

**RAJ RISHI BHARTRIHARI MATSYA UNIVERSITY,**  
**ALWAR**

**SYLLABUS**

**(THREE /FOUR YEAR UNDER GRADUATE PROGRAMME IN SCIENCE)**

**I & II SEMESTER**

**EXAMINATION – 2023-24**



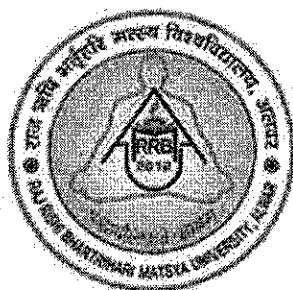
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**Syllabus for B.Sc. Botany**  
**Three/Four years Undergraduate Programme**

(From the Academic Year 2023-24 onwards)

(Syllabus as per NEP-2020 and Choice Based Credit System)

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# R.R.B.M. UNIVERSITY

## ALWAR

### **Vision:**

To create potential and competent professionals in Botany through the courses with practical training and advanced technical skill equipped with knowledge and aptitude for higher education and research.

### **Mission:**

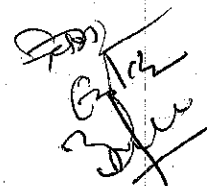
- Dissemination of global demand- based knowledge through teaching with technical professionalism.
- Creation of individuals with social and environmental concern.
- Training the students to create economically and environmentally viable solutions in the field of plant science.

### **Programme Outcomes**

- PO1. Developing the potential for vertical career growth in plant sciences, academic and service sectors and related fields.
- PO2. Development of in-depth analytical and critical thinking, so that students would be able to identify and solve the problems with the help of botany.
- PO3. Proficient knowledge in the major domains of plant sciences including plant identification, plant diseases, microbiology, Plant biotechnology etc.
- PO4. Students can successfully learn tools and techniques related to plant research.
- PO5. After completion of course students would be able to execute their professional roles in society as botanist, plant taxonomist, plant pathologist, etc.
- PO6. Students will be able to learn skills to work as a team with the people from multidisciplinary environment.
- PO7. To design and develop sustainable solutions to major biological problems by applying appropriate tools.
- PO8. Develop skills, attitude and values required for self-directed, lifelong learning and professional development.
- PO9. Acquire knowledge and understanding of norms and ethics in the field of botany.

**B.Sc. BOTANY**  
COURSE STRUCTURE UNDER C.B.C.S. AND NEP-2020

Year	Sem	Course Code	Course Title	Credit		Mark s
				<b>T</b>	<b>P</b>	
<b>1<sup>st</sup></b>			Hindi			
			English			
	<b>I</b>	<b>BOT-UG-</b>	Diversity of Plant Kingdom	4	2	
	<b>II</b>	<b>BOT-UG-</b>	Cell Biology, Molecular Biology and Genetics	4	2	
<b>2<sup>nd</sup></b>	<b>III</b>	<b>BOT-UG-</b>	Microbiology and Plant Pathology	4	2	
	<b>VI</b>	<b>BOT-UG-</b>	Plant Taxonomy and Economic Botany	4	2	
<b>3<sup>rd</sup></b>	<b>V</b>	<b>BOT-UG-</b>	Plant Biochemistry and Physiology	4	2	
	<b>VI</b>	<b>BOT-UG-</b>	Angiosperms Anatomy and Embryology	4	2	
<b>4<sup>th</sup></b>	<b>VII</b>	<b>BOT-UG-</b>	Ecology and Conservation Biology	4	2	
	<b>VIII</b>	<b>BOT-UG-</b>	Plant Biotechnology	4	2	
		<b>Discipline specific Elective</b>	Plant Tissue Culture	2	2	
			Plant Disease Management	2	2	
			Plant Stress Biology	2	2	
			Phytopharmacology	2	2	
			Genetic Engineering	2	2	
			Molecular Genetics	2	2	
		<b>Multidisciplinary Elective course</b>	Plant Propagation Techniques	2	2	
			Herbal Medicine and Human Health	2	2	
			<b>Plant Diseases</b>	2	2	
			Management of Crop Diseases	2	2	
			<b>Plant Biodiversity and conservation</b>	2	2	
			<b>Ethnobotany</b>	2	2	
			<b>Phytochemistry</b>	2	2	
			<b>Paleobotany</b>			

  
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## **BOT-UG- Diversity of Plant Kingdom**

### **Objectives**

- To understand microscopic to macroscopic view of the plants.
- To differentiate algal members from different class of the kingdom Algae
- To understand structure and reproduction in bryophytes.
- To understand difference between Hepaticopsida, Anthocerotopsida and Bryopsida.
- To interpret structure, reproduction, life cycle and economic importance of Lichens.

### **Course Outcome:**

On completion of the course, the student would be able to develop the following:

<b>BOTANY -</b>	
<b>Cognitive level</b>	<b>Course outcome</b>
1. Understanding	<ul style="list-style-type: none"><li>➤ To aware students, diversity of plants present in various habitats.</li><li>➤ To understand microscopic to macroscopic view of the plants.</li><li>➤ To interpret amphibious to symbiotic relationship of the plants.</li></ul>
2. Memorizing	<ul style="list-style-type: none"><li>➤ Diagrammatic representation of the algae, bryophytes and lichens.</li><li>➤ Habit, habitat, thallus organization of various members.</li><li>➤ Typical type of Life cycles found in algae and bryophytes.</li></ul>
3. Applying	<ul style="list-style-type: none"><li>➤ Economic importance of algae, bryophytes and lichens.</li><li>➤ Microscopic identification of algae, bryophytes and lichens.</li></ul>

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## B.Sc. BOTANY (SEM-I)

### **Diversity of Plant Kingdom**

#### **UNIT I**

**Algae:** General characters, Classifications (Fritsch) upto classes. Diverse Habitat. Range of thallus structure. Reproduction (Vegetative, Asexual, Sexual). Types of the life cycle. Type studies of: Cyanophyceae - *Nostoc*, Oscillatoria, Chlorophyceae- *Chara*; Rhodophyceae-*Polysiphonia*.

**Fungi:** General characteristics; Thallus organization; types of fruiting bodies, Cell wall composition; Heterokaryosis and parasexuality; Nutrition; Classification (*Alexopoulos*); reproduction, economic importance. Type studies: Oomycetes: *Albugo*, Zygomycota: *Rhizopus*, Basidiomycota: *Agaricus*.

**Lichens-** General characters, habitat, morphology and reproduction.

**15 hrs**

#### **UNIT II**

**Bryophytes:** General characters, Origin, and evolution of Bryophyta. Classification (Rothmaler), Habitat, Range of thallus structure, Reproduction (Vegetative and Sexual), Alternation of generations and Economic importance. Study of Morphology, Anatomy, Reproduction, Gametophytes and sporophytes of *Marchantia*, *Anthoceros*, and *Funaria*.

**15 hrs**

#### **UNIT III**

**Pteridophytes:** General characters of Pteridophytes, affinities with Bryophytes & Gymnosperms, classification, economic importance, study of life histories of fossil Pteridophytes – Rhynia. Type studies Life histories of *Selaginella*- (Heterospory and seed habit) *Marsilea*. Stele System in Pteridophytes

**15 hrs**

#### **UNIT IV**

**Gymnosperms:** General characters, classification, Gymnosperms: Type studies Life histories of *Cycas* and *Ephedra* Economic importance of gymnosperms.

**Angiosperms:** General characters, Differences between Monocotyledons and Dicotyledons, Typical life cycle of Angiosperm.

**15 hrs**

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### Suggested Laboratory Exercises:

- Visit Local Garden /field study of plants
- Study of anatomy by making suitable temporary slides and study of permanent slides of *Chara, Vaucheria, Ectocarpus, Polysiphnia* (vegetative and reproductive).
- Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
- *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.; *Agaricus*: *Peziza*, Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*.
- **Bryophytes**- morphology of vegetative and reproductive stages of *Marchantia*, *Anthoceros* and *Funaria*.
- **Pteridophytes**- study of vegetative and reproductive stages of *Selaginella*- (Heterospory and seed habit), *Equisetum*, *Marsilea*
- Study of Vegetative and reproductive stages of *Cycas*, *Pinus* and *Ephedra* using temporary and permanent slides.
- Study of monocot and dicot flowers and seeds.

### Suggested Readings:

- Alexopoulos, C.J. and Mims, C.W.: Introductory Mycology, John Wiley and Sons, New York, 2000
- Dube, H.C. :Fungi, Rastogi Publication, Meerut, 1989.
- Vashihsta, B.R. Botany for Degree Students -Fungi, S. Chand & Co., New Delhi, 2001.
- Gilbert, M.Smith: Cryptogamic Botany, Vol. I & II (2nd Ed.) Tata McGraw Hill. Publishing Co., Ltd., New Delhi, 1985.
- Kumar, H.D.: Introductory Phycology, Affiliated East—West Press, Ltd. New York, 1988.
- Puri. P.: Bryophytes, Atmaram& Sons. Delhi, Lucknow, 1985.
- Aneja, K.R.: Experiments in Microbiology, Plant Pathology and Biotechnology New Age International (P) Ltd., Publishers, New Delhi 2003.
- Pandey BP(2022) Algae, Bryophytes and Lichens, S Chand Publication

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**BOT-UG-****Cell biology, Molecular Biology and Genetics****Objectives**

- To understand the structural organization of cells.
- To understand functions of organelles in the cell.
- To differentiate between plant and animal cells and to analyse different stages of mitosis and meiosis
- To understand Mendel laws.
- To understand functions genes, linkage and crossing over.

**Course Outcomes:**

At the completion of the course, the student would be able to develop

<b>BOTANY-</b>	
<b>Cognitive level</b>	<b>Course outcome</b>
1. Understanding	<ul style="list-style-type: none"><li>➤ The functions and structural properties of different cells.</li><li>➤ Learn, understand and develop skill and hands on training in basics of cell biology and genetics.</li><li>➤ Function of genes, linkage and crossing over.</li><li>➤ To interpret genetics of a large group of population.</li></ul>
2. Memorizing	<ul style="list-style-type: none"><li>➤ The structural and functional aspects of cellular organelles.</li><li>➤ Human chromosomes and organization of chromosomes.</li><li>➤ Differentiation between linkages, crossing over, allelic interactions.</li><li>➤ Mendel's laws of genetics.</li></ul>
3. Applying	<ul style="list-style-type: none"><li>➤ Variations in functions of cell organelles.</li><li>➤ Concept of cell cycle, abnormalities, cell membrane, cell-cell interactions.</li><li>➤ Possibilities of mutations and mutagens.</li></ul>



## **B.Sc. BOTANY (SEM-II)**

### **Cell biology, Molecular Biology and Genetics**

#### **UNIT I**

**Ultrastructure of Cell and Cell Organelles:** Eukaryotic and Prokaryotic cell structure; Ultrastructure and functions of different cell organelles (Cell wall, Plasma membrane, Nucleus, Mitochondria, Chloroplast, Ribosome, Peroxisomes, Lysosome, Golgi bodies and Endoplasmic Reticulum); Basic idea of Mitochondrial and Chloroplast genome.

**15 hrs**

#### **UNIT II**

**Chromosome organization:**Chromosome Morphology, Specialized types of chromosomes: Polytene chromosomes. **Cell Division:** Cell cycle; Mitosis and Meiosis, **Chromosomal aberrations in human and ploidy in plants:** Deletion, Duplication, Translocation, Inversion, Aneuploidy and Polyploidy. **Mutations:** Spontaneous and induced Mutations, Physical and Chemical mutagens.

**15 hrs**

#### **UNIT III**

**Gene and DNA:** Concept of Genome, Gene. **Genetic material:** DNA as genetic material (Griffith's transformation experiment); structure of DNA (Watson and Crick Model); Structure and function of different types of RNA ( rRNA, m RNA, tRNA). **DNA replication:** Mechanisms of Eukaryotes DNA replication: Initiation, Elongation and Termination; Leading and lagging strands, Okazaki fragments. **Transcription:** initiation, elongation and termination. **Translation:** initiation, elongation and termination in Eukaryotes Genetic code

**15 hrs.**

#### **UNIT IV**

**Genetic inheritance:** Mendel's laws of inheritance and their exceptions; allelic (incomplete dominance, co-dominance, lethality) and non-allelic interactions (complementary genes, epistasis and duplicate genes); Multiple allelism (ABO blood groups in men); Quantitative inheritance (Grain color in wheat). **Cytoplasmic inheritance:** Plastid inheritance (different types of leaves in *Mirabilis jalapa*); Mitochondrial inheritance (Cytoplasmic male sterility in plants).

**15 hrs**

### Suggested Laboratory Exercises:

- Study of cell structure from Onion,
- Study of cyclosis in *Tradescantia* spp.
- Study of plastid for pigment distribution in *Lycopersicon*, *Cassia* and *Capsicum*.
- Study of electron microphotographs of Prokaryotic cells for various cell organelles.
- Study of electron microphotographs of virus, bacteria and eukaryotic cells for comparative study of cellular organization.
- Study of different stages of mitosis and meiosis in root-tip cells and flower buds respectively of onion.
- To solve genetic problems based upon Mendel's laws of inheritance: Monohybrid, Dihybrid, Back cross and Test cross.
- Permanent slides/photographs of different stages of mitosis and meiosis, polytene chromosome

### Suggested Reading

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). **Molecular Biology of the Cell** (6th Ed.). New York: Garland Science
- Cooper, G. M., and Hausman, R. E. (2013). **The Cell: A Molecular Approach** (6th Ed.). Washington: ASM ; Sunderland.
- Karp, G. **Cell and Molecular Biology. Concepts and experiments**. John Harris, D., Wiley & sons, New York
- Lodish, H. F., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Aman, A., Martin, K. (2016). **Molecular Cell Biology** (8th Ed.). New York: W. H. Freeman
- Gupta P. K. **Cell and Molecular Biology** 2018. 5<sup>th</sup> edition Rastogi Publication India.
- Hartl, D. L., & Jones, E. W. (1998). **Genetics: Principles and Analysis**. Sudbury, MA: Jones and Bartlett.
- Pandey BP (2022) **Cell Biology and Genetics**, S Chand Publication

## Multidisciplinary courses

### 1. Herbal Medicine and Human Health

#### Course Objective

To introduce students to complementary and alternative medicine

To explore uses of plants as medicine ranging from traditional indigenous approach for treating ailments to modern pharmaceuticals

To inculcate awareness about the rich diversity of medicinal plants in India.

#### Unit I

Scope and importance of medicinal plants in the traditional systems of medicine and modern medicine. Importance of preventive and holistic healing in the Indian traditional systems of medicine. **Ayurveda:** History, origin, fundamental doctrine and concepts of Panchamahabhutas, Saptadhatus and Tridoshas in relation to health and diseases.

#### Unit II

Therapeutic and pharmaceutical uses of important plants used in the Ayurveda, Siddha and Unani system of medicine. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. Medico-ethnobotanical sources in India; Significance of the following plants: (a) *Azadirachta indica* (b) *Ocimum sanctum* (c) *Vitex negundo*. (d) *Pongamia pinnata* (e) *Cassia auriculata* (f) *Indigofera tinctoria* (g) *Prosopis cineraria* (h) *Acacia nilotica* (i) *Ficus religiosa*.

#### Unit III

Nutraceuticals and polyherbal formulations. Plants used for the treatment of hepatic disorders, cardiac diseases, infertility, diabetes, blood pressure, cancer and skin diseases. Role of AYUSH, NMPB and AIIA in the promotion of medicinal plants. Evaluation and Standardization of crude drugs. Fundamentals of Pharmacognosy. Organoleptic, microscopic and phytochemical evaluation of plant drugs.

#### Unit IV

Conservation of Endangered and Endemic Medicinal plants. Red Data List Criteria. In situ Conservation: Biosphere Reserves, National Parks, Sacred Groves. Ex-situ conservation: Botanic Gardens, National Gene Banks, Plant cell, tissue, and Organ culture, Cryopreservation. Role of NBPGR, CIMAP, JNTBGRI and RRL.

## 2. Plant Biodiversity and Conservation

### Unit I

**Plant diversity and its scope-** Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro-biodiversity and cultivated plant taxa, wild taxa. **Values and uses of Biodiversity:** Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

### Unit II

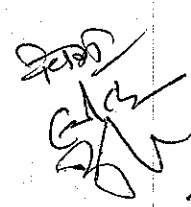
**Loss of Biodiversity:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management- IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

### Unit III

**Conservation of Biodiversity:** Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.

### Unit IV

Role of plants in relation to Human Welfare; (a) Importance of forestry their utilization and commercial aspects (b) Avenue trees, (c) Ornamental plants of India. (d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

  
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