

KOLHAN UNIVERSITY, CHAIBASA JHARKHAND



Revised Curriculum and Credit Frame Work

**As per FYUGP, NEP-2020
(U.G. Botany- 2022 Onwards)**

Major Papers- From MJ 1 to MJ 20 as per FYUGP Syllabus under NEP

**UNIVERSITY DEPARTMENT OF BOTANY
KOLHAN UNIVERSITY, CHAIBASA
WEST SINGHBHUM, JHARKHAND – 833202**

UNIVERSITY DEPARTMENT OF BOTANY

Kolhan University, Chaibasa

Four-Year Under Graduate Programme (FYUGP)

As per Provisions of NEP-2020 to be implemented from Academic Year 2022-23

COMPOSITIONS OF BOARD OF STUDIES

1. Dr. Krishna Pyare

Head, University Deptt. of Botany

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Assistant Professor

University Deptt. of Botany

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3. Mrs. Pushpa Salo Linda

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Assistant Professor

University Deptt. of Botany

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(Dr. Krishna Pyare)

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Kolhan University, Chaibasa

**UNIVERSITY DEPARTMENT OF BOTANY, K.U
CHAIBASA
FYUGP 2023**

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Major Paper From MJ 1 to MJ 20 as per FYUGP Syllabus under NEP

Sem	Code	Title of the Paper	Credits (Th +P)
I	MJ-1	Major Paper-1 (Phycology & Microbiology)	3
	MJ1(Practical)	Practical Based on MJ-1	0 + 1
II	MJ 2	Major Paper -2 (Mycology & Phytopathology)	3
	MJ 3	Major Paper -3 (Bryophyte & Pteridophytes)	3
	MJ2(Practical)	Practical Based On –MJ 2 and MJ 3	0 + 2
III	MJ 4	Major Paper-4 (Gymnosperms & Paleobotany)	3
	MJ 5	Major Paper -5 (Anatomy of Angiosperms)	3
	MJ3(Practical)	Practical Based On- MJ -4 and MJ- 5	0 + 2
IV	MJ 6	Major Paper-6 (Reproductive biology of Angiosperms)	3
	MJ 7	Major Paper -7 (Biomolecules)	3
	MJ 8	Major Paper -8 (Cell Biology)	3
	MJ4(Practical)	Practical Based On MJ-6, MJ-7 and MJ-8	0 + 3
V	MJ 9	Major Paper -9 (Molecular Biology)	3
	MJ 10	Major Paper -10 (Genetics & Cytogenetics)	3
	MJ 11	Major Paper -11 (Economic botany & plant resource utilization)	3
	MJ5(Practical)	Practical Based on MJ-9, MJ-10 and MJ-11	0 + 3
VI	MJ 12	Major Paper -12 (Plant Systematics)	3
	MJ 13	Major Paper -13 (Plant Physiology)	3
	MJ 14	Major Paper -14 (Plant Metabolism)	3
	MJ 15	Major Paper-15 (Plant Ecology)	3
	MJ6(Practical)	Practical Based On MJ-12, MJ-13, MJ-14 and MJ-15	0 + 4

VII	MJ 16	Major Paper -16 (Plant Breeding)	3
	MJ 17	Major Paper -17 (Genetic Engineering & Biotechnology)	3
	MJ 18	Major Paper -18 (Biostatistics)	3
	MJ 19	Major Paper-19 (Research Methodology)	3
	MJ 7(Practical)	Practical based on -MJ-16,MJ-17,MJ-18 and MJ-19	0 + 4
VIII	MJ 20	Major Paper-20 (Natural resources Managements)	3
	MJ8(Practical)	Practical Based On MJ-8	0 + 1

- **For End Semester Examination (ESE 60 Marks , 3 Hrs Exam) :**

There will be **two** group of question. **Group A is compulsory** which will contain three questions. **Question No. 1 will be very short answer types** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks each. **Group B will contain descriptive type** five questions of fifteen marks (15) each, out of which any three are to answer.

- **For End Semester Examination (ESE 75 Marks , 3 Hrs Exam) :**

There will be **two** group of question. **Group A is compulsory** which will contain three questions. **Question No. 1 will be very short answer type** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks each. **Group B will contain descriptive type** six questions of fifteen marks (15) each, out of which any four are to answer

SEMESTER - I
Paper Title – Major Paper 1 (MJ-1)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Microbiology and Phycology

Course Outcomes: ---

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

1. General characteristics, structure and replication of Viruses.
2. Examine the general characteristics of bacteria and their cell reproduction/ Recombination.
3. To understand detail information of different classes of Algae like Cyanophyta, Chlorophyta, Xanthophyta, Phaeophyta and Rhodophyta.
4. Commercial cultivation and their economic importance of algae.

Full Mark - 60

Time: - 3 Hrs

Unit I: Viruses and Bacteria

15 Hrs

General characteristics; classification (Baltimore), structure and replication of DNA virus (T4 phage), lytic and lysogenic cycle; RNA virus (TMV), General characteristics of bacteria, Cell structure; Reproduction and recombination (conjugation, transformation and transduction).

Unit II: Algae, Cyanophyta and Xanthophyta

15 Hrs

Characteristic features of Algae & its Classification (by Fritsch), Ranges of thallus organization in Cyanophyta and Xanthophyta. Cell structure and Reproduction of *Spirulina*, *Nostoc* & *Vaucheria*.

Unit III: Chlorophyta and Phaeophyta and Rhodophyta

15 Hrs

General characteristics features of Chlorophyta, Phaeophyta and Rhodophyta; Occurrence & Range of thallus organization of Chlorophyta, Phaeophyta and Rhodophyta. Structure and Reproduction in *Volvox*, *Oedogonium*, *Chara*, *Ectocarpus* and *Polysiphonia*. Commercial cultivation and economic importance of green algae, red algae and brown algae.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings:-

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Algae. S Chand and Co, New Delhi.
4. Sharma T.A., Dubey, R.C. And Maheshwari, D.K. (1999). A Text Book of Microbiology. S Chand and Co, New Delhi.
5. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
6. Campbell, N.A., Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky P.V. and Jackson, R.B. (2008). Biology, 8th edition. Pearson Benjamin Cummings, USA..
7. Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi

Semester – I

Paper Title – Botany Practical – MJ-I Lab

Credits – 01

Full Marks – 25

Pass Marks - 10

Microbiology

1. Electron micrographs/Models of viruses – T4 and TMV, Line drawings/Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs. Water bloom. Electron Micrographs or charts of bacteria, binary fission, endospore, conjugation.
3. Gram-staining of root nodule and curd.

Phycology

1. Microscopic observation of vegetative and reproductive structures of *Nostoc*, *Volvox*, *Oedogonium*, *Chara*, *Vaucheria*, *Ectocarpus*, and *Polysiphonia*.

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Mark

SEMESTER - II

Paper Title – Major Paper 2 (MJ-2)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Mycology & Phytopathology

Course Outcomes: ---

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

1. Identify true fungi and demonstrate the principles and application of plant pathology in the control of plant disease.
2. Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies.
3. Identify the common plant diseases according to geographical locations and device control measures .
4. Understand the economic and pathological importance of fungi, bacteria , and viruses .

Full Mark - 60

Time: - 3 Hrs

Unit I: Introduction to fungi and classification

10 lectures

Introduction – General characters, ecology and significance ,range of thallus organization ,nutrition ,reproduction and classification (Alexopolus). Economic Importance of fungi.

Unit II: True Fungi

10 lectures

General characteristics; ecology significance and Life cycle of *Rhizopus* , *peziza* , *puccinia*, & *Cercospora*.

Unit III: Symbiotic associations

10 lectures

Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Economic importance of Lichen; Mycorrhiza- Ectomycorrhiza, Endomycorrhiza and their significance.

Unit IV: Phytopathology

15 lectures

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.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings:-

1. Agrios, G.N. (1997). Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd. 5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

Paper Title – Major Paper 3 (MJ-3)
CREDIT-04 [THEORY- 03 + PRACTICAL - 01]
Bryophytes & Pteridophytes

Course outcomes :---

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

1. Demonstrate an understanding of Bryophytes and Pteridophytes (Archegoniate).
2. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes and Pteridophytes .
3. Understanding of plant evolution and their transition to land habitat.
4. Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes and Pteridophytes.

Full Mark - 60

Time: - 3 Hrs

Unit I: Bryophytes

20 lectures

General characteristics; Adaptations to land habit; Classification (up to family); Range of thallus organization. Morphology, anatomy, reproduction and evolutionary trends in Riccia, Marchantia, Anthoceros, Sphagnum and Funaria; Progressive sterilization of Bryophytes. ecological and economic importance with special reference to Sphagnum.

Unit II: Pteridophytes

25 lectures

General characteristics; Classification (up to family); General account of early land plants. Morphology, anatomy and reproduction of Psilotum, Selaginella, Equisetum and Pteris (Developmental details not to be included). Apogamy and apospory, heterospory and seed habit, telome theory, stellar evolution; Common ferns of India, Ecological and economic importance.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings:-

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

Semester – II

Paper Title – Botany Practical Based on – MJ-2 and MJ-3

Credits – 02

Time- 3 Hrs

Full Marks – 50

Pass Marks - 20

Group- “A” Based on MJ-2

Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).

1. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
2. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
3. *Peziza*: sectioning through ascocarp.
4. *Alternaria*: Specimens/photographs and temporary mounts.
5. *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.
6. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
7. *Albugo*: Study of symptoms of plants infected with *Albugo*; asexual phase study through section/temporary mounts and sexual structures through permanent slides.

8. 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).
9. 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.

Group – “ B’ Based on MJ-3

1. *Riccia* – Morphology and Anatomy of thallus.
2. *Marchantia*- Morphology and Anatomy of thallus, whole mount of rhizoids and Scales, vertical section of thallus through Gemma cup (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).
3. *Anthoceros*- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
4. *Sphagnum*- Morphology of plant, whole mount of leaf (permanent slide only)
5. *Funaria*- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule; whole mount of protonema.
6. *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).
7. *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).
8. *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, whole mount of sporangiophore, whole mount of spores (temporary slide), transverse section of rhizome (permanent slide).
9. *Pteris*- Morphology, transverse section of rachis, transverse section of sporophyll through sorous, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).

Experiments – 30 Marks
Viva Voice –10 Mark
Practical Records – 10 Mark

SEMESTER - III

Paper Title – Major Paper 4 (MJ-4)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Gymnosperm & Paleobotany

Course outcomes :---

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

1. Demonstrate an understanding of Gymnosperms and Palaeobotany.
2. Develop critical understanding on morphology, anatomy and reproduction of Gymnosperms
3. Understanding of plant evolution and their transition to land habitat.
4. Demonstrate proficiency in the experimental techniques and methods of appropriate Gymnosperms

Full Mark - 60

Time: - 3 Hrs

Unit I: Gymnosperms

20 lectures

General characteristics, classification (up to family), morphology, anatomy and reproduction of Cycas, Pinus and Gnetum (excluding developmental details); Cycas and Pinus of India, Ecological and economic importance.

Unit II : PALAEOBOTANY

25 lectures

1. Basic principles of Paleobotany-conditions of fossilization, different types of Sedimentary rocks bearing fossils.

2. Study of *Lyginopteris* and *Cycadeoidea*.
3. Modes of fossilization-kinds of Fossils-Techniques involve in the study of plant Fossils, Paleobotanical nomenclature.
4. A brief idea about the Plant Fossils of Rajmahal area of Jharkhand.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings:-

1. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International Publishers, New Delhi, India
2. Chamberlain, C.J. Gymnosperms: Structure and evolution
3. Sporne K. R: The Morphology of Gymnosperms.
4. Vashistha, P.C. 1978: Gymnosperms.
5. Foster & Gifford. Comparative Morphology of Vascular Plants
6. Delevoryas, T.1963. Morphology and evolution of Fossil Plants
7. Arnold C.W. introduction to Paleobotany
8. Shukla & Mishra: Essentials of Paleobotany
9. Steward, W.N. 1988: Paleobotany & Evolution of plants
10. Sergey, Moyen: Fundamentalist of Paleobotany – 1098
11. Taylor, T.N. 1981. Introduction to Fossils

Paper Title – Major Paper 5 (MJ-5)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Anatomy of Angiosperm

Course outcomes :---

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

1. Develop an understanding of concepts and fundamentals of plant anatomy
2. Examine the internal anatomy of plant systems and organs

3. Develop critical understanding on the evolution of concept of organization of shoot and root apex.
4. Analyse the composition of different parts of plants and their relationships
5. Evaluate the adaptive and protective systems of plants

Full Mark - 60

Time: - 3 Hrs

Unit I: Adaptive and Protective Systems

10 lectures

Introduction to Epidermal tissue system, cuticle, trichomes, stomata (structure, function and classification); Anatomical adaptations of xerophytes, mesophytes and hydrophytes..

Unit II: Introduction to plant anatomy and plant body

10 lectures

Internal organization of plant body: tissue system, types of cells and tissues. Classification of tissues; Simple and complex tissues,

Unit III: Apical meristems

10 lectures

Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation); Organization of root apex (Apical cell theory, Histogen theory, Korper- Kappe theory).

Unit IV: Vascular Cambium and Wood

15 lectures

Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Anomalous secondary growth; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings:-

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergamon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/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. Any local/state/regional flora published by BSI or any other agency

Semester – III

Paper Title – Botany Practical Based on – MJ-4 and MJ-5 Credits – 02

Time- 3 Hrs

Full Marks – 50

Pass Marks - 20

Group- “A” Based on MJ-4

1. *Cycas*- Morphology (coralloid roots, 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).

2. *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 and radial longitudinal sections stem (permanent slide).

3. *Gnetum*- Morphology (stem, male and female cones), transverse section of stem, vertical section of ovule (permanent slide)

4. Study of Fossils through Permanent Slides / Photographs.

Group – “ B’ Based on MJ-5

Study of anatomical details through permanent slides/temporary stain mounts/
macerations/museum specimens with the help of suitable examples or experimentally

1. Study of stomata through peel method and replica method.
2. Simple microtomy – hand sections and / or using microtome- handheld or rotary microtome
3. Staining techniques
4. Apical meristem of root, shoot and vascular cambium.
5. Distribution and types of parenchyma, collenchyma and sclerenchyma.
6. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
7. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
8. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
9. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
10. Root: monocot, dicot, secondary growth.
11. Stem: monocot, dicot - primary and secondary growth; anomalous secondary growth in Achyranthes, Boerhaavia and Dracaena; periderm; lenticels.
12. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
13. Adaptive Anatomy: xerophytes, hydrophytes.

Experiments – 30 Marks

Viva Voice – 10 Mark

Practical Records –10 Mark

SEMESTER - IV

Paper Title – Major Paper 6 (MJ-6)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Reproductive Biology of Angiosperm

Course Outcomes: ---

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

1. Recall the history of reproductive biology of angiosperms & recognize the importance of genetic and molecular aspects of flower development
2. Understand structure and functions of anther wall and pollen wall
3. Evaluate the special structures of Ovule
4. Comprehend the causes of Polyembryony and apomixes with its classification.

Full Mark - 60

Time: - 3 Hrs

Unit I: Introduction

5 lectures

History (contributions of G.B. Amici, W. Hofmeister E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope. Types of reproduction and regeneration in plants: Sexual, asexual / vegetative reproduction.

Unit II: Flower Formation, Male and Female Gametophyte Development

15 lectures

Flower as a modified determinate shoot. Anther and pollen biology: Anther wall: Structure and functions, micro-sporogenesis, Micro- gametogenesis; Pollen wall structure, Palynology and scope (a brief account); Ovule: Types of ovules; Special structures— endothelium, obturator, aril, caruncle and hypostase; Female gametophyte— mega- sporogenesis (monosporic, bisporic and tetrasporic) and mega- gametogenesis (details of Polygonum type); Ultrastructure of mature embryo sac.

Unit III: Pollination and Fertilization

5 lectures

Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.

Unit IV: Embryo, Endosperm and Seed, Polyembryony and Apomixes

20 lectures

Structure and types of embryo; General pattern of development of dicot and monocot embryo; Suspensor: structure and functions; structure and development of endosperm; Embryo-endosperm relationship; Nutrition of embryo;. Seed structure, importance and dispersal mechanisms. Polyembryony and apomixes: Introduction; Classification; Causes and applications.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi.
2. Pandey, A.K. (1997). Introduction to Embryology of Angiosperms. CBS Publishers & Distributors, New Delhi.
3. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
4. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands. 5. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlan

Paper Title – Major Paper 7 (MJ-7)

CREDIT-04 [THEORY- 03 + PRACTICAL - 01]

Biomolecules

Course Outcomes:---

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

1. Develop understanding on chemical bonding among molecules.
2. Describe the relationship between the structure and function of biomolecules.
3. Classify the enzymes and explain mechanism of action and structure.

Full Mark - 60

Time: - 3 Hrs

Unit I: Bioenergetics

5 lectures

Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as an energy currency molecule. Types and significance of chemical bonds; Structure and properties of water; significance of pH and buffers.

Unit II: Biomolecules

20 lectures

Carbohydrates: Nomenclature and classification and isomeric form; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides. Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerides. Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins. Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit III: Enzymes

15 lectures

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), enzyme inhibitors and factors affecting enzyme activity.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
2. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
3. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.

4. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
5. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H.Freeman.
6. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company
7. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.

Paper Title – Major Paper 8 (MJ-8)
CREDIT-04 [THEORY- 03 + PRACTICAL - 01]
Cell Biology

Course Outcomes:---

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

1. Identify the various types of cell, chemical composition ,structure of cell wall and cell membrane.
2. To know about the cell organells of the plants along with functions .
3. Compare the structure and function of cells & explain the development of cells.
4. To know about the Mitosis and Meiosis and role of Proteins.

Full Mark - 60

Time: - 3 Hrs

Unit I: Cell Introduction

7 lectures

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Plant and animal cells; Origin of eukaryotic cell (Endosymbiotic theory).

Unit II : Cell Wall and Plasma Membrane

10 lectures

Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Unit III : Cell Organelles

20 lectures

Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament; Intracellular trafficking. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Lysosomes and Vacuoles. Endomembrane system: Endoplasmic Reticulum – Types and Structure. Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus;

Unit IV: Cell Division

8 lectures

Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle - checkpoints and regulation; role of protein kinases.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8th edition. Pearson Education Inc. U.S.A.
2. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Semester – IV

**Paper Title – Botany Practical Based on – MJ-6, MJ-7 and
MJ-8**

Credits – 03

Time- 6 Hrs

Full Marks –7 5

Pass Marks -30

Group- “A” Based on MJ-6

1. Anther: Wall structure; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bi-celled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
2. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, pseudomonads, polyads, pollinia (slides/photographs, fresh material), ultrastructure of pollen wall (micrograph); Pollen viability: Tetrazolium test. Demonstration of pollen germination using hanging drop method.
3. Ovule: Types-anatropous, orthotropous, amphitropous/ campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/ specimens/ photographs).
4. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature embryo sac.
5. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.
6. 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.

Group – “ B” Based on MJ-7

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Separate chloroplast pigments by paper chromatography.
3. Demonstrate the activity of any two enzymes (Urease, Amylase, Catalase)
4. Study the effect of organic solvent and temperature on membrane permeability.
5. Acid/ Alkaline phosphatase or amylase: Enzyme characteristics: pH/temperature/ kinetics.

Group – “ C” Based on MJ-8

1. Study of plant cell structure with the help of epidermal peel mount of Onion/ Rhoeo/ Crinum.
2. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
3. Measurement of cell size by the technique of micrometry.
4. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
5. Study of cell and its organelles with the help of electron micrographs.
6. Study the phenomenon of plasmolysis and deplasmolysis.
7. Study different stages of mitosis and meiosis.

Experiments – 45 Marks

Viva Voice – 15 Mark

Practical Records –15 Mark

SEMESTER - V

Paper Title – Major Paper 9 (MJ-9)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Molecular Biology

Course Outcomes :---

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

1. Analyse the structures and chemical properties of DNA and RNA through various historic experiments.
2. Differentiate the main types of prokaryotes through their grouping abilities and their characteristic
3. Evaluate the experiments establishing central dogma and genetic code.
4. Gain an understanding of various steps in transcription, protein synthesis and protein modification.

Full Mark - 60

Time: - 3 Hrs

Unit I: Nucleic Acids: Carriers of Genetic Information and Structure

10 lectures

Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiments). DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material.

Unit II: The replication of DNA and Central dogma

10 lectures

Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi- conservative and semi discontinuous replication, Enzymes involved in DNA replication. DNA proofreading. The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Central Dogma Reverse (RNA viruses etc.),

Unit III: Genetic code and transcription

10 lectures

Genetic code (deciphering & salient features) and wobble hypothesis. Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Concept of operon Prokaryotes: lac operon. Regulation of lactose metabolism and tryptophan synthesis in E.coli.

Unit IV: Mechanism of Translation

15 lectures

Translation prokaryotes and eukaryotes ; Understand the steps in process of translation – Initiation, Elongation and Termination . Enzymes and factors involved in translation .: Ribosome structure and assembly (In prokaryotes and eukaryotes);Charging of tRNA, aminoacyl tRNA synthetases; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins,

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, 6th edition. Pearson Benjamin Cummings, CSHL Press, New York, U.S.A.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, 5th edition. John Wiley and Sons Inc., U.S.A.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics, 9th edition. Benjamin Cummings. U.S.A.
4. Russell, P. J. (2010). i-Genetics- A Molecular Approach, 3rd edition. Benjamin Cummings, U.S.A.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis, 10th edition. W. H. Freeman and Co., U.S.A.
6. J. E. Krebs, E.S. Goldstein and S.T. Kilpatrick. (2017). Lewin's Genes XII. 12th Edition: Jones and Bartlett.

Paper Title – Major Paper 10 (MJ-10)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Genetics & Cytogenetics

Course Outcomes :---

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

1. Have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
2. Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
3. Analyze the effect of mutations on gene functions and dosage.
4. Examine the structure, function and replication of DNA.

Full Mark - 60

Time: - 3 Hrs

Unit I: Principles of genetics and Biology of Inheritance

15 lectures

Mendelism: History; Mendel's Laws of inheritance; Chromosome theory of inheritance sex determination (briefly with reference to humans and Drosophilla); Probability and Pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy .

Unit II: Extra-Chromosomal Inheritance, Linkage and Crossing over

15 lectures

Chloroplast Inheritance: Variegation in Four O'clock plant; Mitochondrial Inheritance in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium. Linkage and crossing over; Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage (Drosophilla).

Unit III: Variation in Chromosome Number and Structure

7 lectures

Chromosome morphology and Karyotype concept, Deletion, Duplication, Inversion, Translocation, Position effect; Euploidy, Aneuploidy and Amphiploidy and their implications,

Unit IV: Gene Mutations

8 lectures

Types of mutations; Molecular basis of Mutations; Induction of mutations and Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics. 8th edition. John Wiley & sons, India.
2. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. 10th edition. W. H. Freeman and Co., U.S.A.
3. Gupta, P.K. (2018) Genetics. 5th Edition, Rastogi Publications, Meerut.
4. Hartl, D.L. and Jones, E.W. (1999). Essential Genetics, 2nd Edition, Jones and Barlett Publishers, Boston.
5. Jain, H.K. (1999). Genetics: Principles, Concepts and Implications. Science Pub Inc.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.
7. Singh, R. J. (2016). Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA. 8. Singh, R.J. (2017). Practical Manual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.
8. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. 5th edition. John Wiley & Sons Inc., India.
9. Strickberger, M.W. (1985) Genetics, 3rd Edition. Pearson Printice Hall (printed in India by Anand Sons).

Paper Title – Major Paper 11 (MJ-11)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Economic Botany

Course Outcomes :---

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

1. Understand core concepts of Economic Botany and relate with environment, populations, communities and ecosystems
2. Develop critical understanding on the evolution of concept of organization of apex new crops/varieties, importance of germplasm diversity, issues related to access and ownership
3. Develop a basic knowledge of taxonomic diversity and important families of useful plants
4. Increase the awareness and appreciation of plants & plant products encountered in everyday life
5. Appreciate the diversity of plants and the plant products in human use

Full Mark - 60

Time: - 3 Hrs

Unit I: Origin and conservation of Cultivated Plants

8 lectures

Concept of centres of Origin, their importance with reference to Vavilov's work . Examples of major plant introductions; Crop domestication and loss of genetic diversity (Only conventional plant breeding methods) ; Importance of Germplasm diversity .

Unit II: Botany, Utilization of Plant Wealth (Cereals and Millets, Pulses and Legumes, Sources of Sugars and Starches)

13 lectures

Cereals : Wheat and Rice (origin, evolution,morphology,post-harvest processing & uses);Green revolution ; Brief account of millets and pseudocereals.

Pulses and Legumes : General account (including chief pulses grown in India);Importance to man and ecosystem.

Sugars and Starches : Morphology,ratooning,evolution (nobilization)and processing of sugarcane , products and by-products of sugarcane industry ; Potato- Morphology , tuber Anatomy, Propagation (conventional and TPS) and uses.

Unit III: Botany, Utilization of Plant Wealth (Spices, Beverages, Oil seeds fats and Essential oils)

12 lecture

Spices: Listing of important spices, their family and part used , economic importance with special reference to fennel, saffron, clove and black pepper.

Beverages: Tea, Coffee (Morphology , Processing & Uses)

Oils and Fats : General description , classification , extraction , their uses and health implications;groundnut,coconut, linseed,mustard (Botanical name, Family & Uses)

Essential Oils : General Account , Extraction methods , comparison with fatty oils and other uses.

Unit IV: Botany, Utilization and Processing of Plant Wealth (Natural Rubber , Fibrers ,Drug-yielding and Medicinal plants,)

12 lectures

Natural Rubber : Para Rubber : tapping, processing and uses .

Fibers: Classification based on the origin of fibers : Cotton (origin of tetraploid cotton , morphology, extraction and uses) and Jute (morphology, extraction and uses).

Drug- yielding plants: Therapeutic and habit- forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis.

Tobacco: Morphology, processing , uses and health hazards.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett Publishers.
2. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow (2016). Aush Gyanya : Handbook of Medicinal and Aromatic Plant Cultivation.
3. Kochhar, S.L. (2016). Economic Botany: A Comprehensive Study. 5th Edition. Cambridge
4. Samba Murty, AVSS and Subrahmanyam, N.S. (1989). a text book of Economic Botany. Wiley Eastern Ltd., New Delhi
5. Sambamurty, AVSS and Subrahmanyam, N.S. (2008). A Textbook of Modern Economic Botany. 1st Edition, Paperback . CBS Publishers & Distributors Pvt.Ltd.; 1st edition (4 September 2008)
6. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
7. Any local/state/regional flora published by BSI or any other agency

Semester – V

Paper Title – Botany Practical Based on – MJ-9, MJ-10 and MJ-11

Credits – 03

Time- 6 Hrs

Full Marks –7 5

Pass Marks -30

Group- “A” Based on MJ-9

1. Preparation of LB medium and raising E.Coli.
2. DNA isolation from cauliflower head.
3. DNA estimation by diphenylamine reagent/UV Spectrophotometry.

4. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
5. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
6. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
7. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Group – “ B” Based on MJ-10

1. Mitosis, and study of chromosome morphology through squash preparation, including effect of chemicals on mitosis.
2. Meiosis and study of chiasma frequency through temporary squash preparation.
3. laws through seed ratios. Laboratory exercises in probability and chi-square.
4. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
7. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
8. Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Color blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached earlobe.

Group – “ C” Based on MJ-11

1. Cereals: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests) Rice(habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. Legumes: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. Sources of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato(habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).
4. Spices: Black pepper, Fennel, Curcuma and Clove (habit and sections).
5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. Sources of oils and fats: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.
7. Essential oil-yielding plants: Habit sketch of Rosa, Vetiveria, Santalum and Cymbopogon spp., Mint, Basil, Eucalyptus (specimens/photographs).

8. Rubber: specimen, photograph/model of tapping, samples of rubber products.
9. Drug-yielding plants: Specimens of Ashwagandha, Artemisia, Kalmegh, Phyllanthus, Satavar, Gilloi, Digitalis, Papaver and Cannabis.
10. Tobacco: specimen and products of Tobacco. .
11. Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

Experiments – 45 Marks

Viva Voice – 15 Mark

Practical Records – 15 Mark

SEMESTER - VI

Paper Title – Major Paper 12 (MJ-12)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Plant Systematics

Course Outcomes: ---

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

1. Classify Plant systematics and recognize the importance of herbarium and Virtual herbarium
2. Evaluate the Important herbaria and botanical gardens
3. Interpret the rules of ICN in botanical nomenclature
4. Assess terms and concepts related to Phylogenetic Systematics
5. Generalize the characters of the families according to Bentham & Hooker's system of classification

Full Mark - 60

Time: - 3 Hrs

Unit I: Significance of Plant systematics

20 lectures

Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology embryology, cytology, phytochemistry and molecular data. Field inventory; Importance of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: intended (yolked) and bracketed keys. Phenetics vs. Cladistics,

Unit II: Taxonomic hierarchy

10 lectures

Taxonomic Hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concepts (biological, morphological, evolutionary). Modes of speciation. Problems with species concepts. Rankless system of phylogenetic systematics

Unit III: Botanical Nomenclature

7 lectures

Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit IV : System of Classification

8 lectures

System of classification: Natural system of classification (Bentham and hooker), Takhtajan classification of Angiosperms, Principles of Angiosperm Phylogeny Group (APG IV) classification.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

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. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.
5. Sambamurty A.V.S.S. (2005). Taxonomy of Angiosperms. I. K. International Pvt. Ltd., New Delhi. Singh, V., Pande, P. C. & Jain, D. K. (2008). Taxonomy and Economic Botany. Rastogi Publications, Meerut.
6. Pandey, B. P. (2009). A Textbook of Botany Angiosperms. . S. Chand and Company Ltd., New Delhi.
7. Hall, B.G. (2011). Phylogenetic Trees Made Easy: A How-To Manual. Sinauer Associates, Inc. USA
8. Any local/state/regional flora published by BSI or any other agenc

Paper Title – Major Paper 13 (MJ-13)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Plant Physiology

Course Outcomes: ---

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

1. Understand Water relation of plants with respect to various physiological processes.
2. Explain chemical properties and deficiency symptoms in plants
3. Classify aerobic and anaerobic respiration
4. Explain the significance of Photosynthesis and respiration
5. Assess dormancy and germination in plants

Full Mark - 60

Time: - 3 Hrs

Unit I: Plant Water Relationship

10 lectures

Water relation to plants ;water potential,osmosis and plasmolysis, unique physico chemical properties of water; water absorption, uptake and bulk movement of water, stomatal regulation of transpiration and antitranspirants.

Unit II: Nitrogen Nutrition

8 lectures

Metabolism: Nitrogen nutrition, organic nitrogen, nitrogen fixation in microbes/legumes, nif genes and NOD factors, nitrate and ammonia assimilation.

Unit III: Photosynthesis and Respiration

20 lectures

Photosynthesis: Importance of photosynthesis for food security and environment. (a) Light reaction: Radiant energy, photosynthetic apparatus, pigments and their biosynthesis; light harvesting complex; light absorption and composition and characteristics of two photosystems, photosynthetic electron transport, (b) Dark reaction: Carbon dioxide fixation in C3, C4 and CAM plants, photorespiration and its significance, environmental factors affecting photosynthesis. (Explain RUBISCO).

Respiration

Respiration: Aerobic and anaerobic respiration; fermentation; cytochrome system; and factors affecting respiration.

Unit IV:, Phytohormone

7 lectures

Phytohormones: Auxin; cytokinin; Gibberellins; ethylene; ABA. Synthesis, distribution and physiological effects. Application of hormones in agriculture and horticulture. Polyamines, brassinosteroids and their functions. Seed dormancy ,germination and senescence.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Reading

1. Buchanan, B.B. and Gruissem, W. (2015). Biochemistry and molecular biology of plants. Willy Blackwell ASPB USA.
2. Campbell, M.K. and Farrell, S.O. (2007). Biochemistry. Thomson Brooks/cole, USA.
3. Dey, P.M. and Harborne, J.B. (2000). Plant biochemistry. Academic Press, UK.

4. Goodwin, T.W. and Mercer, E.I. (2003). Introduction to plant biochemistry. CBS Publishers & Distributors, New Delhi, India.
5. Ross and Salisbury. (2009). Plant Physiology. Cengage Learning (Thompson), New Delhi, India.
6. Segel, I.H. and Segel, E. (1993). Enzyme kinetics: Behavior and analysis of rapid equilibrium and steady-state enzyme systems. Wiley-Interscience, USA.
7. Taiz, L., Zeiger, E. Mollar, I. M. and Murphy, A. (2015). Plant physiology and Development 6th edition. . Sinauer Associates Inc., USA.

Paper Title – Major Paper 14 (MJ-14)
CREDIT-04 [THEORY - 03 + PRACTICAL - 01]

Plant Metabolism

Course Outcomes: ---

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

1. Differentiate anabolic and catabolic pathways of metabolism
2. Recognize the importance of Carbon assimilation in photorespiration
3. Explain the ATP-Synthesis
4. Interpret the Biological nitrogen fixation in metabolism

Full Mark - 60

Time: - 3 Hrs

Unit I: Concept of Metabolism

10 lectures

Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes). Historical background, role of photosynthetic pigments (chlorophylls and accessory pigments).

Unit II: Carbon Assimilation

10 lectures

Photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO₂ reduction/ Carbon assimilation: C₃ and C₄ pathways.

Unit III : Metabolism and Oxidation

10 lectures

photorespiration; Crassulacean acid metabolism; Factors affecting CO₂ reduction. Glycolysis and its regulation of glycolysis, oxidative decarboxylation of pyruvate, regulation NADH ; TCA cycle, mitochondrial electron transport, oxidative phosphorylation.

Unit IV: Lipid and Nitrogen Metabolism

15 lectures

Synthesis and breakdown of triglycerides, β -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation. Biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Nitrate and Ammonia assimilation;

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. 4th edition. John Wiley and Sons.U.S.A.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. 6th edition. Sinauer Associates Inc. USA.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
4. H. W. Heldt and B. Piechulla.(2019). Plant Biochemistry. 4th Edition. Paperback. Academic Press.
5. B. Buchanan, W. Gruissem and R. L. Jones (Eds) (2015) Biochemistry and Molecular Biology of Plants. Second Edition. Paper back. Wiley-Blackwell.

Paper Title – Major Paper 15 (MJ-15)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Plant Ecology

Course Outcomes: ---

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

1. Understand core concepts of biotic and abiotic

2. Classify the soils on the basis of physical, chemical and biological components
3. Evaluate energy sources of ecological system
4. Assess the adaptation of plants in relation to light, temperature, water, wind and fire.
5. Conduct experiments using skills appropriate to subdivisions

Full Mark - 60

Time: - 3 Hrs

Unit I: Introduction, soil and water

15 lectures

Basic concepts; Levels of organization. Abiotic and biotic Components and their interrelationships. Soil: Origin; Types and Formation; Composition; Physical, Chemical and Biological components; Soil profile. Types of soils in India. Water: States of water in the environment; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle.

Unit II: Ecological adaptations, Population ecology

7 lectures

Variations in adaptation of plants in relation to light, temperature, water, wind and fire. Population ecology: Characteristics and population growth, population regulation, life history strategies; r and k selection. Ecological Speciation.

Unit III: Ecosystem

15 lectures

Community characteristics: analytical and synthetic; Concept of ecological amplitude; Habitat and niche; Ecotone and edge effect; Succession: processes, types; climax concept. Primary vs Secondary succession. Ecosystem: Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Ecosystems of India.

Unit IV: Functional Aspects of Ecosystem

8 lectures

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles of carbon, nitrogen and phosphorus.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

Semester – VI

**Paper Title – Botany Practical Based on – MJ-12, MJ-13,
MJ-14 and MJ-15**

Credits – 04

Time- 6 Hrs

Full Marks –100

Pass Marks - 40

• Group- “A” Based on MJ-12

1. Study of 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):
 - Brassicaceae - Mustard, Rafflesia
 - Papaveraceae - Argemone
 - Umbelliferae - Coriandrum

- Asteraceae - Tridax
- Solanaceae - Solanum nigrum
- Lamiaceae - Ocimum
- Euphorbiaceae - Euphorbia hirta/ Jatropha, Croton
- Poaceae - Triticum/Hordeum/Avena

2. Field visit (local or outside depending on situation) –
3. Mounting of a properly dried and pressed specimen of any 20 wild plant with Herbarium label (to be submitted in the record book).
4. Construction of plant phylogenetic trees using various loci (rbcL, ITS, trnL etc) with various phylogenetic methods (Neighbour Joining, Maximum Likelihood etc)

• **Group- “B” Based on MJ-13**

1. Determination of Osmotic potential of plant cell sap by plasmolysis method.
2. Determination of water potential of given tissue (potato tuber) by weight method .
3. Determination of water potential of given tissue (potato tuber) By falling drop method.
4. Study of the effect of light on the rate of transpiration in excised twig / leaf .
5. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and a xerophyte .
6. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and a xerophyte (any one surface) .
7. To study the phenomenon of seed germination (effect of light and darkness) .
8. To study the induction of amylase activity in germinating barley grains.

• **Group- “C” Based on MJ-14**

1. Solvent partitioning of photosynthetic pigments.
2. Experimental demonstration of Hill’s reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.
7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.

• **Group- “D” Based on MJ-15**

1. Determination of pH of various soil and water samples (with pH meter, universal indicator/Lovibond comparator and/or pH paper strip)
2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
3. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
4. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
5. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
6. Study of morphological adaptations of hydrophytes and xerophytes (four each).
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.

Experiments –60 Marks

Viva Voice – 20 Mark

Practical Records – 20 Mark

SEMESTER - VII

Paper Title – Major Paper 16 (MJ-16)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Plant Breeding

Course Outcomes: ---

On completion of this course students will be able to:

1. Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool.

2. Familiarize with genetic basis of heterosis.
3. Classify Sexual and Asexual modes of reproduction.
4. Explain monogenic and polygenic inheritance
5. Reflect upon the role of various non- conventional methods used in crop improvement.

Full Mark - 60

Time: - 3 Hrs

Unit I: An Introduction to Plant Breeding

10 Lectures

Introduction and objectives of Plant Breeding, Breeding systems : Modes of reproduction in crop plants . **Self incompatibility, male sterility and apomixis**. Important achievements and undesirable consequences of plant breeding .

Unit II: Methods of Crop Improvement

15 lectures

Introduction : Centers of Origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods : For self-pollinated, cross pollinated and vegetatively propagated plants; Hybridization : For self, cross and vegetatively propagated plants – Procedure , advantages and limitations.

Unit III: Inbreeding Depression and Heterosis

10 lectures

History , genetic basis of inbreeding depression and Heterosis: Applications.

Unit IV: Crop improvement and breeding

10 lecture

Role of mutations; Polyploidy; Distant hybridization, Molecular Breeding , role of biotechnology in crop improvement.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.

2. Das, L.D. Vijendra (2006) Plant Breeding. New Age International Publishers, New Delhi.
3. Sharma, J.R.(1994) : Principles and practices of Plant Breeding. Tata McGraw-Hill Publishing Company Ltd. , New Delhi
4. Singh, B.D. (2012). Plant Breeding: Principles and Methods. Kalyani Publishers. 9th edition.
5. Singh, Phundan (1996): Essentials of Plant Breeding. Kalyani Publishers, New Delhi-2.

Paper Title – Major Paper 17 (MJ-17)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Plant Biotechnology

Course Outcomes: ---

On the completion of the course the students will be able to

1. Understand the core concepts and fundamentals of plant biotechnology and genetic engineering
2. Develop their competency on different types of plant tissue culture
3. Analyze the enzymes and vectors for genetic manipulations
4. Examine gene cloning and evaluate different methods of gene transfer
5. Critically analyze the major concerns and applications of transgenic technology

Full Mark - 60

Time: - 3 Hrs

Unit I: Plant Tissue Culture

11 lectures

Historical perspective; Composition of media; Nutrient and Hormone requirements (role of vitamins and hormones) Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion, Tissue Culture Applications.

Unit II: Recombinant DNA technology

11 lectures

Restriction Endonucleases (History, Types I-IV , biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC18 and pUC19, pBR322, Ti plasmid, BAC); , Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).

Unit III: Gene Cloning and Methods of Gene Transfer

11 lectures

Basic concept of Gene cloning, advantages of gene cloning, Bacterial Transformation and selection of recombinant clones using various strategies, PCR- mediated gene cloning; Gene Construct; Plant transformation vector, T-DNA and viral vector, Agrobacterium-mediated Transformation protocols, molecular mechanism of T-DNA transfer, direct gene transfer method by Electroporation

Unit IV: Applications of Biotechnology

12 lectures

Engineering plants to overcome abiotic (drought and salt stress) and biotic stress pest Resistant (Bt- cotton) and herbicide resistant plants (RoundUp Ready soyabean) ; Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice) ; improved horticultural varieties (Moondust carnations) ; Role of Transgenics in bioremediation (Superbug)

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. A. Slater, N.W. Scott and M.R. Fowler (2008). Plant Biotechnology. Second Edition. Oxford. 4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K.
4. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
5. Chrispeels, M.J. and Sadava, D.E. (1994). Plants, Genes and Agriculture. Jones & Bartlett Publishers.
6. N. Santosh and A. Madhavi. (2010). Practical Book of Biotechnology and Plant Tissue Culture. S. Chand & Co.

Paper Title – Major Paper 18 (MJ-18)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Biostatistics

Course Outcomes: ---

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

1. Comprehend the fundamental concepts related to descriptive and inferential biostatistics.
2. Develop skills in data tabulation, its treatment, analysis, interpretation and graphical representation of data.
3. Analyze the implications of inferential statistics in biology.
4. Develop their competence in hypothesis testing and interpretation.

Full Mark - 60

Time: - 3 Hrs

Unit I: Biostatistics

10 lectures

Biostatistics – definition- statistical methods- basic principles. Variables- measurements , functions , limitations and uses of statistics.

Unit II: Data Summarization

10 lectures

Collection of data primary and secondary – types and methods of data collection , procedures- merits and demerits. Classification – tabulation and presentation of data- sampling methods.

Unit III: Descriptive Statistics

15 lectures

Mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co- efficient of variations.

Unit IV: Correlation, Regression and Statistical inference

10 lectures

Types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression. Hypothesis -Student 't' test, chi square test.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Dannel, W.W.(1987). Biostatistics, New York, John Wiley Sons.
2. Sundarrao, P.S.S and Richards, J. Christian. An introduction to Biostatistics, 3rd edition. Medical College, Vellore
3. Selvin, S. (1991). Statistical Analysis of epidemiological data New York University Press
4. Campbell, R.C. (1998). Statistics for Biologists, Cambridge University Press.

Paper Title – Major Paper 19 (MJ-19)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Research Methodology

Course Outcomes: ---

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

1. Understand the concept of research and different types of research in the context of biology
2. Develop laboratory experiment related skills.
3. Develop competence on data collection and process of scientific documentation
4. Analyze the ethical aspects of research
5. Evaluate the different methods of scientific writing and reporting

Full Mark - 60

Time: - 3 Hrs

Unit I: Basic Concepts of Research

12 lectures

Research- definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

Unit II: Data Collection and Documentation of Observations

12 lectures

Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. The art of field photography.

Unit III: Overview of Biological Problems

10 lectures

History; Key biology research areas, Model organisms in biology (A brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics- Transcriptional regulatory network.

Unit IV: Ethics and Good Practical's and Art of Scientific Writing 11 lectures

Authors, acknowledgements, reproducibility, plagiarism, Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Power-point presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S. E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

Semester – VII

**Paper Title – Botany Practical Based on – MJ-16, MJ-17,
MJ-18 and MJ-19**

Credits – 04

Time- 6 Hrs

Full Marks –100

Pass Marks - 40

• Group- “A” Based on MJ-16

1. Methods of emasculation (Wheat, Barley, Mustard, Pigeon pea, Cotton)
2. Pollen viability test

3. Seed viability test
4. Effect of radiation and chemical mutagens on seed germination, seedling growth and cell division (mitotic index).
5. More Practical may be added depending on the local habitats and available facilities

- **Group- “B” Based on MJ-17**

1. (a) Preparation of liquid and solid MS medium.
(b) Demonstration of in vitro sterilization of seeds and germination in MS media containing petri plates.
(c) in vitro selection and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
2. Callus formation in tobacco and rice using MS medium containing phytohormones.
3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
4. Isolation of protoplasts and protoplast culture using photographs
5. Construction of restriction map of circular and linear DNA from the data provided.
6. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
8. Isolation of plasmid DNA.
9. Restriction digestion and gel electrophoresis of plasmid DNA.

- **Group- “C” Based on MJ-18**

1. Classification- tabulation and presentation of data.
2. Calculation of mean, mode, median, standard deviation, quartile deviation, standard error and coefficient of variance.
3. Calculation of correlation coefficient values by Karl Pearson's and Spearman rank methods.
4. Statistical inference – hypothesis- student 't' test- chi square test.
5. One way analysis of variance.
6. Uses of software in biostatistics.

- **Group- “D” Based on MJ-19**

1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.
6. Identification of different type of research in day by day life
7. Testing of a formulated hypothesis with type I and type II errors
8. Curation of relevant scientific literature from Google Scholar
9. Poster presentation on defined topics
10. Demonstration for checking of plagiarism using recommended software
11. Technical writing on topics assigned.
12. More Practical may be added depending on the local habitats and available facilities

Experiments –60 Marks

Viva Voice – 20 Mark

Practical Records – 20 Mark

SEMESTER - VIII

Paper Title – Major Paper - 20 (MJ-20)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Natural resources Management

Course Outcomes: ---

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

1. Understand the concept of different natural resources and their utilization.
2. Critically analyze the sustainable utilization land, water, forest and energy resources.
3. Evaluate the management strategies of different natural resources.
4. Reflect upon the different national and international efforts in resource management and their conservation

Full Mark - 60

Time: - 3 Hrs

Unit I: Natural Resources and Sustainable Utilization

8 lectures

Definition and types, concept, approaches (economic, ecological and socio-cultural) for sustainable utilization.

Unit II: Land, Water and Biological Resources

15 lectures

Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management. Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies. Biodiversity-definition and types; Significance; Threats; Management strategies; Bio- prospecting; IPR; CBD; National Biodiversity Action Plan).

Unit III: Forests and Energy

10 lectures

Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management. Renewable and non-renewable sources of energy .

Unit IV: Contemporary Practices in Resource Management

12 lectures

EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. National and international efforts in resource management and conservation

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.

3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
4. United States Government Accountability Office (2008) Natural Resource Management. Nova Science Publishers Inc, 10th Edition
5. Stacy Keach (2016) Natural Resources Management. Syrawood Publishing House
6. Rathor, V.S. and Rathor B. S. (2013) Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi

Paper Title – Botany Practical – MJ-20
Credits – 01

Full Marks – 25

Pass Marks - 10

Practical

1. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation.
2. Collection of data on forest cover of specific area.
3. Measurement of dominance of woody species by DBH (diameter at breast height) method.
4. Calculation and analysis of ecological footprint.
5. Ecological modeling.
6. More Practical may be added depending on the local habitats and available facilities

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Mark

KOLHAN UNIVERSITY, CHAIBASA JHARKHAND



Revised Curriculum and Credit Frame Work

**As per FYUGP, NEP-2020
(U.G. Botany- 2022 Onwards)
Advanced Major Papers- AMJ 1 to AMJ 3**

**UNIVERSITY DEPARTMENT OF BOTANY
KOLHAN UNIVERSITY, CHAIBASA
WEST SINGHBHUM, JHARKHAND – 833202**

UNIVERSITY DEPARTMENT OF BOTANY

Kolhan University, Chaibasa

Four-Year Under Graduate Programme (FYUGP)

As per Provisions of NEP-2020 to be implemented from Academic Year 2022-23

COMPOSITIONS OF BOARD OF STUDIES

1. Dr. Krishna Pyare

Head, University Deptt. of Botany

Kolhan University, Chaibasa

2. Dr. Salomy Kujur

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University Deptt. of Botany

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3. Mrs. Pushpa Salo Linda

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4. Dr. Vishnu Shankar Sinha

Assistant Professor

Department of Botany

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5. Dr. Dara Singh Gupta

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University Deptt. of Botany

Kolhan University, Chaibasa

**UNIVERSITY DEPARTMENT OF BOTANY, K.U
CHAIBASA
FYUGP 2023**

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Advanced Major Papers – AMJ 1 to AMJ 3

Sem	Code	Title of the Paper	Credits (Th +P)
VIII	AMJ 1	Advanced Major Paper-1 (Pomology)	3
	AMJ 2	Advanced Major Paper-2 (Agronomy)	3
	AMJ 3	Advanced Major Paper-3 (Horticultural Practices)	3
	AMJ1(Practical)	Practical Based On AMJ-1, AMJ-2 and AMJ-3	0 + 3

- **For End Semester Examination (ESE 60 Marks , 3 Hrs Exam) :**

There will be **two** group of question. **Group A is compulsory** which will contain three questions. **Question No. 1 will be very short answer types** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks each. **Group B will contain descriptive type** five questions of fifteen marks (15) each, out of which any three are to answer.

- **For End Semester Examination (ESE 75 Marks , 3 Hrs Exam) :**

There will be **two** group of question. **Group A is compulsory** which will contain three questions. **Question No. 1 will be very short answer type** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks each. **Group B will contain descriptive type** six questions of fifteen marks (15) each, out of which any four are to answer

SEMESTER -VIII
Paper Title – Advanced Major Paper – 1 (AMJ-1)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Pomology

Course Outcomes: ---

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

1. Understand the concept of registration procedures with cultivars, vegetative and generative pomology
2. Classify the cultivars according to scientific names.
3. Plan the development of orchards and its management
4. Explain the methods of post-harvest preservation requirements i.e. refrigeration, canning, dehydration and chemical preservation.

Full Mark - 60

Time: - 3 Hrs

Unit I

12 lectures

Definition, scope and importance of pomology, pomological systems, pomological collection, role of fruits in human nutrition. Major groups of fruit crops of local climates/regions,

(a) deciduous (stonefruits, pomefruits) and

(b) evergreen (e.g. olive, citrus species) fruit crops

(c) nut trees and small fruit crops species of subtropical and tropical origin.

Unit II

12 lectures

Origin-spread, botanical classification, Economic importance-applications, Specific requirements for cultivation (soil management, fertilization, pruning, thinning, irrigation), Climate and soil, Propagation (rootstocks), Pruning, Pollination, Fertilization, Fruit growth, Harvest, Cultivars, Pests, Diseases, Physiological disorders

Unit III

11 lectures

Registration procedure with new cultivars, vegetative and generative pomological traits, Botanical classification of cultivars and characteristics of the important traits. Planning and

layout of orchards, preparation of land for orchard development, selection of planting materials and transplanting, protection of young plants, orchard management systems

Unit IV

10 lectures

Fruit preservation, present status, future prospecting nutritive value of fresh and processed fruits, Brief account on principles and methods of refrigeration, canning dehydration and chemical preservation.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings:

1. Gourley, J H, (2009). Text-Book of Pomology. Laing Press, ISBN:1444646283
2. T.K. Chattopadhyay, T.K. (2015). A textbook on Pomology Devoted to Temperate, Kalyani Publishers.
3. Chattopadhyaya, T.K. (2014) A Textbook on Pomology (Fundamental, Vol-I), , Kalyani Publishers., New Delhi.

Paper Title – Advanced Major Paper – 2(AMJ-2)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Agronomy

Course Outcomes: ---

On the completion of the course the students will be able to:

1. Understand the concept of agronomy and sustainable agriculture.
2. Analyze different aspects diversified agriculture and farm enterprises, production technology of vegetation and flowers.
3. Examine the implications integrated farming system along with production economics and farm management
4. Evaluate the IT communication and diffusion of agricultural innovation.

Full Mark - 60

Time: - 3 Hrs

Unit I

12 lectures

Introductory Agriculture, Fundamental of Soil Science, Field crop production, Production technology of fruit crops, Soil fertility management, Agroforestry system, Agriculture extension management.

Unit II

11 lectures

Basic genetics, Diversified Agriculture and farm enterprises, Production technology of vegetation and flowers, Rained Agriculture and water shed management.

Unit III

12 lectures

Crop improvement principles and practices, Integrated farming system and sustainable Agriculture, Integrated pest management, Post-harvest technology and value addition, Production economics and farm management

Unit IV

10 lectures

Manures, Fertilizers and Agrochemicals, Weed management, Crop modelling- Mechanization of small farms, IT communication and diffusion of agricultural innovation.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings

1. Craig C. Sheaffer and Kristine M. Moncada (2012). Introduction to Agronomy- Food crops and Environment (Second Edition).
2. Reddy S.R. (2017). Principles of Agronomy.
3. George Acquah (2004). Principles of Crop production.

**Paper Title – Advanced Major Paper – III(AMJ-3)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]**

Horticultural Practices

Course Outcomes: ---

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

1. Understand the concept of different types of horticultural crops, their conservation and management
2. Examine the various branches of horticulture, fruit and vegetable crops, floriculture, medicinal and aromatic plants.
3. Critically evaluate different cultivation practices and disease management
4. Reflect upon different Landscaping practices and garden design.

Full Mark - 60

Time: - 3 Hrs

Unit I: Horticultural Crops - Conservation and Management 12 lectures

Scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; urban horticulture and ecotourism. Documentation and conservation of germplasm; Role of micro-propagation and tissue culture techniques; Varieties and cultivars of various horticultural crops.

Unit II: Ornamental Plants, Floriculture 12 lectures

Propagation of plants for beauty: Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants [rose, marigold, gladiolus, orchids, poppies, gerberas, tuberose, cacti and succulents (Aloe ,opuntia, agave and spurges)] Ornamental flowering trees (Indian laburnum, gulmohar, Jacaranda, Lagerstroemia, fishtail and areca palms, semul, coral tree etc.- as are available in the area). Cut flowers, bonsai, commerce (market demand and supply); Importance of flower shows and exhibitions .

Unit III: Plants for Nutrition and Health: Fruit and Vegetable Plants 11 lectures

Production, origin and distribution; Description of plants and their economic products; Management and marketing of vegetable and fruit crops; Identification of some fruits and vegetable varieties (citrus, banana, mango, chillies and cucurbits). Production, origin and distribution; Description of plants and their economic products; Cultivation, processing and marketing of products of major medicinal plants (Mints, Ashwagandga, Amla, Saravar, Vetiver, Damask Rose, Aloe vera)..

Unit IV: Medicinal and Aromatic Plants, Cultivation and Cultural Practices, Disease Management and Scaping and Garden Design 10 lectures

Application of manure, organic, chemical and Biofertilizers, micronutrients; Weed control; biopesticides; Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Scope and limitations. Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures and nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices; Identification of common diseases and pests of ornamentals, fruits and vegetable crops. Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A – Internal Written Examination – 10 Marks (1 Hrs)

B- Overall performance including regularity – 05 Marks

Suggested Readings

1. NIIR Board. (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research, New Delhi.
2. Kader, A. A. (2002). Postharvest technology of horticultural crops, third edition. University of California, Agriculture and Natural Resources, Publication 3311, 535p.
3. Kadar, A.A. (2013). Postharvest Technology of Horticultural Crops - An Overview from Farm to Fork Ethiop .J. Appl. Sci. Technol. (Special Issue No.1): 1- 8.
4. Chadha, K.L. and Pareek, O.P. (1996). (Eds.). Advances in Horticulture. Vols. IV. Malhotra Publ. House.
5. Chadha, K.L. (2002). Hand Book of Horticulture. ICAR.
6. Peter, K.V. (2008). (Ed.). Basics of Horticulture . New India Publ. Agency.
7. Hartmann, H.T. and Kester, D.E. (1989). Plant Propagation – Principles and Practices. Prentice Hall of India.
8. Sudheer, K.P. and Indira, V. (2007). Post Harvest Technology of Horticultural Crops. New India Publ. Agency.
9. Willis, R., Mc Glassen, W.B., Graham, D. and Joyce, D. (1998). Post Harvest. An Introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals. CABI.

10. Pradeepkumar, T., Suma, B., Jyothibhaskar. and Satheesan, K.N. (2007). Management of Horticultural Crops. Parts I, II. New India Publ. Agency.
11. Singh, H.P., Singh, G., Samuel, J.C. and Pathak, R.K. (2003). Precision Farming in Horticulture . NCPAH, DAC/PFDC, CISH, Lucknow.
12. Sudeer, K.P. and Indira V. (2007). Post Harvest Technology of Horticultural Crops. New India Publication Agency, New Delhi.

Semester – VIII

Paper Title – Botany Practical Based on – AMJ-1, AMJ-2, and AMJ-3 Credits – 03

Time- 6 Hrs

Full Marks –75

Pass Marks -30

- **Group- “A” Based on AMJ-1**

1. Lectures and field trips to local orchards to include every type of fruit tree in the area
2. Development of nursery for at least 5 types of trees with regular detailed notes
3. Study of pathological diseases and their control
4. Study of Physiological disorders of the fruit trees, identifying the cause and application of solution
5. Study of economics of the Fruit farming.

- **Group- “B” Based on AMJ-2**

1. Identification of soil types, soil texture, soil moisture, soil pH, Soil conductivity, organic and inorganic matter,
2. Identification of major soil fauna
3. Identification of Agronomic crops in the region
4. Soil metagenomics 16S rRNA
5. Diversity of farming system of village/district/region
6. Farming techniques in village/district/region
7. Agroforestry techniques in village/district/region.
8. Vermiculture and vermicomposting/ vermiwash
9. Tools and their use in cropland
10. Water conservation techniques

- **Group- “C” Based on AMJ-3**

1. Field trips: Field visit to gardens, standing crop sites, nurseries, vegetable gardens and horticultural fields at agricultural institutes / universities or other suitable locations.
2. Identification of major conditions responsible for spoilage of horticultural crops.
3. Identification of pathogenic and non-pathogenic diseases of horticultural plants
4. More Practical may be added depending on the local habitats and available facilities

Experiments – 45 Marks

Viva Voice – 15 Mark

Practical Records – 15 Mark

KOLHAN UNIVERSITY, CHAIBASA JHARKHAND



Revised Curriculum and Credit Frame Work

**As per FYUGP, NEP-2020
(U.G. Botany- 2022 Onwards)**

Minor Papers 1A, 1B, 1C and 1D

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KOLHAN UNIVERSITY, CHAIBASA
WEST SINGHBHUM, JHARKHAND – 833202
UNIVERSITY DEPARTMENT OF BOTANY
Kolhan University, Chaibasa**

Four-Year Under Graduate Programme (FYUGP)

As per Provisions of NEP-2020 to be implemented from Academic Year 2022-23

COMPOSITIONS OF BOARD OF STUDIES

1. Dr. Krishna Pyare

**Head, University Deptt. of Botany
Kolhan University, Chaibasa**

2. Dr. Salomy Kujur

**Assistant Professor
University Deptt. of Botany
Jamshedpur Women's University, JSR**

3. Mrs. Pushpa Salo Linda

**Assistant Professor
Department of Botany
Jamshedpur Worker's College, JSR**

4. Dr. Vishnu Shankar Sinha

**Assistant Professor
Department of Botany
Tata College, Chaibasa**

5. Dr. Dara Singh Gupta

**Assistant Professor
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Kolhan University, Chaibasa**

**(Dr. Krishna Pyare)
Chairman & Head,
University Deptt. of Botany
Kolhan University, Chaibasa**

**UNIVERSITY DEPARTMENT OF BOTANY, K.U
CHAIBASA
FYUGP 2023**

INDEX

Minor Papers – MN 1A ,1B,1C and 1D as per FYUGP under NEP

Sem	Code	Title of the Paper	Credits (Th +P)
I	MN 1A	Minor Paper-1A (Plant ecology & taxonomy)	3 + 1
III	MN 1B	Minor Paper – 1B (Biodiversity and human welfare)	3 + 1
V	MN 1C	Minor Paper – 1C (Plant Anatomy & Embryology)	3 + 1
VII	MN 1D	Minor Paper – 1 D (Global Environmental Issues)	3 + 1

• **For End Semester Examination (ESE 60 Marks , 3 Hrs Exam) :**

There will be **two** group of question. **Group A is compulsory** which will **contain** three questions. **Question No. 1 will be very short answer types** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks each. **Group B will contain descriptive type** five questions of fifteen marks (15) each, out of which any three are to answer.

• **For End Semester Examination (ESE 75 Marks , 3 Hrs Exam) :**

There will be **two** group of question. **Group A is compulsory** which will contain three questions. **Question No. 1 will be very short answer type** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks each. **Group B will contain descriptive type** six questions of fifteen marks (15) each, out of which any four are to answer

SEMESTER - I
Paper Title – Minor Paper – 1 (MN-1A)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
PLANT ECOLOGY AND TAXONOMY

Course Outcomes: ---

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

1. Comprehend the basic concepts of plant ecology, taxonomy and botanical
2. nomenclature
3. Analyze the characteristics of different plant communities.
4. Examine the structure and functions of eco-system.
5. Evaluate the significance of herbarium
6. Analyze the implications of biometrics, numerical taxonomy and cladistics.

Full Mark - 60

Time: - 3 Hrs

Unit I: --- Introduction, Factors, Communities and Ecosystem 15 Hrs

Soil: Origin, formation, composition, soil profile. Water:--States of water in the environment
Adaptation of hydrophytes and xerophytes. Succession: processes and types. Structure, trophic
organization; energy flow; food chains and food web. Ecological pyramids. Gross and net
productivity. Biogeochemical cycles of carbon and nitrogen.

Unit II: --- Phylogeography, Introduction to Plant Taxonomy 20 Hrs

Biogeographical zones and Endemism. Plant Taxonomy: -- Description, Identification,
Nomenclature and Classification. Importance of Herbarium, important herbaria and botanical
gardens of the world and India. Ranks, categories and taxonomic groups, Principles and rules of
International Code of Nomenclature (ICN), binominal system, Typification, author citation, valid
publication, rejection of names, principle of priority and its limitations.

Unit III: --- Classification, Biometrics, Numerical Taxonomy and Cladistics

10 Hrs

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series),
Takhtajan (upto superorder). Characters; variations; OTUs, character weighting and coding;
cluster analysis; phenograms.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings:-

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4 edition. Hall, U.S.A.
2. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India.
3. Singh, J.S., Singh, S.P. and Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
4. Ambasht R. S. and Ambasht P. K. (1999) Environment and Pollution. C. B. S. Publishers & Distributers, New Delhi.
5. Dash, M. C. (2007). Fundamentals of Ecology. Tata Mc Graw Hill Publishing Company Limited.
6. Verma, P.S. and Agrawal, V. K. (2010). Environmental Biology. S. Chand and Company Ltd., New Delhi.
7. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
8. Singh, G. (2012). Plant Systematics: Theory and Practice. 3rd edition. Oxford & IBH Pvt. Ltd., NewDelhi.
9. Sambamurty A.V.S.S. (2005). Taxonomy of Angiosperms. I. K. International Pvt. Ltd., New Delhi. 10. Singh M. P. & Abbas S. G. Essentials of Plant Taxonomy and Ecology. Daya Publishing House, New Delhi.
11. Singh, V., Pande, P. C. & Jain, D. K. (2008). Taxonomy and Economic Botany. Rastogi Publications, Meerut.
12. Pandey, B. P. (2009). A Textbook of Botany Angiosperms. . S. Chand and Company Ltd., New Delhi.

Semester – I

Paper Title – Botany Practical – MN-IA Lab

Credits – 01

Full Marks – 25

Pass Marks - 10

1. Determination of pH and analysis of two soil samples for carbonates chlorides, nitrates,
 - a. sulphates, organic matter and base deficiency by rapid field test.
2. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
3. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).
4. (b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite
 - a. (*Orobanche*), Epiphytes.
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
7. Study of 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): Brassicaceae – *Brassica*; Asteraceae – *Ageratum*, *Eclipta* and *Tridax*; Solanaceae -*Solanum nigrum*, ; Lamiaceae - *Ocimum*; Liliaceae - *Lilium* and *Allium*.
8. Mounting of a properly dried and pressed specimen of any wild plants with herbarium label

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Marks

SEMESTER - III

Paper Title – Minor Paper – I (MN-1B)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Biodiversity nand Human welfare

Course outcomes :---

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

1. Develop understanding of the concept and scope of plant biodiversity
2. Identify the causes and implications of loss of biodiversity
3. Apply skills to manage plant biodiversity
4. Utilize various strategies for the conservation of biodiversity

5. Conceptualize the role of plants in human welfare with special reference to India

Full Mark - 60

Time: - 3 Hrs

Unit I: Plant Diversity and its Scope

10 lectures

Levels of biodiversity: Genetic, Species and Ecosystem; Agrobiodiversity and cultivated plant taxa and related wild taxa. Values and uses of Biodiversity, Methodologies for valuation, Ethical and aesthetic values, Uses of plants; Ecosystem services.

Unit II: Loss of Biodiversity

10 lectures

Loss of biodiversity- causes and implications, Hot spots of biodiversity, extinction of species, projected scenario for biodiversity loss.

Unit III: Management of Plant Biodiversity

10 lectures

Organizations associated with biodiversity management, IUCN, UNEP, WWF, UNESCO, NBPGR; Methodology for execution; Biodiversity legislation; Information management and communication.

Unit IV: Conservation of Biodiversity, Role of Plants in Relation to Human Welfare

15 lectures

Conservation of genetic, species and ecosystem diversity, In situ and ex situ conservation strategies, India's biodiversity and its conservation Social approaches to conservation, Biodiversity awareness programmes, Sustainable development

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings :-

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2. Singh, J.S., Singh, S.P. and Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.

3. Reddy, K.V. and Veeraiah, S. (2010). Biodiversity and Plant Resources. Aavishkar publication, New Delhi.
4. Heywood, V. H. and Watson, R. T. (1995). Global biodiversity and Assessment. Cambridge University Press.

Semester – III

Paper Title – Botany Practical – MN-1B Lab

Credits – 01

Full Marks – 25

Pass Marks - 10

Practical

1. Visit any unattended area with natural vegetation
2. Use Quadrat method to evaluate the minimum size of the quadrat required for vegetation study
3. Find out the minimum number of quadrats need for analyzing the vegetation structure in the study area
4. Find out the alpha-diversity of plants in the area

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Marks

SEMESTER - V

Paper Title – Minor Paper – 1 (MN-1C)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Plant Anatomy & Embryology

Course Outcomes :---

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

1. Understand the fundamental concepts of plant anatomy and embryology
2. Analyze and recognize the different organs of plant and secondary growth.
3. Examine the structure and functions of eco-system.

- Evaluate the structural organization of flower and the process of pollination and fertilization.

Full Mark - 60

Time: - 3 Hrs

Unit I: Plant Tissues and Organs

7 lectures

Root and shoot apical meristems; Simple and complex tissues, Structure of dicot and monocot root stem and leaf.

Unit II: Secondary Growth, Adaptive and Protective of Flower **15 lectures**

Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). Adaptive and protective systems: Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit III: Structural Organization of flower and fertilization **15 lectures**

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac. Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit IV: Embryo and Endosperm, Apomixis and Polyembryo **8 lectures**

Endosperm types, structure and functions; Dicot and monocot embryo; Embryo- endosperm relationship Definition, types and Practical applications of apomixes and polyembryony

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings

- Bhojwani, S.S. and Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi.
- Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

Semester – V

Paper Title – Botany Practical – MN-1C Lab

Credits – 01

Full Marks – 25

Pass Marks - 10

Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
4. Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous campylotropous.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Marks

SEMESTER - VII

Paper Title – Minor Paper – 1 (MN- 1D)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Global Environmental Issues

Course Outcomes: ---

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

1. Understand the fundamental issues of environment
2. Analyze different sources of environmental problems and methods of measurement of pollution.
3. Examine economic growth and quality of life
4. Examine the microbiology of waste water treatment and its various schemes

Full Mark - 60

Time: - 3 Hrs

Unit I: Environment and Environmental Problems

10 lectures

Basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management.

Unit II

10 lectures

Environmental pollution - types of pollution, sources of pollution, measurement of pollution, methods of measurement of pollution, fate of pollutants in the environment, Bioconcentration, bio/geomagnification.

Unit III

10 lectures

Environmental Economics : Basic concept; methods of evaluation; Economic growth, Gross National Productivity and the quality of life, Tragedy of Commons, Economics of Pollution control, Cost-benefit and cost effectiveness analysis

Unit IV: Microbiology of Waste Water Treatment

15 lectures

Aerobic process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industries.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings

1. Frances, H. (2012). Global Environmental Issues Willey-Blackwell, 2nd edition. pp336
2. Mahesh, R. (2007) Environmental Issues in India: A Reader. Pearson-Longman

Semester – VII
Paper Title – Botany Practical – MN-1D Lab
Credits – 01

Full Marks – 25

Pass Marks - 10

Practical

There are no structured class lab experiments involved. However the students are expected to visit various sites on the web, make teams for group-discussion indulge in debates, collect justifiable information from various sources, make historical report on the following major global environmental issues:

- (i) Atmosphere Management: Pollution, global warming/climate change, Stratospheric ozone depletion its impact and possible solutions
- (ii) Fresh water Management: Pollution, reasons, severity of problem, impact for the present and the future, its impact and possible solutions
- (iii) Marine Ecosystem: Pollution of marine ecosystem, its impact and possible solutions
- (iv) Soil degradation and Desertification
- (v) Forests' and Biodiversity depletion
- (vi) Solid Waste Management
- (vii) Human health and Toxicology

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Marks

KOLHAN UNIVERSITY, CHAIBASA JHARKHAND



Revised Curriculum and Credit Frame Work

**As per FYUGP, NEP-2020
(U.G. Botany- 2022 Onwards)
Minor Papers 2A, 2B,2C and 2D**

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Minor Papers – MN 2A ,2B,2C and 2D as per FYUGP under NEP

Sem	Code	Title of the Paper	Credits (Th +P)
II	MN 2A	Minor Paper-2A (Ethnobotany)	3 + 1
IV	MN 2B	Minor Paper – 2B (Nursery and Gardening) (Practical based)	3 + 1
VI	MN 2C	Minor Paper – 2C (Agriculture and food Microbiology) (Practical based)	3 + 1
VIII	MN 2D	Minor Paper – 2D (Mushroom Culture Technology)(Practical based)	3 + 1

- **For End Semester Examination (ESE 60 Marks , 3 Hrs Exam) :**

There will be **two** group of question. **Group A is compulsory** which will contain three questions. **Question No. 1 will be very short answer types** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be short answer type** of 5 marks each. **Group B will contain descriptive type** five questions of fifteen marks (15) each, out of which any three are to answer.

- **For End Semester Examination (ESE 75 Marks , 3 Hrs Exam) :**

There will be **two** group of question. **Group A is compulsory** which will contain three questions. **Question No. 1 will be very short answer type** consisting of five questions of 1 mark each. **Question No. 2 & 3 will be**

short answer type of 5 marks each. **Group B will contain descriptive type** six questions of fifteen marks (15) each, out of which any four are to answer

SEMESTER -II
Paper Title – Minor Paper – 2 (MN-2A)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Ethnobotany

Course outcomes :---

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

1. Conceptualize ethnobotany as an interdisciplinary science
2. Restate the established methodology of ethnobotany studies
3. Categories various indigenous ethnic groups and their environmental practices.
4. Understand the legalities associated with ethnobotany.

Full Mark - 60

Time: - 3 Hrs

Unit I: Ethnobotany

12 lectures

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit II: Methodology of Ethnobotanical Studies

10 lectures

- a) Field work
- b) Herbarium
- c) Ancient Literature
- d) Archaeological findings
- e) temples and sacred places.

Unit III: Role of Ethnobotany in Modern Medicine

15 lectures

Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology).

- a) *Azadiractha indica*
- b) *Ocimum sanctum*
- c) *Vitex negundo*.
- d) *Gloriosa superba*
- e) *Pongamia pinnata*
- f) *Cassia auriculata*
- g) *Adhatoda vasica*

Unit IV: Ethnobotany and Legal Aspects

8 lectures

Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings :-

1. Jain, S.K. (1995). Manual of Ethnobotany, Scientific Publishers, Jodhpur.
2. Jain, S.K. (1981). Glimpses of Indian. Ethnobotany, Oxford and I B H, New Delhi.
3. Jain, S.K. (1989). Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. Jain, S.K. (1990). Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
5. Colton, C.M. (1997). Ethnobotany – Principles and applications. John Wiley and sons.
6. Rama, R, N and Henry, A.N. (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
7. Sinha, R. K. (1996). Ethnobotany; The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur.

8. Faulks, P.J. (1958).An introduction to Ethnobotany, Moredale pub. Ltd

Semester – II
Paper Title – Botany Practical – MN-2A Lab
Credits – 01

Full Marks – 25

Pass Marks - 10

Practical

1. Visit to the field and botanical garden in the nearby area and attempt to identify the plants
2. Attempt be made to grow the ethnobotanical plants
3. Visit the villages and rural areas to consult some senior people to discuss the traditional medicines being used since ages.
4. Prepare a list of plants that provide parts for traditional uses and construct a chart or check-list in terms of botanical significance, chemical constituent, medicinal use, and major industries available in India and the world; Economical-value strength.

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Marks

SEMESTER –IV
Paper Title – Minor Paper – 2 (MN-2B)
CREDIT-04 [THEORY- 03 + PRACTICAL- 01]
Nursery and Gardening

Course Outcomes:---

On completion of this course the students will be able to;

1. Understand the process of sowing seeds in nursery
2. List the various resources required for the development of nursery
3. Distinguish among the different forms of sowing and growing plants
4. Analyse the process of Vegetative propagation

5. Appreciate the diversity of plants and selection of gardening
6. Examine the cultivation of different vegetables and growth of plants in nursery and gardening

Full Mark - 60

Time: - 3 Hrs

Unit I

7 lectures

Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

Unit II

8 lectures

Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification.

Unit III

10 lectures

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glasshouse.

Unit IV

20 lectures

Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings: Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings

1. Bose T.K. & Mukherjee, D. (1972). Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K. (1989) Plant Propagation, Wile Eastern Ltd., Bengaluru.
3. Kumar, N. (1997) Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. (1993). Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
6. Janick Jules (1979). Horticultural Science. (3rd Ed.), W.H. Freeman and Co., SanFrancisco, USA.

Semester – IV

Paper Title – Botany Practical – MN-2B Lab

Credits – 01

Full Marks – 25

Pass Marks - 10

Practical

- Based on Nursery and Gardening.

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Marks

SEMESTER -VI

Paper Title – Minor Paper – 2 (MN-2C)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Agriculture and Food Microbiology

Course Outcomes: ---

After completing this course the learner will be able to;

1. Develop understanding of the significance of intrinsic and extrinsic factors on growth of micro-organism
2. Identify ways to control microbial spoilage of foods
3. Analyze the practices involved in Food Microbiology

Full Mark - 60

Time: - 3 Hrs

Unit I: Role of Microorganisms in Agriculture

8 lectures

Role of symbiotic and free-living bacteria and cyanobacteria in agriculture., Mycorrhiza, Plant Growth Promoting Microorganisms (PGPM) and Phosphate Solubilizing Microorganisms (PSM).

Unit II: Biocontrol and Biofertilization

8 lectures

Biocontrol of plant pathogens, pests and weeds, Restoration of waste and degraded lands, Biofertilizers: Types, technology for their production and application, vermi-compost.

Unit III: Food Microbiology- I

7 lectures

Intrinsic and extrinsic factors influencing growth of microorganisms in food, Microbes as source of food: Mushrooms, single cell protein.

Unit IV: Food Microbiology-II

7 lectures

Microbial spoilage of food and food products: Cereals, vegetables, pickles, fish and dairy products. Food poisoning and food intoxication. Food preservation processes. Microbes and fermented foods: Butter, cheese and bakery products.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested readings

1. Adams, M.R. and Moss M. O. (2008). Food Microbiology, 3rd Edition, Royal Society of Chemistry, Cambridge, U.K.
2. Sylvia D.M. (2004). Principles and Applications of Soil Microbiology, 2nd Edition, Prentice Hall, USA.
3. W.C. Frazier (1995). Food Microbiology, 4th Edition, Tata McGraw Hill Education, Noida, India.
4. Waites M.J., Morgan N.L., Rockey J.S. and Higon G. (2001). Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
5. Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003). Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
6. N. S. Subba Rao. (2000). Soil microbiology. 4th Edition, Oxford and IBH publishing Co. Pvt. Ltd., Calcutta, New Delhi, India.
7. Rangaswami, G. and Bagyaraj, D.J. (2006) Agricultural Microbiology. 2nd Unit 2nd Edition, PHI Learning, New Delhi, India.

Semester – VI

Paper Title – Botany Practical – MN-2C Lab

Credits – 01

Full Marks – 25

Pass Marks - 10

Practical

- Based on Agriculture and Food Microbiology

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Marks

SEMESTER -VIII

Paper Title – Minor Paper – 2 (MN-2D)

CREDIT-04 [THEORY- 03 + PRACTICAL- 01]

Mushroom Culture Technology

Course Outcomes: ---

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

1. Recall various types and categories of mushrooms.
2. Demonstrate various types of mushroom cultivating technologies.
3. Examine various types of food technologies associated with mushroom industry.
4. Value the economic factors associated with mushroom cultivation
5. Device new methods and strategies to contribute to mushroom production.

Full Mark - 60

Time: - 3 Hrs

Unit I

8 lectures

Introduction, History. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus.

Unit II

20 lectures

Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparations of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation- Low cost technology; Composting technology in mushroom production.

Unit III

10 lectures

Storage and nutrition: Short-term storage (Refrigeration – up to 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

Unit IV

7 lectures

Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Sessional Internal Assessment (SIA) Full Marks -15 Marks

A –Internal Written Examination – 10 Marks (1 Hrs.)

B - Overall performance including regularity – 05 Marks

Suggested Readings

1. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. (1991). Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990). Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, P. and Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Bahl, N. (1984-1988). Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Semester – VIII

Paper Title – Botany Practical – MN-2D Lab

Credits – 01

Full Marks – 25

Pass Marks - 10

Practical

Based on Mushroom Culture

Experiments – 15 Marks

Viva Voice – 05 Mark

Practical Records – 05 Marks