

ADIKAVI NANNAYA UNIVERSITY :: RAJAMAHENDRAVARAM

B.Sc-Under C.B.C.S. pattern (w.e.f. 2020-'21 Academic Year)

B.Sc
BOTANY

Details of Paper Titles and Credits

S. No.	Semester	Title of the Course (Paper)	Hours/ week	Max. Marks (SEE)	Marks in CIA	Credits
1.	Sem.-I/ Course-1	Fundamentals of Microbes and Non-vascular Plants	04	75	25	03
	Course-1 Practical	Fundamentals of Microbes and Non-vascular Plants	03	Max. Marks-50 Internal assessment at Semester end		02
2.	Sem.-II/ Course-2	Basics of Vascular plants and Phytogeography	04	75	25	03
	Course-2 Practical	Basics of Vascular plants and Phytogeography	03	Max. Marks-50 External assessment at Semester end		02
3.	Sem.-III/ Course-3	Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity	04	75	25	03
	Course-3 Practical	Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity	03	Max. Marks-50 Internal assessment at Semester end		02
4	Sem.-IV Course-4	Plant Physiology and Metabolism	03	75	25	03
	Course- 4Practical	Plant Physiology and Metabolism	03	Max. Marks-50 External assessment at Semester end		02
	Sem.- IV Course- 5	Cell Biology, Genetics and Plant Breeding	04	75	25	03
	Course- 5Practical	Cell Biology, Genetics and Plant Breeding	03	Max. Marks-50 External assessment at Semester end		02
5.	Sem.- V	Domain related Skill Enhancement Courses (02)	03	75	25	03
	Course – 6 & 7	- Three (3) pairs of courses (each pair has 2 related courses) will be offered, student has to choose a pair of courses.	03	Max. Marks-50 Internal assessment at Semester end		02
			03	75	25	03
			03	Max. Marks-50 Internal assessment at Semester end		02

CBCS / Semester System (w.e.f. 2020-'21 Admitted Batch)
I Semester /Botany Core Course - 1
Fundamentals of Microbes and Non-vascular Plants
(Viruses, Bacteria, Fungi, Lichens, Algae and Bryophytes)
 (Total hours of teaching – 60 @ 04 Hrs./Week)

Theory:

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

- Explain origin of life on the earth.
- Illustrate diversity among the viruses and prokaryotic organisms and can categorize them.
- Classify fungi, lichens, algae and bryophytes based on their structure, reproduction and life cycles.
- Analyze and ascertain the plant disease symptoms due to viruses, bacteria and fungi.
- Recall and explain the evolutionary trends among amphibians of plant kingdom for their shift to land habitat.
- Evaluate the ecological and economic value of microbes, thallophytes and bryophytes.

Unit – 1: Origin of life and Viruses

12Hrs.

1. Origin of life, concept of primary Abiogenesis; Miller and Urey experiment. Five kingdom classification of R.H. Whittaker
2. Discovery of microorganisms, Pasteur experiments, germ theory of diseases.
3. Shape and symmetry of viruses; structure of TMV and Gemini virus; multiplication of TMV; A brief account of Prions and Viroids.
4. A general account on symptoms of plant diseases caused by Viruses. Transmission of plant viruses and their control.
5. Significance of viruses in vaccine production, bio-pesticides and as cloning vectors.

Unit – 2: Special groups of Bacteria and Eubacteria

12Hrs.

1. Brief account of Archaeobacteria, Actinomycetes and Cyanobacteria.
2. Cell structure and nutrition of Eubacteria.
3. Reproduction- Asexual (Binary fission and endospores) and bacterial recombination (Conjugation, Transformation, Transduction).
4. Economic importance of Bacteria with reference to their role in Agriculture and industry (fermentation and medicine).
5. A general account on symptoms of plant diseases caused by Bacteria; Citrus canker.

Unit – 3: Fungi & Lichens**12 Hrs.**

1. General characteristics of fungi and Ainsworth classification (upto classes).
2. Structure, reproduction and life history of (a) *Rhizopus* (Zygomycota) and (b) *Puccinia* (Basidiomycota).
3. Economic uses of fungi in food industry, pharmacy and agriculture.
4. A general account on symptoms of plant diseases caused by Fungi; Blast of Rice.
5. Lichens- structure and reproduction; ecological and economic importance.

Unit – 4 : Algae**12 Hrs.**

1. General characteristics of Algae (pigments, flagella and reserve food material); Fritsch classification (upto classes).
2. Thallus organization and life cycles in Algae.
3. Occurrence, structure, reproduction and life cycle of (a) *Spirogyra* (Chlorophyceae) and (b) *Polysiphonia* (Rhodophyceae).
4. Economic importance of Algae.

Unit – 5 : Bryophytes**12 Hrs.**

1. General characteristics of Bryophytes; classification upto classes.
2. Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life cycle of (a) *Marchantia* (Hepaticopsida) and (b) *Funaria* (Bryopsida).
3. General account on evolution of sporophytes in Bryophyta.

Text books :

- Botany – I (Vrukshasastram-I) : Telugu Akademi, Hyderabad
- Pandey, B.P. (2013) *College Botany, Volume-I*, S. Chand Publishing, New Delhi
- Hait, G., K. Bhattacharya & A.K. Ghosh (2011) *A Text Book of Botany, Volume-I*, New Central Book Agency Pvt. Ltd., Kolkata
- Bhattacharjee, R.N., (2017) *Introduction to Microbiology and Microbial Diversity*, Kalyani Publishers, New Delhi.

Books for Reference:

- Dubey, R.C. & D.K. Maheswari (2013) *A Text Book of Microbiology*, S. Chand & Company Ltd., New Delhi
- Pelczar Jr., M.J., E.C.N. Chan & N.R. Krieg (2001) *Microbiology*, Tata McGraw-Hill Co, New Delhi
- Prescott, L. Harley, J. and Klein, D. (2005) *Microbiology, 6th edition*, Tata McGraw – Hill Co. New Delhi.

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- Alexopoulos, C.J., C.W.Mims&M.Blackwell (2007) *Introductory Mycology*, Wiley& Sons, Inc., New York
 - Mehrotra, R.S. & K. R. Aneja (1990)*An Introduction to Mycology*. New Age International Publishers, New Delhi
 - Kevin Kavanagh (2005) *Fungi ; Biology and Applications* John Wiley & Sons, Ltd., West Sussex, England
 - John Webster & R. W. S. Weber (2007) *Introduction to Fungi*, Cambridge University Press, New York
 - Fritsch, F.E. (1945)*The Structure & Reproduction of Algae (Vol. I & Vol. II)*Cambridge University Press Cambridge, U.K..
 - Bold, H.C. & M. J. Wynne (1984)*Introduction to the Algae*, Prentice-Hall Inc., New Jersey
 - Robert Edward Lee (2008)*Phycology*. Cambridge University Press, New York
 - Van Den Hoek, C., D.G.Mann&H.M.Jahns (1996)*Algae : An Introduction to Phycology*. Cambridge University Press, New York
 - Shaw, A.J.&B.Goffinet (2000)*Bryophyte Biology*. Cambridge University Press, New York.

Practical syllabus of Botany Core Course – 1/ Semester – I
Fundamentals of Microbes and Non-vascular Plants
 (Viruses, Bacteria, Fungi, Lichens, Algae and Bryophytes)
 (Total hours of laboratory exercises 30 Hrs. @ 02 Hrs./Week)

Course Outcomes: On successful completion of this practical course, student shall be able to;

1. Demonstrate the techniques of use of lab equipment, preparing slides and identify the material and draw diagrams exactly as it appears.
2. Observe and identify microbes and lower groups of plants on their own.
3. Demonstrate the techniques of inoculation, preparation of media etc.
4. Identify the material in the permanent slides etc.

Practical Syllabus:

1. Knowledge of Microbiology laboratory practices and safety rules.
2. Knowledge of different equipment for Microbiology laboratory (Spirit lamp, Inoculation loop, Hot-air oven, Autoclave/Pressure cooker, Laminar air flow chamber and Incubator) and their working principles. (In case of the non-availability of the laboratory equipment the students can be taken to the local college/clinical lab. with required infrastructural facilities or they can enter a linkage with the college/lab for future developments and it will fetch credits during the accreditation by NAAC).
3. Demonstration of Gram's staining technique for Bacteria.
4. Study of Viruses (Corona, Gemini and TMV) using electron micrographs/ models.
5. Study of Archaeobacteria and Actinomycetes using permanent slides/ electron micrographs/diagrams.
6. Study of *Anabaena* and *Oscillatoria* using permanent/temporary slides.
7. Study of different bacteria (Cocci, Bacillus, Vibrio and Spirillum) using permanent or temporary slides/ electron micrographs/ diagrams.
8. Study/ microscopic observation of vegetative, sectional/anatomical and reproductive structures of the following using temporary or permanent slides/ specimens/ mounts :
 - a. Fungi : *Rhizopus*, *Penicillium* and *Puccinia*
 - b. Lichens: Crustose, foliose and fruticose
 - c. Algae : *Volvox*, *Spirogyra*, *Ectocarpus* and *Polysiphonia*
 - d. Bryophyta : *Marchantia* and *Funaria*
9. Study of specimens of Tobacco mosaic disease, Citrus canker and Blast of Rice.

Model Question Paper for Practical Examination

Semester – I/ Botany Core Course – 1

Fundamentals of Microbes and Non-vascular Plants

(Viruses, Bacteria, Fungi, Lichens, Algae and Bryophytes)

Max. Time : 3 Hrs.

Max. Marks : 50

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1. Take the T.S. of material 'A' (Fungi), make a temporary mount and make comments about identification. 10 M
 2. Identify any 2 algae from the mixture (material 'B') given with specific comments about identification. 10 M
 3. Take the T.S. of material 'C' (Bryophyta), make a temporary mount and make comments about identification. 10 M
 4. Identify the following with specific reasons. 4x 3 = 12 M
 - D. A laboratory equipment of Microbiology
 - E. Virus
 - F. Archaeobacteria /Ascomycete /Cyanobacteria/ Eu-Bacteria
 - G. Lichen
 5. Record + Viva-voce 5+3 = 8 M

Suggested co-curricular activities for Botany Core Course-1 in Semester-I :**A. Measurable :****a. Student seminars :**

1. Baltimore classification of Viruses.
2. Lytic and lysogenic cycle of T- even Bacteriophages.
3. Viral diseases of humans and animals.
4. Retroviruses
5. Bacterial diseases of humans and animals.
6. Significance of Bacteria in Biotechnology and Genetic engineering.
7. Fungi responsible for major famines in the world.
8. Poisonous mushrooms (Toad stools).
9. Algae as Single Cell Proteins (SCPs)
10. Parasitic algae
11. Origin of Bryophytes through : Algae vsPteridophytes
12. Fossil Bryophytes
13. Evolution of gametophytes in Bryophyta.

14. Ecological and economic importance of Bryophytes.

b. Student Study Projects :

1. Isolation and identification of microbes from soil, water and air.
2. Collection and identification of algae from fresh /estuarine /marine water.
3. Collection and identification of fruiting bodies of Basidiomycetes and Ascomycetes.
4. Collection and identification of Lichens from their native localities.
5. Collection of diseased plants/parts and identification of symptoms.
6. Collection and identification of Bryophytes from their native localities.

c. Assignments: Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

B. General :

1. Visit to Agriculture and/or Horticulture University/College/Research station to learn about microbial diseases of plants.
2. Visit to industries working on microbial, fungal and algal products.
3. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.

II Semester /Botany Core Course – 2
Basics of Vascular plants and Phytogeography
(Pteridophytes, Gymnosperms, Taxonomy of Angiosperms and Phytogeography)
 (Total hours of teaching – 60 @ 02 Hrs./Week)

Theory:

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

- Classify and compare Pteridophytes and Gymnosperms based on their morphology, anatomy, reproduction and life cycles.
 - Justify evolutionary trends in tracheophytes to adapt for land habitat.
 - Explain the process of fossilization and compare the characteristics of extinct and extant plants.
 - Critically understand various taxonomical aids for identification of Angiosperms.
 - Analyze the morphology of the most common Angiosperm plants of their localities and recognize their families.
 - Evaluate the ecological, ethnic and economic value of different tracheophytes and summarize their goods and services for human welfare.
 - Locate different phytogeographical regions of the world and India and can analyze their floristic wealth.
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Unit – 1: Pteridophytes

12 Hrs.

1. General characteristics of Pteridophyta; classification of Smith (1955) into divisions.
2. Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life history of (a) *Lycopodium* (Lycopsida) and (b) *Marsilea* (Filicopsida).
3. Stellar evolution in Pteridophytes;
4. Heterospory and seed habit.

Unit – 2: Gymnosperms

14 Hrs.

1. General characteristics of Gymnosperms; Sporne classification into classes.
2. Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life history of (a) *Cycas* (Cycadopsida) and (b) *Gnetum* (Gnetopsida).
3. Outlines of geological time scale.
4. A brief account on *Cycadeoidea*.

Unit – 3: Basic aspects of Taxonomy

13 Hrs.

1. Aim and scope of taxonomy; Species concept: Taxonomic hierarchy, species, genus and family.
2. Plant nomenclature : Binomial system, ICBN- rules for nomenclature.
3. Herbarium and its techniques, BSI herbarium and Kew herbarium; concept of digital herbaria.

4. Bentham and Hooker system of classification;
5. Systematic description and economic importance of the following families:
 - (a) Annonaceae (b) Curcubitaceae

Unit – 4: Systematic Taxonomy**13 Hrs.**

1. Systematic description and economic importance of the following families:

- (a) Asteraceae (b) Asclepiadaceae (c) Amaranthaceae (d) Euphorbiaceae
 - (e) Arecaceae and (f) Poaceae
2. Outlines of Angiosperm Phylogeny Group (APG IV).

Unit – 5: Phytogeography**08 Hrs.**

1. Principles of Phytogeography, Distribution (wides, endemic, discontinuous species)
2. Endemism – types and causes.
3. Phytogeographic regions of World.
4. Phytogeographic regions of India.
5. Vegetation types in Andhra Pradesh.

Text books :

- Botany – I (Vrukshasastram-I) : Telugu Akademi, Hyderabad
- Botany – II (Vrukshasastram-II) : Telugu Akademi, Hyderabad
- Acharya, B.C., (2019) *Archchegonitates*, Kalyani Publishers, New Delhi
- Bhattacharya, K., G. Hait & Ghosh, A. K., (2011) *A Text Book of Botany, Volume-II*, New Central Book Agency Pvt. Ltd., Kolkata
- Hait, G., K. Bhattacharya & A. K. Ghosh (2011) *A Text Book of Botany, Volume-I*, New Central Book Agency Pvt. Ltd., Kolkata
- Pandey, B.P. (2013) *College Botany, Volume-I*, S. Chand Publishing, New Delhi
- Pandey, B.P. (2013) *College Botany, Volume-II*, S. Chand Publishing, New Delhi

Books for Reference:

- Smith, G.M. (1971) *Cryptogamic Botany Vol. II.*, Tata McGraw Hill, New Delhi
- Sharma, O.P. (2012) *Pteridophyta*. Tata McGraw-Hill, New Delhi
- Kramer, K.U. & P. S. Green (1990) *The Families and Genera of Vascular Plants, Volume –I: Pteridophytes and Gymnosperms* (Ed. K. Kubitzki) Springer-Verlag, New York
- Bhatnagar, S.P. & Alok Moitra (1996) *Gymnosperms*. New Age International, New Delhi
- Coulter, J.M. & C.J. Chamberlain (1910) *Morphology of Gymnosperms*, The University of Chicago Press, Chicago, Illinois
- Govil, C.M. (2007) *Gymnosperms : Extinct and Extant*. KRISHNA Prakashan Media (P) Ltd. Meerut & Delhi
- Sporne, K.R. (1971) *The Morphology of Gymnosperms*. Hutchinsons Co. Ltd., London
- Arnold, C.A., (1947) *An introduction to Paleobotany* McGraw –Hill Book Company, INC, New York
- Stewart, W.N., and G.W. Rothwell (2005) *Paleobotany and the evolution of plants* Cambridge University Press, New York

- Lawrence, George H.M. (1951) *Taxonomy of Vascular Plants*. The McMillan Co., New York
- Heywood, V. H. and D. M. Moore (1984) *Current Concepts in Plant Taxonomy*. Academic Press, London.
- Jeffrey, C. (1982) *An Introduction to Plant Taxonomy*. Cambridge University Press, Cambridge. London.
- Sambamurty, A.V.S.S. (2005) *Taxonomy of Angiosperms I*. K .International Pvt. Ltd., New Delhi
- Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford & IBH Pvt. Ltd., NewDelhi.
- Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA,U.S.A.
- Cain, S.A . (1944) *Foundations of Plant Geography* Harper & Brothers, N.Y.
- Good, R. (1997) *The Geography of flowering Plants (2nd Edn.)* Longmans, Green & Co., Inc., London & Allied Science Publishers, New Delhi
- Mani, M.S (1974) *Ecology & Biogeography of India* Dr. W. Junk Publishers, The Haque

Practical syllabus of Botany Core Course – 2/ Semester – II
Basics of Vascular plants and Phytogeography
(Pteridophytes, Gymnosperms, Taxonomy of Angiosperms and Phytogeography) (Total hours of laboratory exercises 30 Hrs. @ 02 Hrs./Week)

Course Outcomes : On successful completion of this course students shall be able to :

1. Demonstrate the techniques of section cutting, preparing slides, identifying of the material and drawing exact figures.
2. Compare and contrast the morphological, anatomical and reproductive features of vascular plants.
3. Identify the local angiosperms of the families prescribed to their genus and species level and prepare herbarium.
4. Exhibit skills of preparing slides, identifying the given twigs in the lab and drawing figures of plant twigs, flowers and floral diagrams as they are.
5. Prepare and preserve specimens of local wild plants using herbarium techniques.

Practical Syllabus:

1. Study/ microscopic observation of vegetative, sectional/anatomical and reproductive structures of the following using temporary or permanent slides/ specimens/ mounts :
 - a. Pteridophyta : *Lycopodium* and *Marselia*
 - b. Gymnosperms : *Cycas* and *Gnetum*
2. Study of fossil specimens of *Cycadeoidea* and *Pentoxylon* (photographs /diagrams can be shown if specimens are not available).
3. Demonstration of herbarium techniques.
4. Systematic / taxonomic study of locally available plants belonging to the families prescribed in theory syllabus. (Submission of 30 number of Herbarium sheets of wild plants with the standard system is mandatory).
5. Mapping of phytogeographical regions of the globe and India.

Model Question Paper for Practical Examination

Semester – II/ Botany Core Course – 2

Basics of Vascular plants and Phytogeography

(Pteridophytes, Gymnosperms, Taxonomy of Angiosperms and Phytogeography)

Max. Time : 3 Hrs.

Max. Marks : 50

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| 1. Take T.S. of the material 'A' (Pteridophyta), make a temporary slide and justify the identification with apt points. | 10 M |
| 2. Take T.S. of the material 'B' (Gymnosperms), make a temporary slide and justify the identification with apt points. | 10 M |
| 3. Describe the vegetative and floral characters of the material 'C' (Taxonomy of Angiosperms) and derive its systematic position. | 10 M |
| 4. Identify the specimen 'D' (Fossil Gymnosperm) and give specific reasons. | 5 M |
| 5. Locate the specified phytogeographical regions (2x2M) in the world / India (E) map supplied to you. | 4 M |
| 6. Record + Herbarium & Field note book + Viva-voce | 5 +4+3 = 12 M |

Suggested co-curricular activities for Botany Core Course-2 in Semester-II :**A. Measurable :****a. Student seminars :**

1. Fossil Pteridophytes.
2. Aquatic ferns and tree ferns
3. Ecological and economic importance of Pteridophytes
4. Evolution of male and female gametophytes in Gymnosperms.
5. Endemic and endangered Gymnosperms.
6. Ecological and economic importance of Gymnosperms.
7. Floras and their importance :Flora of British India and Flora of Madras Presidency.
8. Botanical gardens and their importance :National Botanic garden and Royal Botanic garden.
9. Artificial, Natural and Phylogenetic classification systems.
10. Molecular markers used in APG system of classification.
11. Vessel less angiosperms.
12. Insectivorous plants.
13. Parasitic angiosperms.
14. Continental drift theory and species isolation.

b. Student Study Projects :

1. Collection and identification of Pteridophytes from their native locality/ making an album by collecting photographs of Pteridophytes.
2. Collection and identification of Gymnosperms from their native locality/ making an album by collecting photographs of Gymnosperms.
4. Collection of information on famous herbaria in the world and preparation of a report.
5. Collection of information on famous botanic gardens in the world and preparation of a report.
6. Collection of data on vegetables (leafy and fruity) plants in the market and preparation of a report on their taxonomy.
7. Collection and identification of fresh and dry fruits plants in the market and preparation of a report on their taxonomy.
7. Collection of data on plants of ethnic and ethnobotanical importance from their native locality.
9. Preparation of a local flora by enlisting the plants of their native place.

c. Assignments: Written assignment at home / during '0' hour at college;

preparation of charts with drawings, making models etc., on topics included in syllabus.

B. General :

1. Visit to Botanic garden in a Research institute/University to see the live plants.
2. Virtual tour in websites for digital herbaria and botanic gardens.
3. Acquaint with standard floras like – Flora of Madras Presidency, Flora of their respective district in Andhra Pradesh.
4. Looking into vegetation of different phytogeographical regions using web resources.
5. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.

III Semester /Botany Core Course - 3
Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity
 (Total hours of teaching – 60 @ 04 Hrs./Week)

Theory:

Learning outcomes: On successful completion of this course, the students will be able to;

- Understand on the organization of tissues and tissue systems in plants.
- Illustrate and interpret various aspects of embryology.
- Discuss the basic concepts of plant ecology, and evaluate the effects of environmental and biotic factors on plant communities.
- Appraise various qualitative and quantitative parameters to study the population and community ecology.
- Correlate the importance of biodiversity and consequences due to its loss.
- Enlist the endemic/endangered flora and fauna from two biodiversity hot spots in India and assess strategies for their conservation.

Unit – 1: Anatomy of Angiosperms

12 Hrs.

1. Organization of apical meristems: Tunica-carpus theory and Histogen theory.
2. Tissue systems—Epidermal, ground and vascular.
3. Anomalous secondary growth in *Boerhaavia* and *Dracaena*.
4. Study of timbers of economic importance - Teak, Red sanders and Rosewood.

Unit – 2 : Embryology of Angiosperms

12 Hrs.

1. Structure of anther, anther wall, types of tapetum. Microsporogenesis and development of male gametophyte.
2. Structure of ovule, megasporogenesis; monosporic (*Polygonum*), bisporic (*Allium*) and tetrasporic (*Peperomia*) types of embryo sacs.
3. Outlines of pollination, pollen – pistil interaction and fertilization.
4. Endosperm - Types and biological importance - Free nuclear, cellular, helobial and ruminate.
5. Development of Dicot (*Capsella bursa-pastoris*) embryo.

Unit – 3 : Basics of Ecology

12 Hrs.

1. Ecology: definition, branches and significance of ecology.
2. Ecosystem: Concept and components, energy flow, food chain, food web, ecological pyramids.
4. Plants and environment: Climatic (light and temperature), edaphic and biotic factors.
5. Ecological succession: Hydrosere and Xerosere.

Unit – 4: Population, Community and Production Ecology 12 Hrs.

1. Population ecology: Natalty, mortality, growth curves, ecotypes, ecads
2. Community ecology: Frequency, density, cover, life forms, biological spectrum
3. Concepts of productivity: GPP, NPP and Community Respiration
4. Secondary production, P/R ratio and Ecosystems.

Unit – 5: Basics of Biodiversity 12 Hrs.

1. Biodiversity: Basic concepts, Convention on Biodiversity - Earth Summit.
2. Value of Biodiversity; types and levels of biodiversity and Threats to biodiversity
3. Biodiversity Hot spots in India. Biodiversity in North Eastern Himalayas and Western Ghats.
4. Principles of conservation: IUCN threat-categories, RED data book
5. Role of NBPGR and NBA in the conservation of Biodiversity.

Text books :

- Botany – III (Vrukshasastram-I) : Telugu Akademi, Hyderabad
- Botany – IV (Vrukshasastram-II) : Telugu Akademi, Hyderabad
- Pandey, B.P. (2013) *College Botany, Volume-II*, S. Chand Publishing, New Delhi
- Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
- Bhattacharya, K., G. Hait & Ghosh, A. K., (2011) *A Text Book of Botany, Volume-II*, New Central Book Agency Pvt. Ltd., Kolkata

Books for Reference:

- Esau, K. (1971) *Anatomy of Seed Plants*. John Wiley and Son, USA.
- Fahn, A. (1990) *Plant Anatomy*, Pergamon Press, Oxford.
- Cutler, D.F., T. Botha & D. Wm. Stevenson (2008) *Plant Anatomy : An Applied Approach*, Wiley, USA.
- Paula Rudall (1987) *Anatomy of Flowering Plants : An Introduction to Structure and Development*. Cambridge University Press, London
- Bhojwani, S. S. and S. P. Bhatnagar (2000) *The Embryology of Angiosperms (4th Ed.)*, Vikas Publishing House, Delhi.
- Pandey, A. K. (2000) *Introduction to Embryology of Angiosperms*. CBS Publishers & Distributors Pvt. Ltd. , New Delhi
- Maheswari, P. (1971) *An Introduction to Embryology of Angiosperms*. McGraw Hill Book Co., London.
- Johri, B.M. (2011) *Embryology of Angiosperms*. Springer-Verlag, Berlin
- Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
- Bhattacharya, K., A. K. Ghosh, & G. Hait (2011) *A Text Book of Botany, Volume-IV*, New Central Book Agency Pvt. Ltd., Kolkata
- Kormondy, Edward J. (1996) *Concepts of Ecology*, Prentice-Hall of India Private Limited, New Delhi
- Begon, M., J.L. Harper & C.R. Townsend (2003) *Ecology*, Blackwell Science Ltd., U.S.A.

- Eugene P. Odum (1996) *Fundamentals of Ecology*, Natraj Publishers, Dehradun
- Sharma, P.D. (2012) *Ecology and Environment*. Rastogi Publications, Meerut, India.
- N.S.Subrahmanyam & A.V.S.S. Sambamurty (2008) *Ecology* Narosa Publishing House, New Delhi
- A. K. Agrawal & P.P. Deo (2010) *Plant Ecology*, Agrobios (India), Jodhpur
- Kumar, H.D. (1992) *Modern Concepts of Ecology (7th Edn.)*, Vikas Publishing Co., New Delhi.
- Newman, E.I. (2000): *Applied Ecology* Blackwell Scientific Publisher, U.K.
- Chapman, J.L. & M.J. Reiss (1992): *Ecology - Principles & Applications*. Cambridge University Press, U.K.
- Kumar H.D. (2000) *Biodiversity & Sustainable Conservation* Oxford & IBH Publishing Co Ltd. New Delhi.
- U. Kumar (2007) *Biodiversity : Principles & Conservation*, Agrobios (India), Jodhpur

Practical syllabus of Botany Core Course – 3 /Semester – III
Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity
 (Total hours of laboratory exercises 30 Hrs. @ 02 Hrs./Week)

Course Outcomes: On successful completion of this practical course students shall be able to :

1. Get familiarized with techniques of section making, staining and microscopic study of vegetative, anatomical and reproductive structure of plants.
2. Observe externally and under microscope, identify and draw exact diagrams of the material in the lab.
3. Demonstrate application of methods in plant ecology and conservation of biodiversity and qualitative and quantitative aspects related to populations and communities of plants.

Practical Syllabus

1. Tissue organization in root and shoot apices using permanent slides.
2. Anomalous secondary growth in stems of *Boerhavia* and *Dracaena*.
3. Study of anther and ovule using permanent slides/photographs.
4. Study of pollen germination and pollen viability.
5. Dissection and observation of Embryo sac haustoria in *Santalum* or *Argemone*.
6. Structure of endosperm (nuclear and cellular) using permanent slides / Photographs.
7. Dissection and observation of Endosperm haustoria in *Crotalaria* or *Coccinia*.
8. Developmental stages of dicot and monocot embryos using permanent slides / photographs.
9. Study of instruments used to measure microclimatic variables; soil thermometer, maximum and minimum thermometer, anemometer, rain gauge, and lux meter. (visit to the nearest/local meteorology station where the data is being collected regularly and record the field visit summary for the submission in the practical).
10. Study of morphological and anatomical adaptations of hydrophytes and xerophytes (02 each).
11. Quantitative analysis of herbaceous vegetation in the college campus for frequency, density and abundance.
12. Identification of vegetation/various plants in college campus and comparison with Raunkiaer's frequency distribution law.
13. Find out the alpha-diversity of plants in the area
14. Mapping of biodiversity hotspots of the world and India.

Model paper for Practical Examination

Semester – III/ BotanyCore Course – 3

Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity

Max. Time : 3 Hrs.

Max. Marks : 50

1. Take T.S. of the material 'A' (Anatomy), prepare a temporary slide and justify the identification with specific reasons. 10 M
2. Write the procedure for the experiment 'B' (Embryology) and demonstrate the same. 10 M
3. Take T.S. of the material 'C', prepare a temporary slide and justify the identification with specific reasons. 10 M
4. Identify the following with specific reasons. 4 x 3 = 12 M
 - D. Anatomy/Embryology
 - E. Ecology instrument
 - F. Mapping of Biodiversity hot spot
 - G. Endemic/endangered plant/animal
5. Record + Viva-voce 5 + 3 = 8 M

Suggested co-curricular activities for Botany CoreCourse-3 in Semester-III :**A. Measurable :****a. Student seminars :**

1. Anatomy in relation to taxonomy of Angiosperms.
2. Nodal anatomy
3. Floral anatomy
4. Embryology in relation to taxonomy of Angiosperms.
5. Apomictics and polyembryony.
6. Biogeochemical cycles- Carbon, Nitrogen and Phosphorous.
7. Deforestation and Afforestation.
8. Green house effect and ocean acidification.
9. The Montreal protocol and the Kyoto protocol.
10. Productivity of aquatic ecosystems.
11. Mangrove ecosystems in India.
12. Kollerulake – Ramsar site.
13. Biodiversity hotspots of the world.
14. Origin of Crop plants - Vavilov centers
15. Agrobiodiversity

16. International organizations working on conservation of Biodiversity
17. Nagoya protocol – ABS system.
18. Endemic and endangered plants in Andhra Pradesh.

b. Student Study Projects :

1. Stomata structure in plants from college campus/ their native place.
 2. Report on xylem elements in plants using maceration technique.
 3. Collection of information on famous herbaria in the world and preparation of a report.
 4. Microscopic observations on pollen morphology from plants in college campus/ their native locality.
 5. Study report on germination and viability of pollen in different plants.
 6. Observation of anthesis time in different plants and their pollinators.
 7. A report on autecology and synecology of some plants in college campus or their native place.
 8. Collection of photos of endemic/endangered plant and animal species to make an album.
 9. Biodiversity of the college or their own residential/ native area.
 10. Collection of seeds/vegetative organs of rare plant species from their localities and to raise/grow in college garden
- c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

B. General :

1. Visit to an arboretum/silviculture station/Forest research institute to see the live timber yielding plants or to visit a local timber depot. to observe various woods.
2. Field visit to a nearby ecosystem to observe the abiotic-biotic relationships.
3. Visit to National park/Sanctuary/Biosphere reserve etc., to observe in-situ conservation of plants and animals.
4. Visit to a Botanical garden or Zoo to learn about ex-situ conservation of rare plants or animals.
5. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.

IV Semester/ Botany Core Course – 4
Plant Physiology and Metabolism
 (Total hours of teaching – 60 @ 04 Hrs./Week)

Theory:

Learning outcomes: On successful completion of this course, the students will be able to;

- Comprehend the importance of water in plant life and mechanisms for transport of water and solutes in plants.
- Evaluate the role of minerals in plant nutrition and their deficiency symptoms.
- Interpret the role of enzymes in plant metabolism.
- Critically understand the light reactions and carbon assimilation processes responsible for synthesis of food in plants.
- Analyze the biochemical reactions in relation to Nitrogen and lipid metabolisms.
- Evaluate the physiological factors that regulate growth and development in plants.
- Examine the role of light on flowering and explain physiology of plants under stress conditions.

Unit – 1 : Plant-Water relations

10 Hrs.

1. Importance of water to plant life, physical properties of water, diffusion, imbibition, osmosis. water potential, osmotic potential, pressure potential.
2. Absorption and lateral transport of water; Ascent of sap
3. Transpiration: stomata structure and mechanism of stomatal movements (K^+ ion flux).
4. Mechanism of phloem transport; source-sink relationships.

Unit – 2 : Mineral nutrition, Enzymes and Respiration

14 Hrs.

1. Essential macro and micro mineral nutrients and their role in plants; symptoms of mineral deficiency
2. Absorption of mineral ions; passive and active processes.
3. Characteristics, nomenclature and classification of Enzymes. Mechanism of enzyme action, enzyme kinetics.
4. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle; electron transport system, mechanism of oxidative phosphorylation, Pentose Phosphate Pathway (HMP shunt).

Unit – 3 : Photosynthesis and Photorespiration

12 Hrs.

1. Photosynthesis: Photosynthetic pigments, absorption and action spectra; Red drop and Emerson enhancement effect
2. Concept of two photosystems; mechanism of photosynthetic electron transport and evolution of oxygen; photophosphorylation

3. Carbon assimilation pathways (C₃, C₄ and CAM);
4. Photorespiration - C₂ pathway

Unit – 4 : Nitrogen and lipid metabolism

12 Hrs.

1. Nitrogen metabolism: Biological nitrogen fixation – asymbiotic and symbiotic nitrogen fixing organisms. Nitrogenase enzyme system.
2. Lipid metabolism :Classification of Plant lipids, saturated and unsaturated fatty acids.
3. Anabolism of triglycerides, β -oxidation of fatty acids, Glyoxylate cycle.

Unit – 5 : Plant growth - development and stress physiology

12 Hrs.

1. Growth and Development: Definition, phases and kinetics of growth.
2. Physiological effects of Plant Growth Regulators (PGRs) - auxins, gibberellins, cytokinins, ABA, ethylene and brassinosteroids.
3. Physiology of flowering :Photoperiodism, role of phytochrome in flowering.
4. Seed germination and senescence.
5. Physiological changes during water stress.

Text books :

- Botany – IV (Vrukshasastram-II) : Telugu Akademi, Hyderabad
- Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
- Ghosh, A. K., K. Bhattacharya & G. Hait (2011) *A Text Book of Botany, Volume-III*, New Central Book Agency Pvt. Ltd., Kolkata

Books for Reference:

- Aravind Kumar & S.S. Purohit (1998) *Plant Physiology – Fundamentals and Applications*, AgroBotanica, Bikaner
- Datta, S.C. (2007) *Plant Physiology*, New Age International (P) Ltd., Publishers, New Delhi
- Hans Mohr & P. Schopfer (2006) *Plant Physiology*, Springer (India) Pvt. Ltd., New Delhi
- Hans-Walter heldt (2005) *Plant Biochemistry*, Academic Press, U.S.A.
- Hopkins, W.G. & N.P.A. Huner (2014) *Introduction to Plant Physiology*, Wiley India Pvt. Ltd., New Delhi
- Noggle Ray & J. Fritz (2013) *Introductory Plant Physiology*, Prentice Hall (India), New Delhi
- Pandey, S.M. & B.K. Sinha (2006) *Plant Physiology*, Vikas Publishing House, New Delhi
- Salisbury, Frank B. & Cleon W. Ross (2007) *Plant Physiology*, Thomsen & Wadsworth, Australia & U.S.A
- Sinha, R.K. (2014) *Modern Plant Physiology*, Narosa Publishing House, New Delhi
- Taiz, L. & E. Zeiger (2003) *Plant Physiology*, Panima Publishers, New Delhi
- Verma, V. (2007) *Text Book of Plant Physiology*, Ane Books India, New Delhi

Practical Syllabus of Botany Core Course – 4 / Semester – IV
Plant Physiology and Metabolism
(Total hours of laboratory exercises 30 Hrs. @ 02 Hrs./Week)

Course outcomes: On successful completion of this practical course, students shall be able to:

1. Conduct lab and field experiments pertaining to Plant Physiology, that is, biophysical and biochemical processes using related glassware, equipment, chemicals and plant material.
2. Estimate the quantities and qualitative expressions using experimental results and calculations
3. Demonstrate the factors responsible for growth and development in plants.

Practical Syllabus

1. Determination of osmotic potential of plant cell sap by plasmolytic method using *Rhoeo/ Tradescantia* leaves.
2. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
3. Determination of rate of transpiration using Cobalt chloride method / Ganong's potometer (at least for a dicot and a monocot).
4. Effect of Temperature on membrane permeability by colorimetric method.
5. Study of mineral deficiency symptoms using plant material/photographs.
6. Demonstration of amylase enzyme activity and study the effect of substrate and Enzyme concentration.
7. Separation of chloroplast pigments using paper chromatography technique.
8. Demonstration of Polyphenol oxidase enzyme activity (Potato tuber or Apple fruit)
9. Anatomy of C₃, C₄ and CAM leaves
10. Estimation of protein by biuret method/Lowry method
11. Minor experiments – Osmosis, Arc-auxometer, ascent of sap through xylem, cytoplasmic streaming.

Model Question Paper for Practical Examination
Semester – IV/ Botany Core Course – 4
Plant Physiology and Metabolism

Max. Time : 3 Hrs.

Max. Marks : 50

1. Conduct the experiment 'A' (Major experiment), write aim, principle, material and apparatus/equipment, procedure, tabulate results and make conclusion. 20 M
2. Demonstrate the experiment 'B' (Minor experiment) , write the principle, procedure and give inference. 10 M
3. Identify the following with apt reasons. 3 x 4 = 12 M
 - C. Plant water relations / Mineral nutrition
 - D. Plant metabolism
 - E. Plant growth and development
4. Record + Viva-voce 5 + 3 = 8 M

Suggested co-curricular activities for Botany Core Course-4 in Semester-IV :

A. Measurable :

a. Student seminars :

1. Antitranspirants and their significance in crop physiology and horticulture.
2. Natural chelating agents in plants.
3. Criteria of essentiality of elements and beneficial elements.
4. Hydroponics, aquaponics and aeroponics.
5. Mycorrhizal association and mineral nutrition in plants.
6. Non-proteinaceous enzymes.
7. Respiratory inhibitors.
8. Structure of ATPase and Chemiosmotic hypothesis.
9. Transpiration and photosynthesis – a compromise.
10. Amphibolic pathways and bypass pathways in plants.
11. Non-biological nitrogen fixation.
12. Role of Hydrogenase in nitrogen fixation.
13. Plant lectins – their role in plants and use in medicine and medical research.

b. Student Study Projects :

1. Stomatal densities among different groups of plants.
2. Various treatments (salt, cold, high temperature, heavy metals) and their effects on seed germination.
3. Effects of plant hormones (IAA, Gibberellin and Kinetin) on Seed Germination.
4. Diurnal variation of stomatal behavior in CAM and C3 plants found in local area.
5. Effects of nitrogen fertilizer on plant growth.
6. Enumeration of C3, C4 and CAM plants in the local area.
7. Effect of different light wavelengths (red light, green light, blue light) on apparent photosynthesis in terms of growth.
8. Light effects on leaf growth and leaf orientation.
9. Artificial Fruit Ripening Process by various treatments (carbide and ethylene).
10. Study of relative water content and water retention by leaves under different environments.
11. Study of soil nutrients in local agricultural fields.
12. Study of mineral deficiency symptoms of various crops of local area.
13. Study of local weeds in crop fields.
14. Studies on seed storage proteins, oils and starch in local millets and pulse crops.
15. Making a report on LDPs, SDPs and DNPs in their locality.

- c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

B. General :

1. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.
2. Visit to a Plant Physiology laboratory in a University or Physiology division in a Agriculture/Horticulture University/Research station.

IV Semester / Botany Core Course –5
Cell Biology, Genetics and Plant Breeding
 (Total hours of teaching – 60 @ 04 Hrs./Week)

Theory:

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

- Distinguish prokaryotic and eukaryotic cells and design the model of a cell.
- Explain the organization of a eukaryotic chromosome and the structure of genetic material.
- Demonstrate techniques to observe the cell and its components under a microscope.
- Discuss the basics of Mendelian genetics, its variations and interpret inheritance of traits in living beings.
- Elucidate the role of extra-chromosomal genetic material for inheritance of characters.
- Evaluate the structure, function and regulation of genetic material.
- Understand the application of principles and modern techniques in plant breeding.
- Explain the procedures of selection and hybridization for improvement of crops.

Unit – 1 : The Cell

12 Hrs.

1. Cell theory; prokaryotic vs eukaryotic cell; animal vs plant cell; a brief account on ultra-structure of a plant cell.
2. Ultra-structure of cell wall.
3. Ultra-structure of plasma membrane and various theories on its organization.
4. Polymorphic cell organelles (Plastids); ultrastructure of chloroplast. Plastid DNA.

Unit – 2 : Chromosomes

12 Hrs.

1. Prokaryotic vs eukaryotic chromosome. Morphology of a eukaryotic chromosome.
2. Euchromatin and Heterochromatin; Karyotype and ideogram.
3. Brief account of chromosomal aberrations - structural and numerical changes
4. Organization of DNA in a chromosome (solenoid and nucleosome models).

Unit – 3 : Mendelian and Non-Mendelian genetics

14Hrs.

1. Mendel's laws of inheritance. Incomplete dominance and co-dominance; Multiple allelism.
2. Complementary, supplementary and duplicate gene interactions (plant based examples are to be dealt).
3. A brief account of linkage and crossing over; Chromosomal mapping - 2 point and 3 point test cross.
4. Concept of maternal inheritance (Corren's experiment on *Mirabilis jalapa*); Mitochondrial DNA.

Unit – 4 :Structure and functions of DNA**12 Hrs.**

1. Watson and Crick model of DNA. Brief account on DNA Replication (Semi-conservative method).
2. Brief account on Transcription, types and functions of RNA. Gene concept and genetic code and Translation.
3. Regulation of gene expression in prokaryotes - Lac Operon.

Unit – 5 :Plant Breeding**12 Hrs.**

1. Plant Breeding and its scope; Genetic basis for plant breeding. Plant Introduction and acclimatization.
2. Definition, procedure; applications and uses; advantages and limitations of:(a) Mass selection, (b) Pure line selection and (c) Clonal selection.
3. Hybridization – schemes, and technique; Heterosis(hybrid vigour).
4. A brief account on Molecular breeding – DNA markers in plant breeding. RAPD, RFLP.

Text books :

- Botany – III (Vrukshasastram-I) : Telugu Akademi, Hyderabad
- Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
- Ghosh, A.K., K.Bhattacharya&G. Hait (2011) *A Text Book of Botany, Volume-III*, New Central Book Agency Pvt. Ltd., Kolkata
- Chaudhary, R. C. (1996) *Introduction to Plant Breeding*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

Books for Reference:

- S. C. Rastogi (2008)*Cell Biology*,New Age International (P) Ltd. Publishers, New Delhi
- P. K. Gupta (2002)*Cell and Molecular biology*,Rastogi Publications, New Delhi
- B. D. Singh (2008) *Genetics*,Kalyani Publishers, Ludhiana
- A.V.S.S. Sambamurty (2007) *Molecular Genetics*,Narosa Publishing House,New Delhi
- Cooper, G.M. & R.E. Hausman (2009)*The Cell – A Molecular Approach*, A.S.M. Press, Washington
- Becker, W.M., L.J. Kleinsmith& J. Hardin (2007)*The World of Cell*, Pearson Education, Inc., New York
- De Robertis, E.D.P. & E.M.F. De Robertis Jr. (2002)*Cell and Molecular Biology*, Lippincott Williams & Wilkins Publ., Philadelphia
- Robert H. Tamarin (2002)*Principles of Genetics*,Tata McGraw –Hill Publishing Company Limited, New Delhi.
- Gardner, E.J., M. J. Simmons & D.P. Snustad (2004)*Principles of Genetics*, John Wiley & Sons Inc., New York
- Micklos, D.A., G.A. Freyer& D.A. Cotty (2005) *DNA Science: A First Course*, I.K. International Pvt. Ltd., New Delhi
- Chaudhari, H.K.(1983)*Elementary Principles of Plant Breeding*, TMHpublishers Co., New Delhi

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- Sharma, J.R. (1994)*Principles and Practice of Plant Breeding*, Tata McGraw- Hill Publishers, New Delhi
 - Singh, B.D. (2001)*Plant Breeding : Principles and Methods*, Kalyani Publishers, Ludhiana
 - Pundhan Singh (2015) *Plant Breeding for Undergraduate Students*, Kalyani Publishers, Ludhiana
 - Gupta, S.K. (2010)*Plant Breeding : Theory and Techniques*, Agrobios (India), Jodhpur
 - Hayes, H.K., F.R. Immer & D.C. Smith (2009) *Methods of Plant Breeding*, Biotech Books, Delhi

Practical Syllabus of Botany Core Course – 5/IV Semester
Cell Biology, Genetics and Plant Breeding
(Total hours of laboratory exercises 30 Hrs. @ 02 Hrs./Week)

Course Outcomes: After successful completion of this practical course the student shall be able to:

1. Show the understanding of techniques of demonstrating Mitosis and Meiosis in the laboratory and identify different stages of cell division.
2. Identify and explain with diagram the cellular parts of a cell from a model or picture and prepare models
3. Solve the problems related to crosses and gene interactions.
4. Demonstrate plant breeding techniques such as emasculation and bagging

Practical Syllabus:

1. Study of ultra structure of plant cell and its organelles using Electron microscopic Photographs/models.
2. Demonstration of Mitosis in *Allium cepa*/*Aloe vera* roots using squash technique; observation of various stages of mitosis in permanent slides.
4. Demonstration of Meiosis in P.M.C.s of *Allium cepa* flower buds using squash technique; observation of various stages of meiosis in permanent slides.
4. Study of structure of DNA and RNA molecules using models.
5. Solving problems monohybrid, dihybrid, back and test crosses.
6. Solving problems on gene interactions (at least one problem for each of the gene interactions in the syllabus).
7. Chromosome mapping using 3- point test cross data.
8. Demonstration of emasculation, bagging, artificial pollination techniques for hybridization.

Model paper for Practical Examination

Semester-IV / Botany Core Course – 5

Cell Biology, Genetics and Plant Breeding

Max. Time : 3 Hrs.

Max. Marks : 50

1. Make a cytological preparation of given material 'A' (mitosis or meiosis in Onion) by squash technique, report any two stages, draw labeled diagrams and write the reasons.

15 M

2. Solve the given Genetic problem (Dihybrid cross/ Interaction of genes/ 3-point test cross) 'B' and write the conclusions.

15 M

3. Identify the following and justify with apt reasons.

3 x 4 = 12 M

C. Cell Biology (Cell organelle)

D. Genetics (DNA/RNA)

E. Plant Breeding

4. Record + Viva-voce

5 + 3 = 8 M

Suggested co-curricular activities for Botany Core Course- 5 in Semester-IV :**A. Measurable :****a. Student seminars :**

1. Light microscopy : bright field and dark field microscopy.
2. Scanning Electron Microscopy (SEM).
3. Transmission Electron Microscopy (TEM).
4. Mitosis and Meiosis
5. Cell cycle and its regulation.
6. Cell organelles bounded by single membrane.
7. Prokaryotic chromosomes
8. Special types of chromosomes :Polytene, Lampbrush and B-chromosomes.
9. Different forms of DNA.
10. Gene mutations.
11. DNA damage and repair mechanisms.
12. Reverse transcription.
13. Protein structure.
14. Modes of reproduction in plants.
15. Modes of pollination in plants

b. Student Study Projects :

1. Study of mitotic cell cycle in roots of *Allium cepa*
2. Study of mitotic cell cycle in roots of *Aloe vera*
3. Observation of chromosomal aberrations in *Allium cepa* root cells exposed to industrial effluent(s).
4. Observation of chromosomal aberrations in *Allium cepa* root cells exposed to heavy metal(s).
5. Observation of polyembryony in *Citrus* spp. and *Mangifera indica*.

- c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

B. General :

1. Field visit to Agriculture/Horticulture University/ Research station to observe Plant breeding methods.
2. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.

RECOMMENDED ASSESSMENT OF STUDENTS:**Recommended continuous assessment methods for all courses:**

Some of the following suggested assessment methodologies could be adopted. Formal assessment for awarding marks for Internal Assessment in theory.

(a) Formal:

1. The oral and written examinations (Scheduled and surprise tests),
2. Simple, medium and Critical Assignments and Problem-solving exercises,
3. Practical assignments and laboratory reports,
4. Assessment of practical skills,
5. Individual and group project reports,
6. Seminar presentations,
7. Viva voce interviews.

(b) Informal:

1. Computerized adaptive testing, literature surveys and evaluations,
2. Peers and self-assessment, outputs form individual and collaborative work
3. Closed-book and open-book tests,

Common pattern for Question Paper for Theory Examination(s) at Semester end

Max. Time : 3 Hrs.

Max. Marks : 75 M

Section – A**Answer all the following questions.****5 x 2 = 10 M**

- ✓ One question should be given from each Unit in the syllabus.

Section – B**Answer any three of the following questions. Draw a labeled diagram wherever necessary****3 x 5 = 15 M**

- ✓ One question should be given from each Unit in the syllabus.

Section – C**Answer any five of the following questions. Draw a labeled diagram wherever necessary****5 x 10 = 50 M**

- ✓ Two questions (a & b) are to be given from each Unit in the syllabus (internal choice in each unit). Student has to answer 5 questions by choosing one from a set of questions given from a Unit.

Note : Questions should be framed in such a way to test the understanding, analytical and creative skills of the students. All the questions should be given within the frame work of the syllabus prescribed.

Annexure

Objectives and General Outcomes of Programme and Domain Subject

Programme(B.Sc.) Objectives: The objectives of bachelor's degree programme with Botany are:

1. To provide a comprehensive knowledge on various aspects related to microbes and plants.
2. To deliver knowledge on latest developments in the field of Plant sciences with a practical approach.
3. To produce a student who thinks independently, critically and discuss various aspects of plant life.
4. To enable the graduate to prepare and pass through national and international examinations related to Botany.
5. To empower the student to become an employee or an entrepreneur in the field of Botany /Biology and to serve the nation.

Programme Outcomes :

1. Understand the basic concepts of Botany in relation to its allied core courses.
2. Perceive the significance of microbes and plants for human welfare, and structural and functional aspects of plants.
3. Demonstrate simple experiments related to plant sciences, analyze data, and interpret them with the theoretical knowledge.
4. Work in teams with enhanced inter-personal skills.
5. Develop the critical thinking with scientific temper.
6. Effectively communicate scientific ideas both orally and in writing.

Domain Subject(Botany) Objectives :

1. To impart knowledge on origin, evolution, structure, reproduction and interrelationships of microbes and early plant groups.
2. To provide knowledge on biology and taxonomy of true land plants within a phylogenetic framework.
3. To teach aspects related to anatomy, embryology and ecology of plants, and importance of Biodiversity.
4. To explain the structural and functional aspects of plants with respect to the cell organelles, chromosomes and genes, and methods of plant breeding.
5. To develop a critical understanding on SPAC, metabolism and growth and development in plants.
6. To enable the students proficient in experimental techniques and methods of analysis appropriate for various sub-courses in Botany.

Domain Subject(Botany) Outcomes:

1. Students will be able to identify, compare and distinguish various groups of microbes and primitive plants based on their characteristics.
 2. Students will be able to explain the evolution of tracheophytes and also distribution of plants on globe.
 3. Students will be able to discuss on internal structure, embryology and ecological adaptations of plants, and want of conserving Biodiversity.
 4. Students will be able to interpret life processes in plants in relation to physiology and metabolism.
 5. Students will be able to describe ultrastructure of plant cells, inheritance and crop improvement methods.
 6. Students will independently design and conduct simple experiments based on the knowledge acquired in theory and practicals of the different sub-courses in Botany.
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**MODEL QUESTION PAPER
CORE COURSE : BOTANY**

Semester: I

Course -1 : Fundamentals of Microbes and Non-vascular Plants

Time: 3 hours

Max Marks: 75M

SECTION – A

Answer any 5 questions. Each question carries 5 marks. (5 X 5M = 25M)
(Total 8 questions and at least two questions should be given from each unit)

1. (a) Prions (b) Viroids
2. Archaeobacteria
3. (a) Basidiocarp (b) Ascocarp
4. Economic importance of Lichens
5. Reserve food material in Algae
6. (a) Scalariform conjugation (b) Lateral conjugation
7. General characteristics of Bryophytes
8. Anatomy of thallus in *Marchantia*

SECTION – B

Answer all the questions. Each question carries 10 marks. (5 X 10M = 50M)

9. Describe the structure of TMV and Gemini virus with neat labeled diagrams.
(OR)
10. Write a general account on symptoms of plant diseases caused by Viruses.
11. Describe the cell structure of a eubacterium with neat labeled diagram.
(OR)
12. Discuss the economic importance of bacteria in agriculture and industrial sectors with suitable examples.
13. Explain the life cycle in *Puccinia* with the help of a schematic diagram.
(OR)
14. Discuss the economic uses of fungi in food industry, pharmacy and agriculture.
15. Write an essay on sexual reproduction in *Polysiphonia*.
(OR)
16. Discuss the economic importance of Algae with suitable examples.
17. Describe the sexual reproduction in *Funaria* with neat labeled diagrams.
(OR)
18. Write an essay on classification of Bryophytes upto classes.

**MODEL QUESTION PAPER
CORE COURSE : BOTANY**

Semester: II

Course -2 : Basics of Vascular plants and Phytogeography

Time: 3 hours

Max Marks: 75M

SECTION – A

Answer any 5 questions. Each question carries 5 marks (5 X 5M = 25M)
(Total 8 questions and at least two questions should be given from each unit)

1. (a) Eusporangium (b) Leptosporangium
2. Geological time scale.
3. Binomial system
4. (a) Synandrous condition (b) Syngenesious condition
5. Essential organs in flower of Acepiadaceae family
6. Economic importance of Arecaceae family
7. (a) Wides (b) Discontinuous species
8. Vegetation types in Andhra Pradesh

SECTION – B

Answer all the questions. Each question carries 10 marks. (5 X 10M = 50M)

9. Describe the sexual reproduction in Lycopodium with neat labeled diagrams.

(OR)

10. Explain the stellar evolution in Pteridophytes with neat labeled diagrams and suitable examples.

11. Write an essay on general characteristics of Gymnosperms.

(OR)

12. Discuss the structure of ovule in *Gnetum* with a neat labeled diagram.

13. What is a herbarium? Explain the techniques of herbarium.

(OR)

14. Discuss the vegetative and floral characters of Annonaceae family. Add a note on economic importance of that family.

(OR)

15. Discuss the vegetative and floral characters of Asteraceae family.

(OR)

16. Discuss the vegetative and floral characters of Poaceae family. Add a note on economic importance of that family.

17. Explain different types Endemism and causes for it.

(OR)

18. Describe different phytogeographic regions of India with examples of flora.

MODEL QUESTION PAPER
CORE COURSE : BOTANY
Semester: III

Course -3 : Anatomy and Embryology of Angiosperms, Plant Ecology and Biodiversity
Time: 3 hours

Max Marks: 75M

SECTION – A

Answer any 5 questions. Each question carries 5 marks (5 X 5M = 25M)
(Total 8 questions and at least two questions should be given from each unit)

1. (a) Xylem tracheids (b) Xylem vessels
2. (a) Periplasmoidal tapetum (b) Glandular tapetum
3. (a) Helobial endosperm (b) Ruminant endosperm
4. Pyramids of numbers
5. (a) Ecotypes (b) Ecads
6. P/R ratio
7. Earth Summit.
8. Role of NBPGR in conservation of Biodiversity

SECTION – B

Answer all the questions. Each question carries 10 marks. (5 X 10M = 50M)

9. Write an essay on organization of apical meristems with theories proposed.
(OR)
10. Discuss the anomalous secondary growth in stem of *Boerhaavia* with the help of a neat labeled diagram.
11. Explain monosporic and bisporic types of embryo sac development in angiosperms.
(OR)
12. Describe the embryogeny in a dicot plant with neat labeled diagrams.
13. Explain various effects of light factor plants and their communities?
(OR)
14. Define ecological succession. Discuss hydrosere with suitable diagrams and examples.
15. Describe Raunkiaer's life forms with suitable examples.
(OR)
16. Write an essay on primary productivity.
17. Write an essay on value of biodiversity with appropriate examples.
(OR)
18. Define biodiversity hotspot. Discuss the biodiversity in Western Ghats of India.

**MODEL QUESTION PAPER
CORE COURSE : BOTANY**

Semester: IV

Course -4 : Plant Physiology and Metabolism

Time: 3 hours

Max Marks: 75M

SECTION – A

Answer any 5 questions. Each question carries 5 marks

(5 X 5M = 25M)

(Total 8 questions and at least two questions should be given from each unit)

1. (a) Diffusion (b) Imbibition
2. (a) Macro nutrients (b) Micro nutrients
3. (a) Anaerobic respiration (b) Aerobic respiration
4. (a) Absorption spectrum (b) Action spectrum
5. C2 pathway
6. Fatty acids
7. Physiological effects of Brassinosteroids
8. Sigmoid growth curve

SECTION – B

Answer all the questions. Each question carries 10 marks.

(5 X 10M = 50M)

9. Explain how ascent of sap occur in plants with suitable theory.

(OR)

10. Discuss the phloem transport in plants. Add a note on source-sink relationship.

11. Write an essay on classification of enzymes.

(OR)

12. Describe the Krebs cycle with the help of schematic diagram.

13. Define photophosphorylation. Explain the non-cyclic photophosphorylation with the help of a schematic diagram.

(OR)

14. Discuss the carbon assimilation in CAM plants.

15. Write an essay on biological nitrogen fixation.

(OR)

16. Describe the Glyoxylate cycle with the help of a schematic diagram.

17. Define photoperiodism. Write an essay on role of phytochrome in photoperiodic responses of plants.

(OR)

18. Discuss the physiological changes in plants during water stress.

**MODEL QUESTION PAPER
CORE COURSE : BOTANY**

Semester: IV

Course -5 : Cell Biology, Genetics and Plant Breeding

Time: 3 hours

Max Marks: 75M

SECTION – A

Answer any 5 questions. Each question carries 5 marks

(5 X 5M = 25M)

(Total 8 questions and at least two questions should be given from each unit)

1. Differences between prokaryotic and eukaryotic cells.
2. (a) Karyotype (b) Ideogram
3. (a) Incomplete dominance (b) Co-dominance
4. Maternal inheritance
5. Double helical structure of DNA
6. Genetic code
7. Objectives and scope of plant breeding
8. Plant introduction

SECTION – B

Answer all the questions. Each question carries 10 marks.

(5 X 10M = 50M)

9. Describe the ultrastructure of cell wall.

(OR)

10. Write an essay on plastid DNA with a well labeled diagram.

11. Discuss the structure of a eukaryotic chromosome with a neat labeled diagram.

(OR)

12. Explain the organization of DNA in chromosomes with suitable theories.

13. Discuss complementary and duplicate gene interactions with suitable examples.

(OR)

14. Explain mapping of genes with the help of 3-point test cross.

15. Describe the semi-conservative mode of DNA replication.

(OR)

16. Define an operon. Explain the regulation of Lac-operon.

17. Write an essay on procedure; applications and uses; advantages and limitations mass selection.

(OR)

18. Give an account of utilization of RFLP and RAPD in molecular plant breeding.