells (parenchyma, collenchyma, sclerenchyma) and their functions.
* Classify various plant tissues (epidermal, ground, vascular) and explain their arrangement within a plant body.
* Describe the structure and function of meristematic tissues (apical, lateral, intercalary).
* Identify and classify pollen grains based on their size, shape, aperture type, and surface ornamentation.
* Utilize microscopy techniques to study pollen morphology and prepare pollen slides.
* Evaluate pollen viability using different staining methods and Understand the process of pollen germination in vitro.

**Learning Outcomes:**

After Completing the course, Student will be able to

* Distinguish between different types of plant cells (parenchyma, collenchyma, sclerenchyma) and their functions.
* Classify various plant tissues (epidermal, ground, vascular) and explain their arrangement within a plant body.
* Describe the structure and function of meristematic tissues (apical, lateral, intercalary).
* Identify and classify pollen grains based on their size, shape, aperture type, and surface ornamentation.

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| **Unit - I ANATOMY 15 Lectures** |
|  | **Anomalous secondary growth** in the Stems of *Bignonia*,*Salvadora*, *Achyranthes*, *Dracaena*. Storage roots of Beet, Radish**Root stem transition****Types of Stomata**– Anomocytic, Anisocytic, Diacytic, Paracytic,and Graminaceous |  |
|  |  |  |
| **Unit – II PALYNOLOGY 15 Lectures** |
|  | **Pollen Morphology****Pollen viability**–storageGermination and growth of pollenApplication of Palynology in honey industry, coal and oilexploration, Aerobiology and pollen allergies, forensic science |  |
|  |  |  |

**References:**

|  |  |
| --- | --- |
| 1 | A Text Book of Botany-Angiosperms (Taxonomy, Anatomy, Embryology including tissue culture) by Dr. B.P. Pandey |
| 2 | A Textbook of Plant Anatomy and Embryology by Akhil Baruah |
| 3 | Plant Anatomy by B.P. Pandey |
| 4 | Plant Anatomy and Microtechnique by Dr. Annie Ragland |
| 5 | Plant Anatomy by Pijush Roy |
| 6 | Plant Anatomy and Embryology by Ranjit Nath Bhattacharya |

**Course Code and Title: BOPE05 (MAJOR): PRACTICAL BASED ON BOTE05**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 30** | **Semester-VI** |

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| **Experiments** |
| 1-4 | **Anatomy** Study of anomalous secondary growth in the stems of the following plantsusing double staining technique.*1) Bignonia**2) Salvadora**3) Achyranthes**4) Dracaena* |
| 5-6 | Study of anomalous secondary growth in the roots of1) Beet2) Radish |
| 7 | Types of Stomata1) Anomocytic2) Anisocytic3) Diacytic4) Paracytic5) Graminaceous |
| 8 | **Palynology** Study of pollen morphology (NPC Analysis) of the following byChitale’s Method*Hibiscus**Datura**Ocimum**Crinum**Pancratium**Canna* |
| 9 | Determination of pollen viability |
| 10 | Pollen analysis from honey sample – unifloral and multifloral honey |
| 11 | Effect of varying concentration of sucrose on *In vitro* Pollen germination. |

**-Course Code and Title: BOTVSC03 (MAJOR): EXPERIMENTAL BOTANY-III**

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| **Level: 5.5** | **Credits: 02** | **Number of Lectures: 60** | **Semester-VI** |

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| **Experiments** |
| 1 | Economic importance of Bryophyta  |
| 2 | Economic importance of Pteridophyta |
| 3 | Types of Sori and Soral Arrangement in Pteridophytes |
| 4-8 | Study of Ecological Anatomy of Hydrophytes: Hydrilla stem, Nymphaea petiole, Eichhornia offset Epiphytes: Orchid Sciophytes: Peperomia leaf Xerophytes: Nerium leaf, Opuntia phylloclade Halophytes: Avicennia leaf and pneumatophore, Sesuvium / Sueda leaf Mesophytes: Vinca leaf |
| 9-11 | Economic Botany * Demonstration: Extraction of essential oil using Clevenger
* Thin layer chromatography of essential oil of Patchouli and Citronella
* Saponification value of Palm oil
 |
| 12-15 | Post-Harvest Technology * Preparation of Squash .
* Preparation of Jam.
* Preparation of Jelly.
* Preparation of Pickle.
 |
| 16 | Field Visit: Post Harvest Technology |

**Course Code and Title: BOTFP02**

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| **Level: 5.5** | **Credits: 02** | **Number of Hrs. spend: 60** | **Semester-VI** |

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| **Any project related to subject (field work): Report Submission** |

**Or**

**Course Code and Title: BOTCEP02**

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| **Level: 5.5** | **Credits: 02** | **Number of Hrs. spend: 60** | **Semester-VI** |

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| **Any project related to subject (Social awareness work) : Report Submission** |

## **EXAMINATION PATTERN FOR SUBJECTS**

1. **Continuous Internal Assessment (20 Marks):**

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| --- | --- | --- |
| **Sr. No.** | **Particulars** | **Marks** |
| 1 | One offline class test. | 10 |
| 2 | One assignment  | 5 |
| 3 | Attendance in routine class/practical’s. | 02 |
| 4 | Overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities. | 03 |

## Semester End Examination (30 Marks):

Question Paper Pattern

* 1. These examinations shall be of **One Hours** duration. Maximum marks **30**.
	2. There shall be three questions of which first question is MCQ type on all units of **10 marks**. Question 2 will be of 10 marks. Questions 2 will be based on **Unit- I,** Questions 3 will be based on **Unit-I I**.
	3. All questions shall be compulsory with internal choice within the questions.

## **Distribution of external 30 Marks**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Qn.** | **Sub-Qn** | **Particulars** | **Unit** | **Marks with options** | **Total Marks for qn** |
| **1** | **MCQ** | Multiple choice questions(Attempt **all**) | **I&II** |  10 | 10 |
| **2** | **a,b**  | Answer the following(Attempt **any ONE out of TWO**) | **I** | 20 | 10 |
| **3** | **a,b** | Answer the following(Attempt **any ONE out of TWO**) | **II** | 20 | 10 |
|  |  | **Total** |  | **50** | **30** |

1. **Semester End Practical Examination (50 marks):**

## **Scheme of examination:**

* There will be internal assessment for practical (20 marks).
* A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a **certified journal** at the time of practical examination of the semester or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of that semester of T.Y.B.Sc. Botany as per the minimum requirement.
* The practical examination will be conducted in **SINGLE SESSIONS** of two hours.
* The learners will be evaluated based on the experiments performed during the examination.
* The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for the skill and understanding of Botany.

# Distribution of marks in practical examination

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Particulars** | **Marks (50marks)** |
| 1 | Experiments external | 30 |
| 2 | Experiments internal | 20 |
|  | **Total Marks** | **50** |

## **EXAMINATION PATTERN FOR ELECTIVE SUBJECTS**

## Scheme of examination:

* There will be internal assessment for ELECTIVE.
* A candidate will submit one assignments and one unit test carrying 10 Marks each.
* The learners will be evaluated based on the semester end theory examination.

# Distribution of marks (50 marks)

1. **Continuous Internal Assessment (20 Marks):**

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Particulars** | **Marks** |
| 1 | One assignment  | 10 |
| 2 | One test | 10 |

## Semester End Examination (30 Marks):

Question Paper Pattern

* 1. These examinations shall be of **One Hours** duration. Maximum marks **30**.
	2. There shall be three questions of which first question is MCQ type on all units of **10 marks**. Question 2 will be of 10 marks. Questions 2 will be based on **Unit- I,** Questions 3 will be based on **Unit-I I**.
	3. All questions shall be compulsory with internal choice within the questions.

## **Distribution of external 30 Marks**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Qn.** | **Sub-Qn** | **Particulars** | **Unit** | **Marks with options** | **Total Marks for qn** |
| **1** | **MCQ** | Multiple choice questions(Attempt **all**) | **I&II** |  10 | 10 |
| **2** | **a,b**  | Answer the following(Attempt **any ONE out of TWO**) | **I** | 20 | 10 |
| **3** | **a,b** | Answer the following(Attempt **any ONE out of TWO**) | **II** | 20 | 10 |
|  |  | **Total** |  | **50** | **30** |