



YBN UNIVERSITY

Established by the Act of Government of Jharkhand Act15, 2017
Gazette Notification No.505, Dated 17th July 2017
As per Section 2(f) of UGC Act.1956

NEP-2020

BOTANY COURSE/STRUCTURE

For

FOUR YEAR UNDERGRADUATE PROGRAMMES
(FYUGP)

UNDER YBNU RANCHI JHARKHAND

Implemented in the Department of Botany (School of Science)

Semester-I, II, III, & IV

From

Academic Session-2023



RAJAUATU, NAMKUM, RANCHI, JHARKHAND-834010

**COURSE OF STUDY OF FOUR YEAR UNDERGRADUATE
PROGRAMME FOR (2) YEAR-2023 onwards**

**SEMESTER WISE COURSE OF STUDY FOR FOUR YEAR
UNDERGRADUATE PROGRAMME 2023 ONWORDS**

BOTANY

Table 1: Semester Wise Course Code and Credits Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Course		Credits	Examination Structure			
	Code	Paper		Theory	Internal Assessment	Practical	Total
I	1Y4CC-1	Language and Communication Skills (Modern Indian Language including TRL)	6	75	25	---	100
	1Y4CC-2	Understanding India	2	75	25	---	100
	1Y4CC-3	Health & Wellness, Yoga Education, Sports & Fitness	2	50	25	25	100
	1Y4BOT IRC-1	Introductory Regular Course-1 Introductory Botany	3	50	25	25	100
	1Y4IVS-1A	Introductory Vocational Studies-I	3	50	25	25	100
	1Y4BOT MJ-1	Major paper-1 (Disciplinary/Interdisciplinary Major) Microbiology, Phycology and Mycology	6	50	25	25	100
II	2Y4CC-4	Language and Communication Skills (Hindi)	6	75	25	---	100
	2Y4CC-5	Mathematical and Computational Thinking Analysis	2	50	25	25	100
	2Y4CC-6	Global Citizenship Education & Education for Sustainable Development	2	50	25	25	100
	2Y4BOT IRC-2	Introductory Regular Course-2 Introductory Botany	3	50	25	25	100
	2Y4IVS-2B	Introductory Vocational Studies-2	3	50	25	25	100
	2Y4MJ-2	Major paper-2 (Disciplinary/Interdisciplinary Major) Non-Flowering Plants and Palaeobotany	6	50	25	25	100
	2Y4EVS CC-7	Environmental Studies/EVS	3	50	25	25	100
	2Y4CC-	Digital Education (Elementary	3	50	25	25	100

III	8	Computer Applications)					
	2Y4CC-9	Community Engagement & Service (NSS/NCC/Adult education)	3	50	25	25	100
	3Y4BOT IRC-3	Introductory Regular Course-3 Introductory Botany	3	50	25	25	100
	3Y4IAP	Internship/Apprenticeship/Project	4	50	25	25	100
	3Y4BOT MJ-3	Major paper-3 (Disciplinary/Interdisciplinary Major) Plant Anatomy and Embryology	6	50	25	25	100
IV	4Y4BOT MJ-4	Major paper-4 (Disciplinary/Interdisciplinary Major) Ecology and Environmental Studies	6	50	25	25	100
	4Y4BOT MJ-5	Major paper-5 (Disciplinary/Interdisciplinary Major) Plant Taxonomy & Economic Botany	6	50	25	25	100
	4Y4BOT MN-1	Minor paper-1 (Disciplinary/Interdisciplinary Minor) Diversity of Plants, Ecology and Environmental Science	6	50	25	25	100
	4Y4VS-1	Vocational Studies-1 (Minor)	4	50	25	25	100
V	5Y4BOT MJ-6	Major paper-6 (Disciplinary/Interdisciplinary Major) Cell Biology & Genetics	6	50	25	25	100
	5Y4BOT MJ-7	Major paper-7 (Disciplinary/Interdisciplinary Major) Plant Physiology & Biochemistry	6	50	25	25	100
	5Y4BOT MN-2	Minor paper-2 (Disciplinary/Interdisciplinary Minor) Taxonomy, Anatomy & Embryology	6	50	25	25	100
	5Y4VS-2	Vocational Studies-2 (Minor)	4	50	25	25	100
VI	6Y4BOT MJ-8	Major paper-8 (Disciplinary/Interdisciplinary Major) Molecular Biology & Plant Biotechnology	6	50	25	25	100
	6Y4BOT MJ-9	Major paper-9 (Disciplinary/Interdisciplinary Major) Computational Biology & Research Methodology for Plants	6	50	25	25	100
	6Y4BOT MN-3	Minor paper-3 (Disciplinary/Interdisciplinary Minor) Physiology, Biotechnology & Genetics	6	50	25	25	100
	6Y4VS-3	Vocational Studies-3 (Minor)	4	50	25	25	100
	7Y4BOT AMJ-1	Advance Major paper-1 (Disciplinary/Interdisciplinary Major)	6	50		25	

VII		Advance Molecular Biology			25		100
	7Y4BOT AMJ-2	Advance Major paper-2 (Disciplinary/Interdisciplinary Major) Bioinformatics and Nano biotechnology	6	50	25	25	100
	7Y4RC- 1	Research Methodology	6	50	25	25	100
	7Y4RC- 2	Research Proposal	4	50	25	25	100
VIII	8Y4BOT AMJ-3	Advance Major paper-3 (Disciplinary/Interdisciplinary Major) Applied Botany	6	50	25	25	100
	8Y4BOT AMJ-4	Advance Major paper-4 (Disciplinary/Interdisciplinary Major) Advance Biotechnology	6	50	25	25	100
	8Y4RC- 3	Research Internship/Field Work	4	---	---	---	100
	8Y4RC- 4	Research Report	4	---	---	---	100
	8Y4VSR	Vocational Studies (Associated with Research)	2	50	25	25	100
		Total Credits	176				

Abbreviations:

CC	Common Course
IRC	Introductory Regular Courses
IVS	Introductory Vocational Courses
IAP	Internship/Apprenticeship/Project
VS	Vocational Studies
MJ	Major Disciplinary/Interdisciplinary Courses
MN	Minor Disciplinary/ Interdisciplinary Courses
AMJ	Advance Major Disciplinary/ Interdisciplinary Courses
RC	Research Courses
VSR	Vocational Studies associated with Research

Table 6: Semester Wise Course Code and Credits Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Examination Structure				
	Code	Papers	Credits	Theory	Internal Assessment	Practical	Total
I	1Y4BOT MJ-1	Microbiology, Phycology and Mycology	6	50	25	25	100
II	1Y4BOT MJ-2	Non-Flowering Plants and Palaeobotany	6	50	25	25	100
III	1Y4BOT MJ-3	Plant Anatomy and Embryology	6	50	25	25	100
IV	1Y4BOT MJ-4	Ecology and Environmental Studies	6	50	25	25	100
	1Y4BOT MJ-5	Plant Taxonomy & Economic Botany	6	50	25	25	100
V	1Y4BOT MJ-6	Cell Biology & Genetics	6	50	25	25	100
	1Y4BOT MJ-7	Plant Physiology & Biochemistry	6	50	25	25	100
VI	1Y4BOT MJ-8	Molecular Biology & Plant Biotechnology	6	50	25	25	100
	1Y4BOT MJ-9	Computational Biology & Research Methodology for Plants	6	50	25	25	100
VII	1Y4BOT AMJ-1	Advance Molecular Biology	6	50	25	25	100
	1Y4BOT AMJ-2	Bioinformatics and Nano biotechnology	6	50	25	25	100
	1Y4BOT RC-1 R	Research Methodology	6	50	25	25	100
	1Y4BOT RC-2	Research Proposal	4	50	25	25	100
VIII	1Y4BOT AMJ-3	Applied Botany	6	50	25	25	100
	1Y4BOT AMJ-4	Advance Biotechnology	6	50	25	25	100
	1Y4 RC-3	Research Internship/Field Work	4	---	---	---	100
	1Y4 RC-4	Research Report	4	---	---	---	100
	1Y4 VSR	Vocational Studies (Associated with Research)	2	50	25	25	100
		Total Credit	98				

Table 7: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Examination Structure				
	Code	Papers	Credits	Theory (F.M.)	Internal Assessment	Practical	Total
I/ II/ III	IRC	Introductory Botany	3	50	25	25	100
IV	MN-1	Diversity of Plants, Ecology and Environmental Science	6	50	25	25	100
V	MN-2	Taxonomy, Anatomy & Embryology	6	50	25	25	100
VI	MN-3	Physiology, Biotechnology & Genetics	6	50	25	25	100

Table 8: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses						
	Code	Papers	Credits	Theory (F.M.)	Internal Assessment	Practical	Total
I	1Y4IVSO F-1A	ORGANIC FARMING – IRC-1	2	50	25	25	100
	1Y4IVSD M-1A	DIGITAL MARKETING – IRC-2	2	50	25	25	100
	1Y4IVSC M-1A	COMPUTER BASICS AND MULTIMEDIA – IRC-3	2	50	25	25	100
	1Y4IVSE WS-1A	ENGINEERING WORKSHOP-IRC-4	2	50	25	25	100
	1Y4IVSE D-1A	ENGINEERING GRAPHICS-IRC-5	2	50	25	25	100
	1Y4IVSE MC-1A	ENTREPRENEURSHIP AND MANAGEMENT CONCEPTS-IRC-6	2	50	25	25	100
	1Y4IVSO B-1A	ORGANIZATION BEHAVIOUR-IRC-7	2	50	25	25	100
	2Y4IVSO F-2B	ORGANIC FARMING – IRC-1	2	50	25	25	100
	2Y4IVSD M-1B	DIGITAL MARKETING – IRC-2	2	50	25	25	100

II	2Y4IVSC M-1B	COMPUTER BASICS AND MULTIMEDIA– IRC-3	2	50	25	25	100
	2Y4IVSE WS-1B	ENGINEERING WORKSHOP-IRC-4	2	50	25	25	100
	2Y4IVSE D-1B	ENGINEERING GRAPHICS-IRC-5	2	50	25	25	100
	2Y4IVSE MC-1B	ENTREPRENEURSHIP AND MANAGEMENT CONCEPTS-IRC-6	2	50	25	25	100
	2Y4IVOB- 1B	ORGANIZATION BEHAVIOUR-IRC-7	2	50	25	25	100



AIMS OF BACHELOR'S DEGREE PROGRAMME IN BOTANY

The broad aims of bachelor's degree programme in Botany are:

1. The programme is designed to equip students with essential knowledge and technical skills to study plants and related subjects in a holistic manner.
2. The main aim is to train the learners in all areas of plant biology using appropriate combinations of core and elective papers with significant inter- disciplinary components.
3. Students would be exposed to cutting-edge technologies that are currently used in the study of plant life forms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

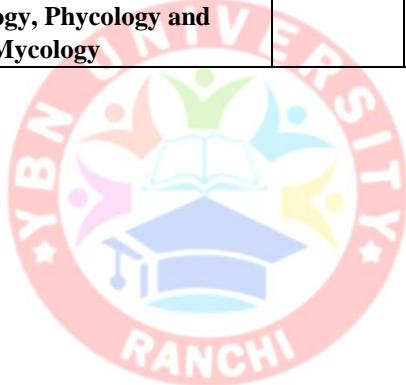
PROGRAM LEARNING OUTCOMES

The broad aims of bachelor's degree programme in Botany are:

1. Students will be able to understand and explain different specializations of Botany such as systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, cell and molecular biology of plants.
2. Students will be trained in various analytical techniques of plant biology, use of plants as industrial resources or as support system for human livelihood and will be well versed with the use of transgenic technologies for both basic and applied research in plants.
3. Students will be able to identify various life forms of plants, design and execute experiments related to basic studies on evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology. Students are also familiarized with the use of bioinformatics tools and databases and in the application of statistics to biological data.
4. Students will acquire core competency in the subject Botany and in allied subject areas.
5. They will be able to use the evidence based comparative studies approach to explain the evolution of organism and understand the genetic diversity and its significance.
6. The students will be able to explain various physiological and metabolic processes unique to plants.
7. They would be able to elaborate on the concepts of gene, genome and the molecular processes of replication, transcription and translation.
8. They will be able to understand adaptation, development and behaviour of different forms of life.
9. The students will get an understanding of functioning of ecosystem and tracing the energy pyramids through nutrient flow.
10. Students will be able to demonstrate the experimental techniques and methods in plant sciences and have innovative research ideas.

SEMESTER-I

Semester	Course Structure For Semester-I Common, Introductory, Major, Minor, Vocational & Internship Course						
	Code	Paper	Credits	Theory	Internal Assessment	Practical	Total
I	1Y4CC-1	Language and Communication Skills (Modern Indian Language including TRL)	6	75	25	---	100
	1Y4CC-2	Understanding India	2	75	25	---	100
	1Y4CC-3	Health & Wellness, Yoga Education, Sports & Fitness	2	50	25	25	100
	1Y4BO TIRC-1	Introductory Regular Course-1 Introductory Botany	3	50	25	25	100
	1Y4IV S-1A	Introductory Vocational Studies-I	3	50	25	25	100
	1Y4BO TMJ-1	Major paper-1 (Disciplinary/Interdisciplinary Major) Microbiology, Phycology and Mycology	6	50	25	25	100



SEMESTER I

COMMON COURSE –CC 1:

(Credits: 6) Total Marks: 100

Language and Communication Skills (Modern Indian Language including TRL)

ENGLISH LANGUAGE &, COMMUNICATION SKILLS (1Y4CC-1)

OBJECTIVE: - To equip students effectively to acquire skills in reading, writing, comprehension and communication for English language & Communication.

COURSE OUTCOMES:

- Students will improve their speaking ability in English both in terms of fluency and comprehensibility
- Students will give oral presentations and receive feedback on their performance
- Students will increase their reading speed and comprehension of academic articles
- Students will strengthen their ability to write academic papers, essays and summaries using the process approach.
- Students will enlarge their vocabulary. They will also heighten their awareness of correct usage of English grammar in writing and speaking

Unit I: Communication – Meaning, Types, Channels, Barriers. Skills of Language learning: Listening, Speaking, Reading & Writing.

Unit II: English as a Global Language Growth & Status of English language in India

Unit III: Class-presentation – Introduction, Conversation, Greetings, Likes and Dislikes, Opinion, Agreeing, Disagreeing, Complaint, Apology

Unit IV: Writing skills notice writing, précis writing, essay writing, letter writing resume writing.

Unit V: Vocabulary building: One word substitution, synonyms and antonyms, idioms and phrases, Common Errors, Prefix, Suffix, Homophones, Confusing words

Suggested Reading:

1. Technical Communication, M.H. Rizvi, Tata McGrawhill
2. Everyday Smart English, Dr. Arti Gupta, I.D. Publishers
3. Effective Business Communication, Asha Kaul
4. Developing Communication Skills, Krishnamohan
5. Functional Grammar and Spoken and Written Communication in English, Bikram K. Das, Orient Blackswan
6. Precis, Paraphrase and Summary, P.N. Gopalkrishnan, Authors Press
7. Communication Skills, Sanjay Kumar and Pushplata, Oxford Publication

COMMON COURSE –CC 2:
Understanding India (1Y4CC-2)

(Credits: 2)

Total Marks: 100

Unit I: Background of India's culture: Harappan civilisation and Vedic age Buddhism, Jainism, Sanatan (Hinduism) and Islam

Unit II: Growth and development of Indian Education and literature: Bharat's Natyashastra, Kalidas, Panini, Patanjali Taxila, Nalanda, Vishwa Bharati, BHU, AMU, IIT, IISC, AIIMS

Unit III: Leaders of India's freedom struggle: Mahatma Gandhi, Jawaharlal Nehru, Subhash Chandra Bose, Freedom fighters of Jharkhand (Tilka Manjhi, Sidho-Kanho, Birsa Munda & Jatra Bhagat)

Unit IV: Geographical features of India

1. India on the map of world and its neighboring Countries.
2. Physical features of India including mountain, plateau, plain, coast, island, vegetation, rivers, soils, and climate

Unit V: The People of India: Racial diversities, Population, its growth, distribution, Migration.

Unit VI: Indian Constitution

1. Preamble
2. Salient features
3. Fundamental rights
4. Fundamental duties

Unit VII: Political ideas: Non-violence, Satyagraha and Social Justice

Unit VIII: The Indian Economy: The Indian Economy through the Ages (Agriculture, Industry and Trade-Transport)

Suggested Readings:-

1. L. Basham, A Cultural History of India, Oxford University Press, 1997
2. A. L. Basham, A Wonder that was India, Rupa, New Delhi, 1994
3. N. R. Ray, An Approach to Indian Art, Publication Bureau, Chandigarh, 1974
4. A. L. Basham, A Cultural History of India, Oxford University Press, 199
5. NayanjotLahiri, Marshaling the Past: Ancient India and its Modern Histories, Permanent Black, 2012

6. R.C. Majumdar (ed.), History and Culture of Indian People (Relevant Volumes and Chapters), Bhartiya Vidya Bhawan, Bombay.
7. S. C. Ghosh, History of Education in Modern India, 1758-1986, Orient Longman, Hyderabad, 1995
8. Tirthankar Ray, The Economic History of India 1857-1947, OUP, 2006
9. Vijay Joshi and I.M.D. Little, India's Economic Reforms, 1991-2001, OUP, 1999



COMMON COURSE –CC 3:
Health & Wellness, Yoga Education, Sports & Fitness (1Y4CC-3)

(Credits: 2)

Total Marks: 100

OBJECTIVE:

- To raise awareness towards fitness among the students.
- To develop the individual as a fit citizen in the society.
- To acquire knowledge about yoga and health & wellness.

COURSE OUTCOMES:

- Students will understand and learn different dimension of active lifestyle
- Student will learn to apply knowledge and lead better quality life
- The students will be able to continue professional courses and research in health & wellness &; yoga

HEALTH AND WELLNESS

Unit1:-Introduction

1. Meaning, Definition and Dimensions of Health and Wellness.
2. Factors affecting Fitness and Wellness.
3. Role of Fitness in maintaining Health and Wellness.
4. Importance of Health Education and Wellness.

Unit2:-Methods to Maintain Health and Wellness

1. Role of Physical Activities and Recreational Games for Health and Wellness
2. Role of Yoga asanas and Meditation in maintaining Health and Wellness
3. Nutrition for Health & Wellness

Unit3:-Anxiety, Stress and Aging

1. Meaning of Anxiety, Stress and Aging
2. Types and Causes of Stress
3. Stress relief through Exercise and Yoga

Suggested Readings:

1. Reklau Marc (2019), “30 Days: Change your habits, Change your life”, Rupa Publications, India
2. Russell, R.P.(1994).Health and Fitness Through Physical Education. USA Human Kinetics.
3. Scates Samantha (2019) “ Healthy Habits for a Healthy Life” Samantha, Ireland

4. D.M Jyoti, Yoga and Physical Activities (2015) lulu.com3101, Hillsborough, NC2 7609, United States.

YOGA EDUCATION

Unit -1: Theory

Introduction to Health and Wellness

1. Meaning, definition and importance of Yoga
2. Types of Yoga, Introduction of Sat karma, definition of asana and Pranayama, it's physical and mental benefits
3. Stretching exercises
4. Warming up and limbering down
 - a) General warm up exercises
 - b) Specific warm up exercises

UNIT II Practical

A. Sukshma Vyayama

B. Suryanamaskara

(12 Poses are Compulsory 1. Ardhashakrasana 2. Padhashtasana 3. Ashwasanchalanasana 4. Dhandasana. 5. Shashtasana 6. Astangasana 7. Bhujangasana 8. Parvathasana 9. Shashangasana 10. Ashwasanchalanasana 11. Padhashtasana 12. Ardhashakrasana)

C. Basic Set of Yoga Asanas -Sitting Poses

Padmasana, Sukhasana, Vajrasana, Gomukhasana,

Prone Position	Supine Position	Invert Position
Noka asang	Ustrasana	
Bhujangasang	Setu Bandhasana	Sarvangasana
Salabhasana	chakrasana	halasana
Marjariasana		Salambha Sarvangasana
makarasana		Sirsasana

Relaxing Pose → Shavasana

D. Basic Set of Pranayama, Meditation & Mudra

Pranayama- Anulom-Vilom Pranayama, Bhramari Pranayama, Ujjai Pranayama, Bhastrika Pranayama, Sitali Pranayama

Meditation- Omkar meditation

Mudra – Pranav mudra, Gyan mudra, Hridaya mudra

Suggested Readings:

1. Nagendra, H.R. & Nagarathna, R. (2002).Samagra Yoga Chikitse. Bengaluru: Swami Vivekananda Yoga Prakasana.
2. Kumar, Ajith. (1984) Yoga Pravesha. Bengaluru: Rashthrothanna Prakashana
3. Shanti KY(1987) & The Science of Yogic Breathier & (Pranayama) DB Bombay
4. Iyengar B.K.S.(2006) “ Light on Yoga” Thorsons (Publ.) India



INTRODUCTORY REGULAR COURSE (IRC)

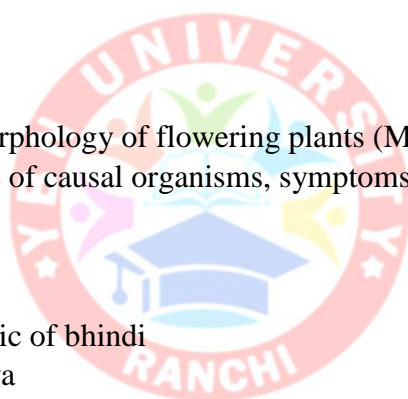
INTRODUCTORY BOTANY (1Y4BOTIRC-1)

(Credits: Theory-03)

Total Marks: 100

Basic Concept of Botany

1. Elementary idea of classification of plant kingdom, Taxonomic hierarchy up to species, Botanical Nomenclature of plants, herbarium - types and use. Family description- Solanaceae and Poaceae
(3 lectures)
2. A concise introduction to branches and scope of botany. **(2 lectures)**
3. Diversity of Plants: General identifying features, structures, life cycle and economic importance of the following groups: **(8 lectures)**
 - a) Bacteria
 - b) Virus
 - c) Algae
 - d) Fungi
 - e) Lichens
 - f) Bryophyta
 - g) Pteridophyta
 - h) Gymnosperms
 - i) Angiosperms: Morphology of flowering plants (Monocots and Dicots)
4. Plant pathology- Name of causal organisms, symptoms and control of the following diseases: **(2 lectures)**
 - a) Wilt of tomato
 - b) Citrus canker
 - c) Yellow vein mosaic of bhindi
 - d) Leaf curl of papaya
 - e) Black stem rust of wheat
 - f) Loose smut of wheat
5. Brief notes on ethnobotanical uses of the following plants with particular reference to Jharkhand : **(3 lectures)**
 - a) Kalmegh
 - b) Palash
 - c) Karanj
 - d) Neem
 - e) Bamboo
 - f) Sal
6. Cell - Ultra structure of a typical prokaryotic and eukaryotic cell and cell division **(4 lectures)**
 - a) Plant cell and its organelles - structure and function
 - b) Cell cycle



- c) Mitosis
- d) Meiosis
- 7. Genetics: Structure and Function of DNA, Mendel's Law. (2 lectures)
- 8. Application of Biotechnology in Agriculture and environment. (1 lectures)
- 9. Introductory knowledge of pollination, Fertilization and seed development in Angiosperms, Monocot and Dicot seeds; Germination of seeds. (2 lectures)
- 10. Physiology of Plants: Ascent of Sap, Transpiration, Photosynthesis and Respiration. Fermentation- Role of microbes in food production and preservation. Biological Nitrogen fixation. (5 lectures)
 - I. Ecology and Environment: Pond Ecosystem, Forest Ecosystem; Biogeochemical cycle – Carbon and Nitrogen. Pollution: Causes and control of air, water, soil and noise pollution; conservation of natural resources, biodiversity: definition, threats, loss and importance. Indigenous eco-friendly practices. An introduction to major global environmental issues and sustainable development. Disaster management. Peoples Biodiversity Register (PBR). (8 lectures)
- 11. An introduction to organic farming. (2 lectures)
- 12. Economic Botany: Food, fodder, fibre, timber, oil and pulses (2 lectures)
- 13. Botanical Survey of India – Objectives and achievements. (1 lectures)

Reference Books:

1. Botany for degree students; A.C. Dutta
2. College Botany; Vol I, Ganguly, Das and Dutta
3. College Botany; Vol. II, Ganguly, Kar and Santra
4. Study of Botany; Mitra, Mitra and Guha
5. A text book of Botany; K. S. Bilgrami
6. A text book of Botany; Vol. I & II, Hait, Bhattacharya and Ghosh
7. Practical botany: Bendre and Kumar, and S. P. Lal

BOTANY PRACTICAL-IRC LAB:

1. Family descriptions of given plant.
2. Anatomical features of: monocot (root and stem) and dicot (root and stem).
3. Morphology of bacteria with the help of photographs.
4. Gram's staining technique.
5. Botanical name, common name, family and uses of cereal, pulses, oil yielding.
6. Osmosis.
7. Plasmolysis.
8. Acquaintance with the instruments.
9. Identifying features and name of the given materials/permanent slides (algae, fungi, bryophytes, pteridophytes and gymnosperms).
10. Mitosis and Meiosis: Study of materials/permanent slides.

SEMESTER – I
ORGANIC FARMING
Course Code: 1Y4IVSOF-1A

(Credits: Theory-01+ Practical 02)

Total Marks: 100

Course Content:

UNIT- I Agronomy

1. Organic farming- concept, characteristics, significance, organic ecosystem, scope of organic farming in India
2. Principles and types of organic farming

UNIT- II Soil Science

1. Organic farming for sustainable agriculture; Manures- compost, methods of composting
2. Green manuring, vermicompost and bio fertilizer

UNIT- III Fundamental of organic farm management

1. Land management in organic farming
2. Water management in organic farming

UNIT- IV Post harvest management

1. Processing, labeling of organic produce
2. Storage and transport of organic produce

ORGANIC FARMING PRACTICAL

Course Code: 1Y4IVSOF-1A-LAB

PRACTICALS: 60 Lectures

1. Field visit of organic farming
2. Seed and seed treatment
3. Preparation of Farm Yard Manure (FYM) & compost
4. Water management in organic agricultural

SEMESTER I
MAJOR COURSE –MJ 1:
MICROBIOLOGY, PHYCOLOGY AND MYCOLOGY

(Credits: Theory-04, Practicals-02)

Total Marks: 100

Course Objectives:

On completion of this course, the students will be able to understand

1. To gain knowledge of diversity, life forms, life cycles, morphology and importance of microorganisms.

Course Learning Outcomes:

On successful completion of this course the student should know:

1. Students would understand the classification, characteristic features, cell structure and growth and reproduction in viruses, bacteria and economic importance.

Unit 1: Introduction to microbial world

Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine). **(5 lectures)**

Unit 2: Viruses

Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). **(7 lectures)**

Unit 3: Bacteria

Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). **(7 lectures)**

Unit 4: Algae

General characteristics of Algae, Criteria for classification of algae, Fritsch (1935) and Lee (2008) systems of classification of algae. Significant contributions of eminent phycologists (F.E. Fritsch and M.O.P. Iyengar). Economic importance of algae, role of algae in integrated aquaculture. Economic importance of major seaweed resources of India. **(5 lectures)**

Unit 5: Cyanophyta and Xanthophyta

Brief account of ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of Nostoc and Vaucheria. **(5 lectures)**

Unit 6: Chlorophyta and Charophyta

Brief account of general characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara. **(6 lectures)**

Unit 7: Phaeophyta and Rhodophyta

Brief account of characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Ectocarpus, Fucus and Polysiphoni **(4 lectures)**

Unit 8: Introduction to Fungi

Classification – Gwynne-Vaughan and Barnes (1926) and Ainsworth (1966, 1973). Brief account of allied fungi and applied mycology. Brief account of evolution. Brief account of thallus structure and life cycle pattern of the following genera:

Characteristic features of Synchytrium and Rhizopus General

Characteristics of Alternaria, Neurospora and Peziza General

Characteristics of Puccinia and Agaricus General

Characteristics of Slime molds General characteristics of Albugo

Unit 9: Phytopathology

Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers. **(21 lectures)**

Reference Books:

1. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
2. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
3. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
4. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
5. Sharma, O.P. (). A text book of algae. TATA McGRAW – HILL.
6. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
7. Agrios, G.N. (2011) Plant Pathology, 6th edition, Academic Press, U.K.
8. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
9. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge Univ Press, Cambridge. 3rd Ed.

10. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Pub. India Ltd.11. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India

BOTANY PRACTICAL- MJ 1 LAB

PRACTICALS:

60 Lectures

Microbiology

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).

Phycology

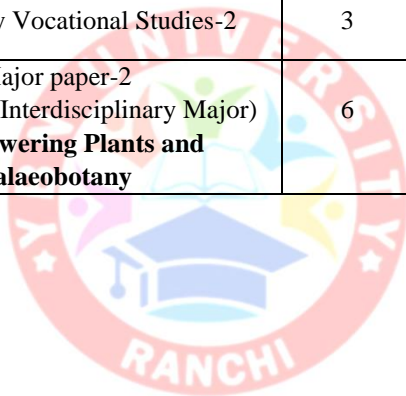
Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia, Prochloron through electron micrographs, temporary preparations and permanent slides

Fungi

1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
2. Rhizopus: study of asexual stage from temporary mounts and sexual structures through permanent slides.
3. Aspergillus and Penicillium: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
4. Peziza: sectioning through ascocarp.
5. Alternaria: Specimens/photographs and temporary mounts.
6. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
7. Agaricus: Specimens of button stage and full-grown mushroom; sectioning of gills of Agaricus, fairy rings and bioluminescent mushrooms to be shown.
8. Study of phaneroplasmodium from actual specimens and/or photograph. Study of Stemonitis sporangia.
9. Albugo: Study of symptoms of plants infected with Albugo; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.
10. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

SEMESTER II

Semester	Course Structure For Semester-II Common, Introductory, Major, Minor, Vocational & Internship Course						
	Code	Paper	Credits	Theory	Internal Assessment	Practical	Total
II	2Y4CC-4	Language and Communication Skills (Hindi)	6	75	25	---	100
	2Y4CC-5	Mathematical and Computational Thinking Analysis	2	50	25	25	100
	2Y4CC-6	Global Citizenship Education & Education for Sustainable Development	2	50	25	25	100
	2Y4BO TIRC-2	Introductory Regular Course-2 Introductory Botany	3	50	25	25	100
	2Y4IV S-2B	Introductory Vocational Studies-2	3	50	25	25	100
	2Y4MJ-2	Major paper-2 (Disciplinary/Interdisciplinary Major) Non-Flowering Plants and Palaeobotany	6	50	25	25	100



SEMESTER II
Language and Communication Skills (Hindi) 2Y4CC-4

I. COMMON COURSE –CC 4:

(Credits: 6) अंक: 100

हिंदी भाषा

इकाई-1 हिन्दीव्याकरण और रचना, संज्ञा, सर्वनाम, विशिष्टाण, क्रिया, अव्यय, कारक, वचन, सठिय, उपसर्ग, प्रत्ययासमास, लिंगनिर्णय शब्द लोड शब्द, अनेक शब्दों के लिए एक शब्द, शब्द-शुद्धि, वाक्य शुद्धि, मुहावरे ओर लोकोकिया, पल्लवन एवं संक्ष पण।

इकाई-2 निबंध, कला तथा समसामयिक एवं राष्ट्रीय विषय पर लेखन

इकाई-3 संप्रेषण (संचार)- संप्रेषण की अवधारण और महत्व, संप्रेषण के लिए आवश्यक शर्त संप्रेषण के प्रकार, संप्रेषण की तकनीक, वाचनकला, समाचारवाचन, साक्षात्कारकला, रचनात्मक लेखनका लक्ष्य, रचनात्मक लघु का आधार, भारत की भाव और विचारो की प्रस्तुति, वाक कला की उपयोगता।

अनुशंसितपुस्तकें:-

- रूहतव्याकरणभास्कर डोे 0 र्चनद कुंमार
- र्हे तहनबर्धे् भास्कर डोे0 र्चनदर कु मार
- आधुहनकहहन्दीव्याकरणऔररचना डोे 0 र्ासुद र्न्दनप्रसाद
- रचनामानस प्रो0 राम श्वरनाथहतरारी
- व्यर्हाररकहहन्दी डोे 0 जंग बहादुरपाण्ड य
- रचनात्मक खन डोे 0 रमशे गौतम
- राजहंसहहन्दीहनबंध प्रो0 आर0 एन0 गौड़
- सफ हहन्दीहनबंध रत्न श्वर
- हनबंध सहचर डोे 0 क्षमणप्रसाद
- उपकारमहु र् और क हियााँ पार् 0 राज श्वरप्रसादचतर्वु दी
- कहाहनयोंकहातर्ि की प्रतापअनम
- सम्प्र षणपरकहहन्दीभाषाहशक्षण डोे 0 र्ैश्रानारंग
- शै हर्ज्ञान डोे 0 सुर शकुमार
- शै हर्ज्ञानप्रहतमानऔरहर्शर्ल षण डोे0 पाडं य शहशभषे ण „शीताशेँ“
- शै हर्ज्ञानकाइहतहास डोे0 पाडं य शहशभषे ण „शीताशेँ“

SEMESTER II

Mathematical and computational Thinking and Analysis (1Y4CC-6)

COMMON COURSE –CC 5:

(Credits: 2) Total Marks: 100

Course Learning Outcomes: This course will enable the students to:

- a) Understand the notions of logic and Mathematical Induction.
- b) Basic concepts of sets.
- c) Analytic approach toward the solution of algebraic equations.
- d) Connections of roots and coefficients.
- e) Understand basic concept of Probability and statistics
- f) Understand and analyze the coordinate systems.

UNIT-1: Logic: statement, truth table, quantifiers, connectives and tautology, Mathematical induction.

UNIT-2: Sets and Number System: operations on sets, Elementary Properties, Decimal system, binary decimal, octal system, hexadecimal system, arithmetic, conversion from binary to decimal and decimal to binary.

UNIT-3: Theory of Equation: Relation between roots and coefficients, Transformation of equation, Symmetric functions of roots, Solutions of cubic and biquadratic equations.

UNIT-4: Statistics and Probability: Data collection and presentation using bar chart, column chart, line chart, pie chart, scatter chart, surface chart. Calculation of frequency. Measure of central tendency, Mean, Median and Mode, Definition of Probability, Elementary properties, addition theorem, multiplication theorem, independent events.

UNIT-5: Geometry: Cartesian, spherical polar and Spherical cylindrical coordinate systems; their interrelationship.

Suggested reading:

1. An introduction to the theory of Numbers, 4th Ed., G. H. HARDY AND E. M. WRIGHT, 1975, Oxford University Press.
2. An Introduction to The Modern Theory of Equations, Florian Cajori, The Macmillan Company & London: Macmhian & Co., Ltd., 1904.
3. N. K. Singh, A text book of Probability and Statistics, 1st Edition, Pragati Publication, Meerut.
4. Probability and Statistics (4th Edition) 4th Edition, Morris H. DeGroot (Author), Mark J. Schervish, Pearson Education limited 2014.
5. N. K. Singh, Theory of Equations, 1st Edition, Pragati Publication, Meerut.
6. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis (3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
7. Discrete Mathematical Structure, 4th Ed., Kolman, Busby and Ross, Pearson Education Asia, 2002.

SEMESTER II
GLOBAL CITIZENSHIP EDUCATION (1Y4CC-6)

I. COMMON COURSE –CC 6:

(Credits: 2) Total Marks: 100

OBJECTIVE:

- To understand the concept and structure of global governance
- To empower learners to become aware of and understand global and sustainable development issues
- To become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies.
- Enabling students to embrace and practice constitutional, humanistic, ethical, and moral values in conducting one & life, including universal human values and citizenship values.
- To practice responsible global citizenship required for responding to contemporary global challenges

COURSE OUTCOMES:

- Enhance the capacity of the learners to acquire and demonstrate problem-solving skills involving the capacity to solve different kinds of problems in familiar and non familiar contexts and apply one's learning to real-life situations.
- Promote critical thinking involving capability to apply analytical thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well analyze and synthesize data related to global issues from a variety of sources and draw valid conclusions and support them with evidence and examples.
- Creativity characterized by the ability to create or think in different and diverse ways, deal with problems and situations that do not have simple solutions; view a problem or a situation from multiple perspectives; think 'out of the box' and generate solutions to complex problems in unfamiliar contexts.
- Communication Skills characterized by skills that enable a person to present complex information in a clear and concise manner to different groups/audiences; express thoughts and ideas effectively in writing and orally and communicate with 3 others using appropriate media, convey ideas, thoughts and arguments using language that is respectful and sensitive to gender and social groups.
- Coordinating/collaborating with others involving the ability to: work effectively and respectfully with diverse teams, facilitate cooperative or coordinated effort on the part of a group, act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

UNIT 1: Global Citizenship Education (GCE) and Education for Sustainable Development

1. Global Citizenship Education; its meaning, characteristics, scope and subject matter emergence and development.
2. Rights and responsibilities of Global citizenship
3. Benefits, Importance and theories of Global Citizenship
4. Global governance – concept and structure
5. Global Citizenship: (a) General idea, (b) Multi cultureless & diversity, (c) tolerance & (d) Acharya Vinoba's ideas of 'Jai Jagat.'

UNIT2: Global Poverty, Inequalities and social change

1. Concept of Global Poverty and its impact on World economy
2. Concept of social change, its types and theories.
3. Human Right Education: Special reference to Universal Declaration of Human Rights, 1943
4. Concept of Peace and Security: Special reference to United Nations Charter

UNIT 3: Sustainable Development – Global Issues and Sustainable Issues

1. Global environment Issue-Climate change mitigation and adaptation
2. Sustainable Development: Brief overview
3. Biodiversity loss, Global warming and carbon emission
4. Effect of Global Issue on Human Species
5. Environmental justice

UNIT 4: Citizenship Education & Culture, Globalization

1. Gender equality
2. Meaning of Globalization and its impact of world economy
3. Meaning of culture, crucial factors in the Globalization of culture

Suggested Readings:

1. Global Politics – Rupak Dattagupta
2. Understanding Global Politics – Chanchal Kumar
3. Global Citizenship Education for Young Children – Robin Elizabeth Hancock
4. A New-World Education: The Global Citizen – Roy Andersen
5. Global Citizenship Education, A Critical and International Perspectives Springer – Adeel Jalil, A.K. Kari, Kathrine Meleg
6. Citizenship in a Globalising World – Ashok Acharya
7. Redesign the World: A Global Call to Action – Sam Pitroda
8. Measuring the World – Daniel Kehlmann
9. Global Citizenship Education: Challenges and Successes – Eva Aboagye & S. Nomburo Dlamini
10. Global Citizenship Education - William Gaudelli

11. Multiculturalism: A very short Introduction – Ali Rattansi
12. Diversity and Inclusion Matters – Jason Thompson
13. Multiculturalism – C. W. Watson
14. Multiculturalism, Identity and Rights – Bruce Haddock and P



INTRODUCTORY REGULAR COURSE (IRC)

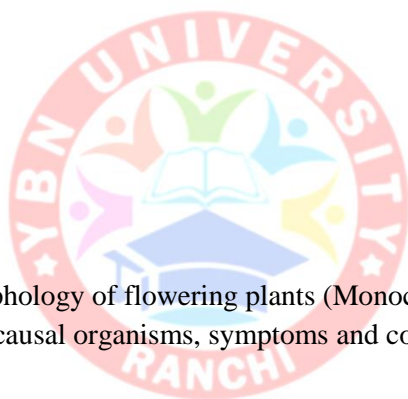
INTRODUCTORY BOTANY(1Y4BOTIRC-1)

(Credits: Theory-03)

Total Marks: 100

Basic Concept of Botany

1. Elementary idea of classification of plant kingdom, Taxonomic hierarchy up to species, Botanical Nomenclature of plants, herbarium - types and use. Family description- Solanaceae and Poaceae **(3 lectures)**
2. A concise introduction to branches and scope of botany. **(2 lectures)**
3. Diversity of Plants: General identifying features, structures, life cycle and economic importance of the following groups: **(8 lectures)**
 - j) Bacteria
 - k) Virus
 - l) Algae
 - m) Fungi
 - n) Lichens
 - o) Bryophyta
 - p) Pteridophyta
 - q) Gymnosperms
 - r) Angiosperms: Morphology of flowering plants (Monocots and Dicots)
4. Plant pathology- Name of causal organisms, symptoms and control of the following diseases: **(2 lectures)**
 - g) Wilt of tomato
 - h) Citrus canker
 - i) Yellow vein mosaic of bhindi
 - j) Leaf curl of papaya
 - k) Black stem rust of wheat
 - l) Loose smut of wheat
5. Brief notes on ethnobotanical uses of the following plants with particular reference to Jharkhand : **(3 lectures)**
 - g) Kalmegh
 - h) Palash
 - i) Karanj
 - j) Neem
 - k) Bamboo
 - l) Sal
6. Cell - Ultra structure of a typical prokaryotic and eukaryotic cell and cell division **(4 lectures)**
 - e) Plant cell and its organelles - structure and function
 - f) Cell cycle
 - g) Mitosis
 - h) Meiosis



7. Genetics: Structure and Function of DNA, Mendel's Law. (2 lectures)
8. Application of Biotechnology in Agriculture and environment. (1 lectures)
9. Introductory knowledge of pollination, Fertilization and seed development in Angiosperms, Monocot and Dicot seeds; Germination of seeds. (2 lectures)
10. Physiology of Plants: Ascent of Sap, Transpiration, Photosynthesis and Respiration. Fermentation- Role of microbes in food production and preservation. Biological Nitrogen fixation. (5 lectures)
 - I. Ecology and Environment: Pond Ecosystem, Forest Ecosystem; Biogeochemical cycle – Carbon and Nitrogen. Pollution: Causes and control of air, water, soil and noise pollution; conservation of natural resources, biodiversity: definition, threats, loss and importance. Indigenous eco-friendly practices. An introduction to major global environmental issues and sustainable development. Disaster management. Peoples Biodiversity Register (PBR). (8 lectures)
11. An introduction to organic farming. (2 lectures)
12. Economic Botany: Food, fodder, fibre, timber, oil and pulses (2 lectures)
13. Botanical Survey of India – Objectives and achievements. (1 lectures)

Reference Books:

1. Botany for degree students; A.C. Dutta
2. College Botany; Vol I, Ganguly, Das and Dutta
3. College Botany; Vol. II, Ganguly, Kar and Santra
4. Study of Botany; Mitra, Mitra and Guha
5. A text book of Botany; K. S. Bilgrami
6. A text book of Botany; Vol. I & II, Hait, Bhattacharya and Ghosh
7. Practical botany: Bendre and Kumar, and S. P. Lal

BOTANY PRACTICAL-IRC LAB:

1. Family descriptions of given plant.
2. Anatomical features of: monocot (root and stem) and dicot (root and stem).
3. Morphology of bacteria with the help of photographs.
4. Gram's staining technique.
5. Botanical name, common name, family and uses of cereal, pulses, oil yielding.
6. Osmosis.
7. Plasmolysis.
8. Acquaintance with the instruments.
9. Identifying features and name of the given materials/permanent slides (algae, fungi, bryophytes, pteridophytes and gymnosperms).
10. Mitosis and Meiosis: Study of materials/permanent slides.

SEMESTER - II
ORGANIC FARMING – IRC-1

Course Code: 2Y4IVSOF-2B

(Credits: Theory-01 + Practical 02)

Theory: 15 Lectures

Total Marks: 100

Course Content:

UNIT- I Agronomy

1. Choice of crops & varieties in organic farming
2. Initiative by Govt/NGOs/Other organizations for promotion of organic farming

UNIT- II Soil Science

1. Harmful effect of non-judicious chemical fertilization
2. Organic farming practices for improving soil health

UNIT- III Fundamental of organic farm management

1. Organic insect disease management
2. Organic pest disease management

UNIT- IV Post harvest management

1. Organic Quality control standards
2. Certification- types, process & procedure and agencies

ORGANIC FARMING PRACTICAL

Course Code: 2Y4IVSOF-2B-LAB

PRACTICALS: 60 Lectures

1. Crop planning & management in organic agriculture
2. Identification of different fungal and bacterial bio control agents
3. Application of manures and composts
4. Preparation of plant protection inputs Periods
5. Application of plant protection inputs

SEMESTER II
MAJOR COURSE- MJ 2:
NON-FLOWERING PLANTS AND PALAEOBOTANY

(Credits: Theory-04, Practicals-02)

Total Marks: 100

Course Objectives:

On successful completion of this course the student should be able to:

1. To introduce students with various fungal groups and lichens, their ecology, classification, characteristics, reproduction and economic Importance.
2. Study of morphology, anatomy, reproduction and developmental changes there in through typological study should create a knowledge base in understanding plant diversity, economic values, taxonomy of lower group of plants.

Course Outcomes:

On successful completion of this course the student should know:

1. Design and syntheses of organic molecules.
2. Structure identification through IR, NMR and Mass spectroscopic data.
3. Lab/Instrumentation techniques used for analyzing reaction mechanisms.

Unit 1: Symbiotic association

Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance. **(5 lectures)**

Unit 2: Bryophytes General characteristics; Adaptations to land habit; Classification; Range of thallus organization. Classification (up to family), morphology, anatomy, reproduction and alteration of generation of Riccia, Marchantia, Anthoceros, Sphagnum and Funaria; Reproduction and evolutionary trends (developmental stages not included). Ecological and economic importance of Bryophytes with special reference to Sphagnum. **(15 lectures)**

Unit 3: Pteridophytes Origin and evolution of land plants, Classification (up to family), morphology, anatomy and life cycle of Psilotum, Selaginella, Equisetum and Pteris (Developmental details not to be included). Apogamy and Apospory, heterospory and seed habit, Telome theory, stelar evolution; Ecological and economic importance. **(15 lectures)**

Unit 4: Gymnosperms General characteristics, classification (up to family), morphology, anatomy and life cycle of Cycas, Pinus and Gnetum (Developmental details not to be included); Ecological and economic importance. **(15 lectures)**

Unit 5: Palaeobotany Brief introduction of Prof. Birbal Sahani. Types of fossils; Process of fossilization and Significance of fossilization. Geological time scale; General characteristics; Classification; Early land plants (Cooksonia and Rhynia). **(10 lectures)**

Reference Books:

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
5. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.

BOTANY PRACTICAL- MJ 2 LAB:

PRACTICALS:

60 Lectures

Non-Flowering Plants and Palaeobotany

Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)

Archegoniate

Riccia – Morphology of thallus

Marchantia- Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).

Anthoceros- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).

Pellia, Porella- Permanent slides.

Sphagnum- Morphology of plant, whole mount of leaf (permanent slide only).

Funaria- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.

Psilotum- Study of specimen, transverse section of synangium (permanent slide).

Selaginella- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).

Equisetum- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).

Pteris- Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).

Cycas- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).

Pinus- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section & radial longitudinal sections stem (permanent slide).

Gnetum- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)

Botanical excursion.



SEMESTER-III

Semester	Course Structure For Semester-III Common, Introductory, Major, Minor, Vocational & Internship Course						
	Code	Paper	Credits	Theory	Internal Assessment	Practical	Total
III	2Y4EVSCC-7	Environmental Studies/EVS	3	50	25	25	100
	2Y4CC-8	Digital Education (Elementary Computer Applications)	3	50	25	25	100
	2Y4CC-9	Community Engagement & Service (NSS/NCC/Adult education)	3	50	25	25	100
	3Y4BOTIR C-3	Introductory Regular Course-3 Introductory Botany	3	50	25	25	100
	3Y4IAP	Internship/Apprenticeship/Project	4	50	25	25	100
	3Y4BOTMJ-3	Major paper-3 (Disciplinary/Interdisciplinary Major) Plant Anatomy and Embryology	6	50	25	25	100

SEMESTER III

Environmental Studies (Course Code: 3Y4CC7)

(Credits: Theory-2 credit + Field Work-1 credit = 3credits)

Course Objectives:

The course will seek to achieve the following objectives:

1. Generating the awareness about environmental problems among people and society.
2. To clarify modern environmental concept like how to conserve biodiversity.
3. Inculcating basic knowledge about the environment and its allied problems.
4. Developing an attitude of concern for the environment.
5. Motivating public to participate in environment protection and environment improvement.
6. Acquiring skills to help the concerned individuals in identifying and solving environmental problems.
7. Striving to attain harmony with Nature.

Course Learning Outcomes:

At the end of the course students will be able to:

1. Know the more sustainable way of living.
2. Use natural resources more efficiently.
3. Know the behaviour of organism under natural conditions.
4. Know the interrelationship between organisms in populations and communities.
5. Aware and educate people regarding environmental issues and problems at local, national and international levels.

Unit 1: Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

(2 lectures)

Unit 2: Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:
 - a) Forest ecosystem
 - b) Grassland ecosystem
 - c) Desert ecosystem
 - d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(8 lectures)

Unit 3: Natural Resources: Renewable and Non-renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over-exploitation of surface and ground water, floods, droughts conflicts over water (international & inter-state).
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(10 lectures)

Unit 4: Biodiversity and Conservation

- Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(10 lectures)

Unit 5: Environmental Pollution

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

(9 lectures)

Unit 6: Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(10 lectures)

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.

- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g. CNG vehicles in Delhi).

(6 lectures)

Environment Studies Field Work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted Site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river, spring, etc.

(Equal to 10 lectures)

References:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Press.
4. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
5. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
6. Room, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology.
7. Sunderland: Sinauer Associates, 2006.
8. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-
9. 37.
10. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
11. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
12. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
13. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
14. J.Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
15. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
16. Rosencranz, A., Divan, S., & Noble, M.L. 2001. Environmental law and policy in India. Tripathi 1992.
17. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.

18. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
19. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
20. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
21. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
22. Wilson, E. O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
23. World Commission on Environment and Development. 1987. Our Common Future. Oxford University



SEMESTER III

Digital Education (Elementary Computer Application)

Course code: 3Y4DECC8

Credits: 03

Course Objectives:

This course is specially designed for better understanding of digital education in India. The course has been designed to introduce key concepts in digital education to the students to sharpen their understanding of importance and significance of digital education in India. The students need to develop a critical thinking about the development of India in the background of expanding digital networks and our constant dependence on them in our day-to-day life.

Learning Outcome:

- Students will understand the meaning of digital education and its importance.
- They will be able to focus on different digital platform, its utility and its applications.
- The students will be exposed to different tools of digital education available in India.
- They will understand the importance of E-Learning in the changing context of Digital India.
- They will come to know about their responsibility as citizen in digital growth in India.

UNIT I: Introduction to Digital Education 5 Classes

Meaning & Evolution of Digital Systems. Role & Significance of Digital Technology, digital education vs traditional education, advantages and disadvantages of digital education.

UNIT II: Digital Education Tools (10 Classes+ 5 Hands on Sessions)

Information & Communication Technology & Tools Interactive tools- Microsoft Teams, Google Classroom, LinkedIn Creative Tools - Google Slides, Google Spreadsheets, Google form, YouTube)

UNIT III: Digital Education in India (10 Classes + 5 Hands on Sessions)

Government initiatives for Digital education in India: SWAYAM, E-Pathshala, National digital library of India (NDL India), DigiLocker. Advantages & challenges in digital education in India.

UNIT IV: E- Governance 10 Classes)

Introduction of E-Governance in India, Types of E-Governance-G2C (Government to Citizen), G2E (Government to Employee), G2B (Government to Business), G2G (Government to Government), E – Governance in Jharkhand.

Suggested Readings:

1. E-Governance in India: Initiatives and issues by R.P.Sinha
2. Information & Communication Technology (ICT) in Education by Dr. Vanaja M,Dr. S Rajasekar, Dr. S. Arulsamy.
3. Digital India: Understanding Information, Communication and Social Change by Pradip N.

References:

1. www.slideshare.net
2. www.lisportal.com/en/lis-blog



SEMESTER III
COMMUNITY ENGAGEMENT NCC/NSS

Course code (1Y4CC6)

Total Marks: 100

Course Objectives

Understand the community in which they work and their relation, Identify the needs and problems of the community and involve them in problem-solving, develop capacity to meet emergencies and natural disasters, Practice national integration and social harmony and, Utilize their knowledge in finding practical solutions to individual and community problems.

Course Outcomes

- To impart hands-on skills in preparation, In the end of the paper, a student should be able to: - Understand the importance of having community problems and their solutions. It might help in job opportunities in some government approved NGOs, and ministry of youth affairs and sports. The students can carry out basic information about the community, which in turn will be of great help in disaster management fields. Students can also go for social community courses, opening opportunities in different social activity related departments.

Unit-I: NSS:

- Introduction, Origin and growth of NSS, Objectives, Motto, Symbol, NSS, Import National Days, NSS Song, Environmental Awareness : Natural Resources – Conservation and Management, Water conservation and Rain water harvesting, Solid waste management, Pollution control: Water, Air, Noise and Soil; Energy conservation- Wildlife Conservation, Global warming.

Unit-II: Special Programme:

- Legal Awareness – Health awareness –Blood Donation Camp, First –Aid –Career Guidance – Leadership. Training cum –Cultural Programme –Globalization ant its Economic Social and Cultural Impacts. Planning and Preparation of special Camping Programme. Planning at institutions level – Guidelines for the success of camp- Importance of successful camping programme – Guiding principles – organization of camp – Administration of camp.

Unit-III: Social Awareness:

- Basics and Social Service, Weaker Section of our society and their needs – NGOs : Role and Contribution –Civic responsibility – causes and Prevention; role of y uth – Drug Abuse and Trafficking –awareness of IV / AIDS.. National Integration : Impo tance and Necessity – Freedom Struggle and Nationalistic movement in India –

<https://twitter.com/nssybnuranchi2> National interests, Objectives, Threats and Opportunities – Unity in Diversity – Contribution of Youth in Nation Building.

Unit-IV: First Aid:

- Artificial Respiration – Control of Bleeding – Fractures – Burns – Shock – Wounds – Eye Injuries – Heat Stroke – Snake Bite – Dog Bites – Poisoning., Disaster Management : Characteristics and types of Disasters (Geological and Mountain Area Disaster , Wind and Water Related natural Disaster, Man-made Disaster) , Causes and effects, Assistance during Natural / Other Calamities Flood / Cyclone / Earth Quake / Accident etc..

Unit-V: N.S.S. Regular Activities

- NSS Programme Officer – NSS Volunteer – Community – Aims of NSS Programme /Activities – Classification of NSS Programme – Adoption of Villages – Contacting Villages / Area Leaders – Survey of the Villages / Area Identification of Problem(s) Completion of Projects – Evaluation of Project – Adoption of Slums – Survey of the Slum – Services in Slums - Coordination with Voluntary – Organizations.

REFERENCES:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. University of Mumbai National Service Scheme Manual 2009.
3. Avhan Chancellor & Brigade-NSS Wing, Training camp on Disaster Preparedness Guidelines, March 2012.
4. Rashtriya Seva Yojana Sankalpana- Prof. Dr. Sankay Chakane, Dr. Pramod Pabrekar, Diamond Publication, Pune.
5. National Service Scheme Manual for NSS District Coordinators, National Service Scheme Cell, Dept. of Higher and Technical Education, Mantralaya,
6. Annual report of National Service Scheme (NSS) published by Dept. of Higher and Technical Education, Mantralaya,
7. NSS Cell, Dept. of Higher and Technical Education, Mantralaya, UTKARSHA- Socio and cultural guidelines.
8. Case material as a Training Aid for Field Workers, Gurmeet Hans.
9. Social service opportunities in hospita's, Kapil K. Krishnan, TISS
10. New Trends in NSS, Research papers published by University of Pune.
11. ANOOGUNJ Research Journal, published by NSS Unit C. K. Thakur college
12. Training Manual for Field Work published by RGNIYD, Shreeperumbudur
13. Prof. Ghatole R.N. Rural Social Science and Community Development.
14. Purushottam Sheth, Dr. Shailaja Mane, National Service Scheme

Related Online Contents:

1. [https://en.wikipedia.org/w/index.php?search=National-service-
title=Special%3ASearch&fulltext=1&ns0=1](https://en.wikipedia.org/w/index.php?search=National-service-title=Special%3ASearch&fulltext=1&ns0=1) scheme &
2. <https://nss.gov.in>
3. <https://twitter.com/nssybnuranchi1>
4. <https://www.facebook.com/profile.php?id=100083943787477>

SEMESTER III

INTRODUCTORY REGULAR COURSE (IRC)

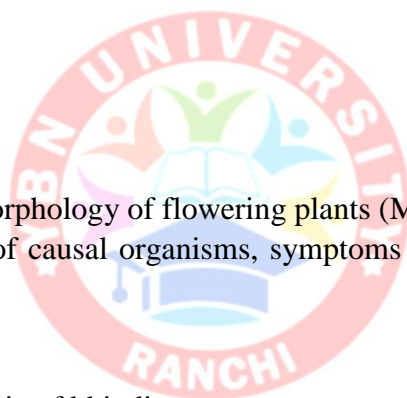
INTRODUCTORY BOTANY(1Y4BOTIRC-3)

(Credits: Theory-03)

Total Marks: 100

Basic Concept of Botany

1. Elementary idea of classification of plant kingdom, Taxonomic hierarchy up to species, Botanical Nomenclature of plants, herbarium - types and use. Family description- Solanaceae and Poaceae **(3 lectures)**
2. A concise introduction to branches and scope of botany. **(2 lectures)**
3. Diversity of Plants: General identifying features, structures, life cycle and economic importance of the following groups: **(8 lectures)**
 - s) Bacteria
 - t) Virus
 - u) Algae
 - v) Fungi
 - w) Lichens
 - x) Bryophyta
 - y) Pteridophyta
 - z) Gymnosperms
 - aa) Angiosperms: Morphology of flowering plants (Monocots and Dicots)
4. Plant pathology- Name of causal organisms, symptoms and control of the following diseases: **(2 lectures)**
 - m) Wilt of tomato
 - n) Citrus canker
 - o) Yellow vein mosaic of bhindi
 - p) Leaf curl of papaya
 - q) Black stem rust of wheat
 - r) Loose smut of wheat
5. Brief notes on ethnobotanical uses of the following plants with particular reference to Jharkhand : **(3 lectures)**
 - m) Kalmegh
 - n) Palash
 - o) Karanj
 - p) Neem
 - q) Bamboo
 - r) Sal
6. Cell - Ultra structure of a typical prokaryotic and eukaryotic cell and cell division **(4 lectures)**
 - i) Plant cell and its organelles - structure and function



- j) Cell cycle
 - k) Mitosis
 - l) Meiosis
7. Genetics: Structure and Function of DNA, Mendel's Law. **(2 lectures)**
 8. Application of Biotechnology in Agriculture and environment. **(1 lectures)**
 9. Introductory knowledge of pollination, Fertilization and seed development in Angiosperms, Monocot and Dicot seeds; Germination of seeds. **(2 lectures)**
 10. Physiology of Plants: Ascent of Sap, Transpiration, Photosynthesis and Respiration. Fermentation- Role of microbes in food production and preservation. Biological Nitrogen fixation. **(5 lectures)**
 - II. Ecology and Environment: Pond Ecosystem, Forest Ecosystem; Biogeochemical cycle – Carbon and Nitrogen. Pollution: Causes and control of air, water, soil and noise pollution; conservation of natural resources, biodiversity: definition, threats, loss and importance. Indigenous eco-friendly practices. An introduction to major global environmental issues and sustainable development. Disaster management. Peoples Biodiversity Register (PBR). **(8 lectures)**
 11. An introduction to organic farming. **(2 lectures)**
 12. Economic Botany: Food, fodder, fibre, timber, oil and pulses **(2 lectures)**
 13. Botanical Survey of India – Objectives and achievements. **(1 lectures)**

Reference Books:

1. Botany for degree students; A.C. Dutta
2. College Botany; Vol I, Ganguly, Das and Dutta
3. College Botany; Vol. II, Ganguly, Kar and Santra
4. Study of Botany; Mitra, Mitra and Guha
5. A text book of Botany; K. S. Bilgrami
6. A text book of Botany; Vol. I & II, Hait, Bhattacharya and Ghosh
7. Practical botany: Bendre and Kumar, and S. P. Lal

BOTANY PRACTICAL-IRC LAB:

1. Family descriptions of given plant.
2. Anatomical features of: monocot (root and stem) and dicot (root and stem).
3. Morphology of bacteria with the help of photographs.
4. Gram's staining technique.
5. Botanical name, common name, family and uses of cereal, pulses, oil yielding.
6. Osmosis.
7. Plasmolysis.
8. Acquaintance with the instruments.
9. Identifying features and name of the given materials/permanent slides (algae, fungi, bryophytes, pteridophytes and gymnosperms).
10. Mitosis and Meiosis: Study of materials/permanent slides.

SEMESTER III

MAJOR COURSE- MJ 3:

PLANT ANATOMY AND EMBRYOLOGY

(Credits: Theory-04, Practicals-02)

Course Objectives:

On completion of this course, the students will be able to understand:

1. To acquaint the students with internal basic structure and cellular composition of the plant body.
2. To correlate structure with important functions of different plant parts.
3. Study of various tissue systems and their development and functions in plants.

Course Outcomes:

On successful completion of this course the student shall know:

1. Knowledge of various cells and tissues, meristem, epidermal and vascular tissue system in plants.
2. Various aspects of growth, development of the tissues and differentiation of various plant organs.
3. Knowledge of basic structure and organization of plant parts in angiosperms.
4. Correlation of structure with morphology and functions.

Plant Anatomy

Unit 1: Introduction and scope of Plant Anatomy

Applications in systematics, forensics and pharmacognosy. **(2 Lectures)**

Unit 2: Tissues Simple and complex tissues (no phylogeny);

cytodifferentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers. **(8 Lectures)**

Unit 3: Apical meristems Evolution of concept of organization of shoot apex and root apex.

(4 Lectures)

Unit 4: Vascular Cambium and Wood Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels. **(12 Lectures)**

Unit 5: Adaptive and Protective Systems Anatomical adaptations of xerophytes and hydrophytes. **(4 Lectures)**

Embryology

Unit 1: Introduction

Brief account of contributions (G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope. **(2 lectures)**

Unit 2: Anther and pollen biology

Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account). **(3 lectures)**

Unit 3: Ovule

Structure; Types; Special structures—endothelium, obturator, aril, caruncle and hypostase; Female gametophyte— megasporogenesis (monosporic, bisporic and tetrasporic) and mega gametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac. **(3 lectures)**

Unit 4: Pollination and fertilization

Brief account of Pollination and double fertilization. **(3 lectures)**

Unit 5: Self incompatibility

Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization; Cybrids, invitro fertilization. **(10 lectures)**

Unit 6: Embryo, Endosperm and Seed

Structure and types; General pattern of development of dicot and monocot embryo and endosperm; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in Paeonia. Seed structure, importance and dispersal mechanisms **(7 lectures)**

Units 7: Polyembryony and apomixis:

Introduction; Classification; Causes and applications. **(2 lectures)**

Reference Books:

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc
5. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Pub. House. Delhi. 5th edition.
6. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Pub. Co. Pvt. Ltd. Delhi.
7. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
8. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands

BOTANY PRACTICAL- MJ 3 LAB:

PRACTICALS:

1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8. Root: monocot, dicot, secondary growth.
9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
11. Adaptive Anatomy: xerophytes, hydrophytes.
12. Secretory tissues: cavities, lithocysts and laticifers.
13. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehiscent anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
14. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/ photographs, fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test. germination: Calculation of percentage germination in different media using hanging drop method.
15. Ovule: Types-anatropous, orthotropous, amphitropous/ campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/ specimens/ photographs).
16. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
17. Intra-ovarian pollination; Test tube pollination through photographs.
18. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.
19. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.

SEMESTER IV

Semester	Course Structure For Semester-IV Common, Introductory, Major, Minor, Vocational & Internship Course						
	Code	Paper	Credits	Theory	Internal Assessment	Practical	Total
IV	4Y4BOT MJ-4	Major paper-4 (Disciplinary/Interdisciplinary Major) Ecology and Environmental Studies	6	50	25	25	100
	4Y4BOT MJ-5	Major paper-5 (Disciplinary/Interdisciplinary Major) Plant Taxonomy & Economic Botany	6	50	25	25	100
	4Y4BOT MN-1	Minor paper-1 (Disciplinary/Interdisciplinary Minor) Diversity of Plants, Ecology and Environmental Science	6	50	25	25	100
	4Y4VS-1	Vocational Studies-1 (Minor)	4	50	25	25	100



SEMESTER IV
MAJOR COURSE- MJ 4:
ECOLOGY AND ENVIRONMENTAL STUDIES

(Credits: Theory-04, Practicals-02)

Course Objectives:

After completion of the course, the learner shall be able to understand:

1. To introduce the students with environmental factors affecting the plants, the basic principles of ecology and phytogeography.
2. To make them understand complex community patterns, processes, and ecosystem functioning.

Course Outcomes:

On successful completion of this course the student should know:

1. It will acquaint the students with complex interrelationship between organisms and environment; make them understand methods to studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.
2. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

Unit 1: Introduction

Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis. **(3 lectures)**

Unit 2: Soil

Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development. **(6 lectures)**

Unit 3: Water

Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table. **(4 lectures)**

Unit 4: Light, temperature, wind and fire Variations; adaptations of plants to their variation.

(3 lectures)

Unit 5: Biotic interactions

Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop. **(2 lectures)**

Unit 6: Population ecology

Characteristics and Dynamics. Ecological Speciation **(4 lectures)**

Unit 7: Plant communities

Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

(6 lectures)

Unit 8: Ecosystems Structure;

Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Pond ecosystem, grassland ecosystem and forest ecosystem. **(3 lectures)**

Unit 9: Functional aspects of ecosystem

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus. **(6 lectures)**

Unit 10: Phytogeography

Principles; Continental drift; Theory of tolerance; Endemism; hotspots, Brief description of major Terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation. Application of Remote sensing and GIS (Geographical International System) **(6 lectures)**

Unit 11: Pollution

Introduction to pollutants, pollution, causes, control and impact of air, water, soil, noise. Role of Biotechnology and Nanobiotechnology in pollution control. **(4 lectures)**

Unit 12: Climate change

Major global environmental issues: Climate change, ozone depletion, global warming, acid rain. Disaster management: Natural and Man-made. Objectives of United Nations Framework Convention on Climate Change (UNFCCC), Green hydrogen. **(5 lectures)**

Unit 13: Biodiversity and Conservation

Biodiversity: Definition, threats and importance, natural resources: renewable and non-renewable, conservation- in-situ and ex-situ methods. IUCN conservation category: Endangered, threatened, vulnerable, Biodiversity management committees, people's biodiversity register; Red Data Book, sustainable development goals: Biofuel. Introduction to United Nation environment program, Convention on Biological Diversity, National Biodiversity Authority and Botanical Survey of India. **(8 lectures)**

Reference Books:

1. Raziuddin, M., Mishra P.K. 2014, A Handbook of Environmental Studies, Akanaksha Publications, Ranchi.
2. Mukherjee, B. 2011: Fundamentals of Environmental Biology. Silverline Publications, Allahabad.
3. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.

4. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
5. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
6. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
7. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
8. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36- --37.
9. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29---64). Zed Books.
10. McNeill, John R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
11. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
12. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. *Environmental and Pollution Science*. Academic Press.
13. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
14. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
15. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. Tripathi 1992.
16. Sengupta, R. 2003. *Ecology and economics: An approach to sustainable development*. OUP.
17. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
18. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
19. Thapar, V. 1998. *Land of the Tiger: A Natural History of the Indian Subcontinent*.
20. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
21. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
22. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University
23. Odum, E.P. (2005). *Fundamentals of ecology*. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
24. Singh, J.S., Singh, S.P., Gupta, S. (2006). *Ecology Environment and Resource Conservation*. Anamaya Publications, New Delhi, India.
25. Sharma, P.D. (2010). *Ecology and Environment*. Rastogi Publications, Meerut, India. 8th edition.
26. Wilkinson, D.M. (2007). *Fundamental Processes in Ecology: An Earth Systems Approach*. Oxford University Press. U.S.A.
27. Das, M.C. Kormondy, E.J. (1996). *Concepts of ecology*. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

BOTANY PRACTICAL- MJ 4 LAB:

PRACTICALS:

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH of various soil and water samples (pH meter, universal indicator/ Lovibond comparator and pH paper)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each).
(b). Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanchae) Epiphytes, Predation (Insectivorous plants).
7. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
8. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
9. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
10. Field visit to familiarise students with ecology of different sites
11. Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Visit to a local polluted site--Urban/Rural/Industrial/Agricultural.
12. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems--pond, river, Delhi Ridge, etc.

SEMESTER IV
MAJOR COURSE- MJ 5:
PLANT TAXONOMY & ECONOMIC BOTANY

(Credits: Theory-04, Practicals-02)

Course Objectives:

After completion of the course, the learner shall be able to understand:

1. To gain the knowledge on the taxonomy, phylogeny of plants.
2. To make the students familiar with economic importance of diverse plants that offer resources to human life.
3. It emphasizes the plants used as- food for man, fodder for cattle, feed for poultry, plants having medicinal value and also plant source of huge economic value etc.

Course Outcomes:

On successful completion of this course the student should know the:

1. Understanding of systematics its importance in bioresource utilization and biodiversity management. Nomenclature pattern, Phylogeny, Classification systems of the plants.
2. After studying Economic Botany, students would have first-hand information of plants used as food, the various kinds of nutrients available in the plants. The dietary requirements of proteins, fats, aminoacids, vitamins etc that can be met by plants.
3. The students will learn to perform the micro-chemical tests to demonstrate various components.
4. The students will learn about the use of fibre plants, beverages, fruits and vegetables that are integral to day to day life of plants.
5. Students will learn to explore the regional diversity in food crops and other plants and their ethnobotanical importance as well.

Plant Taxonomy

Unit 1: Introduction to Plant Taxonomy

1. Fundamental components of taxonomy (identification, nomenclature, classification)
2. Taxonomic resources: Herbarium- functions & important herbaria, Botanical gardens, Flora.
3. Botanical Nomenclature- Principles and rules of ICN (ranks and names; principle of priority, binomial system; type method (Typification), author citation and valid-publication). **(4 lectures)**

Unit 2: Taxonomic hierarchy, Types of classification and Evidences

1. Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).
2. Types of classification- Artificial, Natural and Phylogenetic.

3. Bentham & Hooker's system of classification (up to series) - merits and demerits.
4. Engler & Prantle's system of classification (up to series) - merits and demerits.
5. Hutchinson classification with its - merits and demerits.
6. Angiosperm phylogeny group (APG IV) system classification.
7. Taxonomic evidences from palynology, cytology, phytochemistry & Molecular biology data (Protein and Nucleic acid homology). **(10 lectures)**

Unit 3: Plant Systematics

1. Diagnostic characteristics, Systematic Phylogeny and economic importance of families: Ranunculaceae, Brassicaceae, Apocynaceae, Apiaceae, Asteraceae, Solanaceae, Lamiaceae, Ephorbiaceae. Liliaceae, Poaceae. **(10 lectures)**

Unit 4: Modern trends in Plant taxonomy:

1. Phenetics and Cladistics: Brief idea on Phenetics, Numerical taxonomy- methods, Operational Taxonomic Units (OUT's),
2. Cladistics- construction of dendrogram and primary analysis; Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy.
3. Origin and evolution of angiosperms; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram). **(6 lectures)**

Economic Botany

Unit 1: Introduction, Research centres, Concept of centres of origin, their importance with reference to Vavilov's work. **(4 lectures)**

Study of following economically important plants with special reference to Jharkhand:

Unit 2: Cereals and Millets: Wheat, Rice, Ragi and Jowar -Origin, morphology, uses **(2 Lectures)**

Unit 3: Pulses & Vegetables General account with special reference to Gram, soybean and Potato **(4 Lectures)**

Unit 4: Spices: General account with special reference to clove, black pepper, cinnamon, Ginger and Turmeric (Botanical name, family, part used, morphology and uses) **(4 Lectures)**

Unit 5: Beverages Tea and Coffee (morphology, processing, uses) **(4 Lectures)**

Unit 6: Oils and Sugar General description with special reference to groundnut and sugarcane **(4 Lectures)**

Unit 7: Timber and Fibre and Yielding Plants General description (Botanical name, family, parts used, morphology and uses) **(4 Lectures)**

Unit 8: Medicinal Plants Brief account of Ocimum, Tinospora, Aloe, Rauvolfia, Emblica and Cathranthus (Botanical name, family, part used, morphology and uses) **(4 Lectures)**

Reference Books

1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
5. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.
6. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
7. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.

BOTANY PRACTICAL- MJ 5 LAB:

PRACTICALS:

Plant Taxonomy & Economic Botany

1. Systematic study of locally available plants belonging to the families prescribed in theory syllabus with reference to vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification)
2. Field visit (local) – Subject to grant of funds from the university.
3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).
4. Study of economically important plants: Wheat, Rice, Gram, Soybean, Potato, Black pepper, Clove, Cinnamon, Ginger, Turmeric, Tea, Coffee, Cotton, Groundnut, Sugarcane and Medicinal plants through specimens, sections.

SEMESTER IV
MINOR ELECTIVE (MN 1)
DIVERSITY OF PLANTS, ECOLOGY AND
ENVIRONMENTAL SCIENCE (4Y4BOTMN-1)

(Credits: Theory-04, Practicals-02)

Course Objectives:

1. To introduce the students with diversity of plants such as microbes, algae, fungi, archegoniates, environmental factors affecting the plants, the basic principles of ecology and phytogeography.
2. To make them understand complex community patterns and processes, and ecosystem functioning.

Course Learning Outcomes:

1. It acquaints the students with diversity of plants like microbes, algae, fungi, archegoniates and, complex interrelationship between organisms and environment; community patterns and processes, ecosystem functions, and principles of phytogeography.
2. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

DIVERSITY OF PLANTS

Unit 1: Microbes

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

(5 Lectures)

Unit 2: Algae

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: Nostoc, Oedogonium, Vaucheria, Ectocarpus, Polysiphonia. Economic importance of algae

(5 Lectures)

Unit 3: Fungi

Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of Penicillium, Puccinia, Ustilago, Alternaria; Symbiotic Associations Lichens: General account of Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

(5 Lectures)

Unit 4: Introduction to Archegoniate

Identifying features of archegoniates, Transition to land habit, Alternation of generations.

(2 Lectures)

Unit 5: Bryophytes

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria. (Developmental details not to be included). Ecology and economic importance of bryophytes with special reference to Sphagnum.

(5 Lectures)

Unit 6: Pteridophytes

General characteristics, classification, Early land plants Fossil and Fossilization process (Rhynia). Classification (up to family), morphology, anatomy and reproduction of Lycopodium, Equisetum and Pteris. Heterospory and seed habit, stelar evolution.

(5 Lectures)

Unit 7: Gymnosperms

General characteristics, classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus. Ecological and economical importance.

(4 Lectures)

ENVIRONMENTAL SCIENCE

Unit 1: Introduction to environmental studies

Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

(2 lectures)

Unit 2: Ecosystems

Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: Forest ecosystem Grassland ecosystem Desert ecosystem Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(2 lectures)

Unit 3: Natural Resources: Renewable and Non--renewable Resources

Land resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

Water: Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).

Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(4 lectures)

Unit 4: Biodiversity and Conservation

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega--biodiversity nation; Endangered and endemic species of India.

Threats to biodiversity: Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity: In--situ and Ex--situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. **(3 lectures)**

Unit 5: Environmental Pollution Environmental pollution:

types, causes, effects and controls; Air, water, soil and noise pollution Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies. **(3 lectures)**

Unit 6: Environmental Policies & Practices

Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. **(3 lectures)**

PLANT ECOLOGY

Unit 1: Introduction

General introduction. **(1 lectures)**

Unit 2: Ecological factors

Climatic, Edaphic and Biotic factors: Variation of Optimal and limiting factors; Shelford law of tolerance. Ecological Adaptation of hydrophytes and xerophytes. **(3 lectures)**

Unit 3: Plant communities

Succession (Primary and secondary); hydrosere, xerosere. **(2 lectures)**

Unit 4: Ecosystem

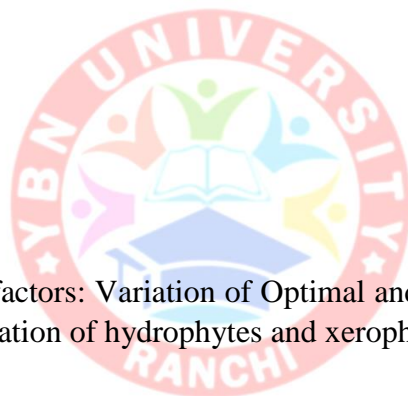
Structure component, types-Pond & Forest, Ecosystem. Energy flow trophic organisation; Food chains and food webs, Ecological pyramids; Biogeochemical cycling with special reference to of carbon and nitrogen. **(3 lectures)**

Unit 5: Phytogeography

Principle biogeographical zones of India. **(2 lectures)**

Reference Books:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.



4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). *Introductory Mycology*, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). *Biology*. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). *Pteridophyta*, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). *Gymnosperms*. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). *An introduction to Embryophyta. Vol. I. Bryophyta*. Central Book Depot, Allahabad.
9. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
10. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
11. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
12. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
13. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
14. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36-37.
15. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29--64). Zed Books.
16. McNeill, John R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
17. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
18. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. *Environmental and Pollution Science*. Academic Press.
19. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
20. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
21. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. Tripathi 1992.
22. Sengupta, R. 2003. *Ecology and economics: An approach to sustainable development*. OUP.
23. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*.
24. S. Chand Publishing, New Delhi.
25. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
26. Thapar, V. 1998. *Land of the Tiger: A Natural History of the Indian Subcontinent*.
27. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
28. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
29. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University
30. Kormondy, E.J. (1996). *Concepts of Ecology*. Prentice Hall, U.S.A. 4th edition.
31. Sharma, P.D. (2010) *Ecology and Environment*. Rastogi Publications, Meerut, India. 8th edition

BOTANY PRACTICAL- MN 1 LAB:

PRACTICALS:

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining.
4. Morphology and structural details of forms belonging to Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperm prescribed in the syllabus and their temporary/permanent stained microscopic slide preparation and studies.
5. Comments upon the spots
6. Vive-voce
7. Field study report
8. Class records, Herbarium, Charts, Model etc.
9. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, hygrometer, rain gauge and lux meter.
10. Determination of pH, and analysis of two soil samples for carbonates and nitrates by rapid field test.
 - a) Study of morphological adaptations of hydrophytes (Hydrilla Eichhornia) and xerophytes (Nerium, Pinus needle) (two each).
 - b) Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanchae), Epiphytes, Predation (Insectivorous plants)
11. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
12. Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Visit to a local polluted site--Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems--pond, river, Delhi Ridge, etc.

SEMESTER IV
INTRODUCTION TO STOCK MARKET – VS-1
Subject Code: 4Y4VS-1

(Credits: Theory-01 + Practical 02)

Course Content:

Unit I: Financial System and Services:

Nature and role of financial structure - Financial system and financial markets - Financial system and economic development -Indian financial system: an overview; Investment alternatives and evaluation; Reforms in financial system, Investment banking; Credit Rating; factoring and Forfaiting; Housing Finance; Leasing and hire purchase; Financial inclusion and Microfinance

Unit II: Financial Markets:

Money market- meaning, constituents & function; Money market instruments – call money, treasury bills, and certificate of deposits, Commercial bills, and trade bills, Acceptance Houses, Discount Houses; Capital markets – primary and secondary market; Government securities markets; Role of SEBI - an overview and recent developments. Role of RBI, SEBI, DFHI, SHCI in Financial Markets.

Unit III: Financial Institutions:

Reserve bank of India – organization, management, and function; Commercial banks - meaning, functions and investment policies; Development banks – concept, objectives, and function; Insurance companies – objectives, role, and investment practices, -IRDS; Unit Trust of India – objective, function, and schemes; role and functions of nonbanking financial institutions; Merchant banking-functions and role.

Unit IV: Financial Instruments

Sources of finance – Financial Instruments – Types, Features and advantages – Equity and special types of equity, ADRs & GDRs; Preferred stock - Equity derivatives – Credit derivatives-Asset –backed securities - Convertibles and warrants - Types of Bonds and debentures- Non- Marketable Financial Assets - Options instruments – securitization.

Unit V: Mutual Funds:

Concept and performance of Mutual funds; Regulation of Mutual funds (with special reference to SEBI guidelines); Designing and marketing of mutual fund schemes; Latest mutual funds schemes in India – an overview; Mutual Fund Evaluation and Tax aspects of Mutual Fund Investments.

Unit VI: Capital Markets in India

An overview of Indian Securities Market, Meaning, Functions, Intermediaries, Role of Primary Market – Methods of floatation of capital – Problems of New Issues Market – IPO's- Investor protection in primary market – Recent trends in primary market – SEBI measures for primary market.

Unit VII: Stock exchanges and its Functions:

Meaning, Nature, Functions of Secondary Market – Organization and Regulatory framework for stock exchanges in India – SEBI: functions and measures for secondary market – Overview of major stock exchanges in India - Listing of Securities: Meaning – Merits and Demerits – Listing requirements, procedure, fee – Listing of rights issue, bonus issue, further issue – Listing conditions of BSE and NSE – Delisting

Unit VIII: Trading, settlement and Surveillance

System in Stock Exchanges: Different trading systems – BSE - BOLT System – Different types of settlements - Pay-in and Pay-out – Bad Delivery – Short delivery – Auction – NSE – NEAT system options – Market types, Order types and books – De-mat settlement – Physical settlement – Institutional segment – Funds settlement – Valuation debit – Valuation price – Bad and short delivery Risk management system in BSE & NSE – Margins – Exposure limits – Surveillance system in BSE & NSE – Circuit breakers

Unit IX: Stock Market Indices:

Meaning, Purpose, and Construction in developing index – Methods (Weighted Aggregate Value method, Weighted Average of Price Relatives method, Free-Float method) – Stock market indices in India – BSE Sensex - Scrip selection criteria – Other BSE indices (briefly) – NSE indices – S&P CNX Nifty – Scrip selection criteria – Construction – Stock market indices in foreign countries (Overview).

Unit X: Commodity and Currency Markets:

Commodity exchanges: evolution and history- role in globalizing economy – governing regulations – price –risk management – commodity exposure – hedge accounting – currency futures – managing exchange rate – carbon markets – weather derivatives – ETFs – Purpose, Importance, types, construction

PRACTICALS:

60 Lectures

1. Visit to a local market to study various marketing functions performed by different agencies (market functionaries).
2. Identification of marketing channels for selected mutual fund.
3. Identification of marketing channels for selected Equity.
4. Identification of marketing channels for selected commodity.
5. Computation of marketable and marketed surplus of important commodities.
6. Construction of index numbers.
7. Collection of data regarding marketing cost and marketing margins of different commodities and presentation of report in the class.
8. Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning.
9. Application of principles of comparative advantage of international trade
10. Plotting and study of demand and supply curves and calculation of elasticity's.
11. Study of relationship between market arrivals and prices of some selected commodities.
12. Study of price behaviour over time for some selected commodities.