B.Sc. Botany Syllabus

Under Choice Based Credit System

w.e.f

2019-20

DEPARTMENT OF BOTANY
NIZAM COLLEGE (AUTONOMOUS)
Osmania University, Hyderabad-5000 01.
E-mail: Nizamsbotany@gmail.com

Annexure – I (Credits)
Proposed CBCS Scheme for B.Sc.
w.e.f 2019-20

Courses		Papers	Total Credits	Credits for each paper / Semester					
				B.Sc.					
				I	II	III	IV	V	VI
Core Courses DSC	Optional-1	4	20	5	5	5	5	-	-
	Optional-2	4	20	5	5	5	5	-	-
	Optional-3	4	20	5	5	5	5	-	-
Elective Courses DSE	Optional-1	2	10	-	-	-	-	5	5
	Optional-2	2	10	-	-	-	-	5	5
	Optional-3	2	10	-	-	-	-	5	5
Language	English(First Language)	5	20	4	4	3	3	3	3
	Second Language	5	20	4	4	3	3	3	3
Ability Enhancement Compulsory Course AECC	Environmental Science / Basic Computer Skills	1	2	2	-	-	-	-	-
	Basic Computer Skills / Environmental Science	1	2	-	2	-	-	-	-
Skill Enhancement Course SEC	SEC1	1	2	-	-	2	-	-	-
	SEC2	1	2	-	-	2	-	-	-
	SEC3	1	2	-	-	-	2	-	-
	SEC4	1	2	-	-	-	2	-	-
Generic Elective GE	Open Stream	1	4	-	-	-	-	4	-
Project Work/Optionals		1	4	-	-	-	-	-	4
Total Credits in each semester				25	25	25	25	25	25
Total Credits in UG				150					
Credits under Non-CGPA		NSS /NCC /sports / Extra curricular	6	Upto 6 (2 in each year)					
		Summer Internship	4	Upto 4 (2 in each, after I & II years)					

Annexure II

Proposed New Grading System

SGPA (SEMESTER GRADE POINT AVERAGE)			
S. No.	Grade Point	Range of marks	Grade Letter
1	10	Equal to and above 90 Marks	A+
2	9	More than or equal to 80 and less than 90 Marks	A
3	8	More than or equal to 70 and less than 80 Marks	B+
4	7	More than or equal to 60 and less than 70 Marks	B
5	6	More than or equal to 55 and less than 60 Marks	C+
6	5	More than or equal to 50 and less than 55 Marks	C
7	4	More than or equal to 40 and less than 50 Marks	D
8	0	Below 40 Marks	F

PROPOSED CBCS COMMON CORE SCHEME FOR B.SC. COURSE
OPTIONAL -1: BOTANY

CODE	PAPER TITTLE	Course Type	HPW	Credits
	FIRST YEAR SEMSTER - I			
BS 104	PAPER-I : Microbial Diversity and Lower Plants	DSC-1A	4T+2P=6	4+1=5
	FIRST YEAR SEMSTER - II			
BS 204	PAPER-II: Gymnosperms, Taxonomy of Angiosperms and Ecology	DSC-1B	4T+2P=6	4+1=5
	SECOND YEAR SEMSTER - III			
BS 301	SEC-1: Nursery and Gardening	SEC-1	2	2
BS 302	SEC-2: Biofertilizers and Organic Farming	SEC-2	2	2
BS 304	PAPER-III: Plant Anatomy and Embryology	DSC-1C	4T+2P=6	4+1=5
	SECOND YEAR SEMSTER - IV			
BS 401	SEC-3: Greenhouse Technology	SEC-3	2	2
BS 402	SEC-4: Mushroom Culture Technology	SEC-4	2	2
BS 404	PAPER-IV : Cell Biology, Genetics & Plant Physiology	DSC-1D	4T+2P=6	4+1=5
	THIRD YEAR SEMESTER - V			
BS 501	GE-1: Industrial Microbiology	GE-1	4T	4
BS 502	DSE -1A: Biodiversity & Conservation DSE -1B: Economic Botany DSE -1C: Seed Technology	DSE-1A / DSE-1B / DSE-1C	4+2	4+1
	THIRD YEAR SEMESTER – VI			
BS 601	DSE-3: Project	PROJECT	4	4
BS 602	DSE -2A: Plant Molecular Biology DSE -2B: Tissue Culture and Biotechnology DSE -2C: Analytical Techniques in Plant Sciences	DSE-2A / DSE-2B / DSE-5E	4T+2P=6	4+1=5

AECC: Ability Enhancement Compulsory Course, **SEC**: Skill Enhancement Course, **GE**: Generic Elective, **DSC**: Discipline Specific Core, **DSE**: Discipline Specific Elective.

B.Sc., BOTANY
First Year, I -Semester
Paper-I
Microbial Diversity and Lower Plants

DSC - 1A (4 hrs./week) **Credits- 4**

Theory Syllabus **(60 hours)**

UNIT – I **(15 hours)**

1) **Bacteria**: Structure, nutrition, reproduction and economic importance. Brief account of Archaebacteria, Actinomycetes and Mycoplasma with reference to little leaf of Brinjal and Papaya leaf curl

2) **Viruses**: Structure, replication and transmission; plant diseases caused by viruses and their control with reference to Tobacco Mosaic and Rice Tungro.

3) An outline of plant diseases of important crop plants caused by bacteria and their control with reference to Angular leaf spot of cotton and Bacterial blight of Rice.

UNIT-II **(15 hours)**

1) General characters, structure, reproduction and classification of algae (Fritsch)
2) **Cyanobacteria**: General characters, cell structure their significance as biofertilizers with special reference to Oscillatoria, Nostoc and Anabaena.
3) Structure and reproduction of the following:
   Chlorophyceae- Volvox, Oedogonium and Chara.
   Phaeophyceae- Ectocarpus
   Rhodophyceae- Polysiphonia.

UNIT-III **(15 hours)**

1) General characters and classification of fungi (Ainsworth).
2) Structure and reproduction of the following:
   (a) Mastigimycotina- Albugo
   (b) Zygomycotina- Mucor
   (c) Ascomycotina- Saccharomyces and Penicillium.
   (d) Basidiomycotina- Puccinia
   (e) Deuteromycotina- Cercospora.
3) Economic importance of lichens

UNIT-IV **(15 hours)**

1) **Bryophytes:** Structure, reproduction, life cycle and systematic position of Marchantia, Anthoceros and Polytrichum, Evolution of Sporophyte in Bryophytes.
2) **Pteridophytes**: Structure, reproduction, life cycle and systematic position of Rhynia, Lycopodium, Equisetum and Marsilea.
3) Stelar evolution, heterospory and seed habit in Pteridophytes.

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References:

1) Alexopolous, J. and W. M. Charles. 1988. Introduction to Mycology. Wiley Eastern, New Delhi.
2) Mckane, L. and K. Judy. 1996. Microbiology – Essentials and Applications. McGraw Hill, New York.
3) Pandey, B. P. 2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
4) Pandey, B. P. 2007. Botany for Degree Students: Diversity of Microbes, Cryptogams, Cell Biology and Genetics. S. Chand & Company Ltd, New Delhi.
5) Sambamurthy, A. V. S. S. 2006. A Textbook of Plant Pathology. I. K. International Pvt. Ltd., New Delhi.
6) Sambamurthy, A. V. S. S. 2006. A Textbook of Algae. I. K. International Pvt. Ltd., New Delhi.
7) Sharma, O. P. 1992. Textbook of Thallophyta. McGraw Hill Publishing Co., New Delhi.
8) Thakur, A. K. and S. K. Bassi. 2008. A Textbook of Botany: Diversity of Microbes and Cryptogams. S. Chand & Company Ltd, New Delhi.
9) Vashishta, B. R., A. K. Sinha and V. P. Singh. 2008. Botany for Degree Students: Algae. S. Chand& Company Ltd, New Delhi.
10) Vashishta, B. R. 1990. Botany for Degree Students: Fungi, S. Chand & Company Ltd, New Delhi.
11) Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
12) Watson, E. V. 1974. The structure and life of Bryophytes, B. I. Publications, New Delhi.
13) Pandey, B. P. 2006. College Botany, Vol. II: Pteridophyta, Gymnosperms and Paleobotany. S. Chand & Company Ltd, New Delhi.
14) Vashishta, P. C., A. K. Sinha and Anil Kumar. 2006. Botany - Pteridophyta (Vascular Cryptogams). . Chand & Company Ltd, New Delhi.
15) Pandey, B. P. 2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
16) Pandey, B. P. 2007. Botany for Degree Students: Diversity of Microbes, Cryptogams, Cell Biology and Genetics. S. Chand & Company Ltd, New Delhi.
17) Thakur, A. K. and S. K. Bassi. 2008. A Textbook of Botany: Diversity of Microbes and Cryptogams. S. Chand & Company Ltd, New Delhi.
18) Vashishta, B. R., A. K. Sinha and Adarsha Kumar. 2008. Botany for Degree Students: Bryophyta. S. Chand & Company Ltd, New Delhi.

Practical Syllabus **(45 hours)**

1. Study of viruses and bacteria using electron micrographs (photographs).
2. Gram staining of Bacteria.
3. Study of symptoms of plant diseases caused by viruses, bacteria, Mycoplasma and fungi:
   Viruses: Tobacco mosaic
   Bacteria: Angular leaf spot of cotton and Rice tungro.
   Mycoplasma: Little leaf of Brinjal and Leaf curl of papaya
   Fungi: White rust on Crucifers, Rust on wheat & Tikka disease of Groundnut.
4. Vegetative and reproductive structures of the following taxa:
   Algae: Oscillatoria, Nostoc, Volvox, Oedogonium,Chara ,Ectocarpus
   and Polysiphonia.
   Fungi: Albugo, Mucor,Saccharomyces, Penicillium, Puccinia and Cercospora
5. Section cutting of diseased material infected by Fungi and identification of pathogens as per theory syllabus. White rust of Crucifers, Rust on wheat & Tikka disease of Groundnut.
6. Lichens: Different types of thalli and their external morphology
7. Examination of important microbial, fungal and algal products:
   Biofertilizers, protein capsules, antibiotics, mushrooms, Agar-agar etc.
8. Field visits to places of algal / microbial / fungal interest (e.g. Mushroom cultivation, water bodies).
9. Study of Morphology (vegetative and reproductive structures) and anatomy of the following
   Bryophytes: Marchantia, Anthoceros and Polytrichum.
10. Study of Morphology (vegetative and reproductive structures) and anatomy of the following
    Pteridophytes: Lycopodium, Equisetum and Marsilea.
11. Study of Anatomical features of Lycopodium stem, Equisetum stem and Marsilea petiole & rhizome by preparing double stained permanent mounts.

Practical Model Paper **Max. Marks: 50**

Time : 3 hrs

1. Identify the given components '**A**'&'**B**' in the algal mixture .
   Describe with neat labeled diagrams & give reasons for the classifications. 2 X 4 = 8M
2. Classify the given bacterial culture '**D**' using Gram – staining technique. 6M
3. Take a thin transverse section of given diseased material '**E**'.
   Identify & describe the symptoms caused by the pathogen. 8M
4. Identify the given specimens **'F'**, '**G**' & '**H**' by giving reasons .
   (Fungal-1, Bacteria-1 & Viral-1) 3 X 2 = 6M
5. Comment on the given slides '**I**' & '**J'** (Algae-1, Fungi-1) 2 X 4 = 8M
6. Identify the given specimen '**K' &** slide **'L'** (Bryophytes & Pteridophytes) 2 X 4 = 8M
7. Record & Viva 6M

B.Sc., BOTANY

First Year, II -Semester

Paper-II
Gymnosperms, Taxonomy of Angiosperms and Ecology

DSC-1B **Credits-4**

Theory Syllabus **(60 hours)**

UNIT-I **(15 hours)**

1) Gymnosperms: General characters, structure, reproduction and classification (Sporne's). Distribution and economic importance of Gymnosperms.
2) Morphology of vegetative and reproductive parts, systematic position and life cycle of Pinus and Gnetum,
3) Geological time scale Introduction to Palaeobotany, Types of fossils and fossilization, Importance of fossils.

UNIT-II (15 hours)

1) Introduction: Principles of plant systematics, Types of classification: Artificial, Natural and Phylogenetic; Systems of classification: Salient features and comparative account of Bentham & Hooker and Engler & Prantl classification systems. An introduction to Angiosperm Phylogeny Group (APG).
2) Current concepts in Angiosperm Taxonomy: Embryology in relation to taxonomy, Cytotaxonomy, Chemotaxonomy and Numerical Taxonomy.
3) Nomenclature and Taxonomic resources: An introduction to ICN, Shenzhen code – a brief account. Herbarium: Concept, techniques and applications.

UNIT-III (15 hours)

1) Systematic study and economic importance of plants belonging to the following families: Polypetalae Annonaceae, Capparidaceae, Rutaceae, Fabaceae (Faboideae/Papilionoideae, Caesalpinioideae, Mimosoideae), Cucurbitaceae.
2) Gamopetalae: Apiaceae, Asteraceae, Asclepiadaceae, Lamiaceae, Monochalmydeae: Amaranthaceae, Euphorbiaceae.
3) Monocotyledons: Orchidaceae, Poaceae and Zingeberaceae.

UNIT-IV (15 hours)

1. Component of eco system, energy flow, food chain and food webs.
2. Plants and environment, ecological adaptations of plants, Hydrophytes, Xerophytes and Mesophytes
3. Plant Succession serial stages, modification of environment, climax formation with reference to Hydrosere and Xerosere.

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References:

1. Watson, E. V. 1974. The structure and life of Bryophytes, B. I. Publications, New Delhi.
2. Pandey, B. P. 2006. College Botany, Vol. II: Pteridophyta, Gymnosperms and Paleobotany. S. Chand & Company Ltd, New Delhi.
3. Sporne, K. R. 1965. Morphology of Gymnosperms. Hutchinson Co., Ltd., London.
4. Vashishta, P. C., A. K. Sinha and Anil Kumar. 2006. Botany - Pteridophyta (Vascular Cryptogams). . Chand & Company Ltd, New Delhi.
5. Pandey, B. P. 2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
6. Pandey, B. P. 2007. Botany for Degree Students: Diversity of Microbes, Cryptogams, Cell Biology and Genetics. S. Chand & Company Ltd, New Delhi.
7. Thakur, A. K. and S. K. Bassi. 2008. A Textbook of Botany: Diversity of Microbes and Cryptogams. S. Chand & Company Ltd, New Delhi.
8. Vashishta, B. R., A. K. Sinha and Adarsha Kumar. 2008. Botany for Degree Students: Bryophyta. S. Chand & Company Ltd, New Delhi.
9. Vashishta, P. C., A. K. Sinha and Anil Kumar. 2006. Botany for Degree Students: Gymnosperms. Chand & Company Ltd, New Delhi.
10. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
11. Pandey, B. P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd, New Delhi
12. Stace, C. A. 1989. Plant Taxonomy and Biostatistics (2nd Ed.). Edward Arnold, London.
13. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
14. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
15. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
16. Heywood, V. H. 1965 . Plant Taxonomy. ELBS , London.
17. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
18. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge. London.
19. Michael, S. 1996, Ecology, Oxford University Press, London
20. Odum, E.P. 1983. Basics of Ecology, Saunder's International Students Edition, Philadelphia.
21. Sharma P.D. 1989. Elements of Ecology, Rastogi Publications, Meerut

Practical Syllabus **(45 hours)**

1. Study of Morphology (vegetative and reproductive structures) of the following taxa:
   Gymnosperms - Pinus and Gnetum.
2. Study of Anatomical features of Pinus needle and Gnetum stem by preparing double stained permanent mounts.
3. Fossil forms using permanent slides / photographs: Cycadeoidea.
   Systematic study of locally available plants belonging to the families prescribed in theory Syllabus (Minimum of one plant representative for each family)
4. Study of morphological and anatomical characteristics of locally available plant species (Eichhorinia, Hydrilla, Pistia, Nymphaea, Asparagus, Opuntia, Euphorbia melii)
5. Demonstration of herbarium techniques.
6. Candidate has to submit at least 30 herbarium sheets.

Practical Model Paper

Time : 3 hrs **Max. Marks: 50**

1. Prepare a mount of the given material ' **A** ' (Hydrophytes /Xerophytes)
   Draw diagram & give reasons for identification. 8M
2. Prepare a double stained permanent mount of the given material ' **B** ' (Gymnosperms)
   Draw diagram & give reasons for identification. 10M
3. Identify the given specimens **C & D** (Gymnosperms /Xerophytes) 2 X 4 =8M
4. Identify the given slides **E&F** (Gymnosperms /Xerophytes) 2 X 4 =8M
5. Technical description of the given plant twig ' A ' 10M
6. Herbarium 3M
7. Record 3M

B.Sc. CBCS Botany

Theory Model Question Paper
For
DSC & DSE

Time :3 hrs Max. Marks: 80

Draw well-labeled diagrams wherever necessary

I. Write short answer of the following 8 X 4 = 32M

a.

b.

c.

d.

e.

f.

g.

h.

II. Essay Questions: 4X 12 = 48M

1. a.

(OR)

b.

2. a.

(OR)

b.

3. a.

(OR)

b.

4. a.

(OR)

b.

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B.Sc. BOTANY
II Year:Semester-III

Paper – III: Plant Anatomy and Embryology

DSC - 1C **Credits- 4**

Theory Syllabus (60 hours)

UNIT – I **(18h)**

1. Meristems: Types, histological organization of shoot and root apices and theories.
2. Tissues and Tissue Systems: Simple, complex and special tissues.
3. Leaf: Ontogeny, diversity of internal structure; stomata and epidermal outgrowths.
4. General account of adaptations in xerophytes and hydrophytes.

UNIT-II **(16h)**

5. Stem and root anatomy: Vascular cambium - Formation and function.
6. Anomalous secondary growth of Stem - *Achyranthes*, *Boerhaavia*, *Bignonia*, *Dracaena*; Root– *Beta vulgaris*
7. Wood structure: General account. Study of local timbers – Teak (*Tectona grandis*), Rosewood (*Dalbergia latifolia*), Red sanders (*Pterocarpus santalinus*), Nallamaddi (*Terminalia tomentosa*) and Neem (*Azadirachta indica*).

UNIT – III **(10h)**

8. History and importance of Embryology.
9. Anther structure, Microsporogenesis and development of male gametophyte.
10. Ovule structure and types; Megasporogenesis; types and development of female gametophyte.

UNIT-IV **(16h)**

11. Pollen morphology, pollination and fertilization, Pollination Types, Pollen – pistil interaction, Double fertilization.
12. Seed – structure appendages and dispersal mechanisms
13. Endosperm – Development and types. Embryo development and types; Polyembryony and Apomixis - an outline.

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References:

1. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
2. Bhojwani, S. S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House, Delhi.
3. M.R.Saxena- A textbook of Palynology.
4. Vashista- A textbook of Anatomy.
5. P.K.K.Nair- A textbook of Palynology.
6. Esau, K. 1971. Anatomy of Seed Plants. John Wiley and Son, USA.
7. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verleg, Berlin.
8. Kapil, R. P. 1986. Pollination Biology. Inter India Publishers, New Delhi.
9. Maheswari, P. 1971. An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London.
10. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.

B.Sc. BOTANY
II Year: Semester-III
Paper – III: Plant Anatomy and Embryology
DSC - 1C **Credits- 1**

Practical syllabus (45 hours)

1. Demonstration of double staining technique.
2. Tissue organization in root and shoot apices using permanent slides
3. Preparation of double stained Permanent slides
   Primary structure: Root - *Cicer, Canna; Stem – Tridax, Sorghu*m
   Secondary structure: Root – *Tridax* sp.; Stem –*Pongamia*
   Anomalous secondary structure: Examples as given in theory syllabus.
4. Anatomy of Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
5. Stomatal types using epidermal peels.
6. Structure of anther and microsporogenesis using permanent slides.
7. Structure of pollen grains using whole mounts - *Hibiscus, Acacia* and Grass).
8. Pollen viability test using Evans Blue – *Hibiscus*
9. Study of ovule types and developmental stages of embryo sac.
10. Structure of endosperm (nuclear and cellular); Developmental stages of dicot and monocot embryos using permanent slides.

Practical Model Paper

Time: 3 hrs **Max. marks: 50**

1. Identify the given material"**A**", Prepare a double stained permanent mount of transverse section ofgiven the given material. 15M
2. Prepare a temporary mount of epidermal peel of the given leaf material " **B** " and identify the stomatal type . 7M
3. Conduct the pollen viability test "**C"** (OR) Isolate the embryo from the given material . 6M
4. Identify and describe the specimens / slides with well labeled diagrams
   (a) Embryology – **D** (b) Palynology – **E** (c) Anatomy – **F**3 X 4 = 12M
5. Record 5M
6. Viva 5M

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B.Sc. Botany

II Year: Semester-III

Skill Enhancement Course

SEC-1 **(Credits - 2)**

Nursery and Gardening **Lectures: 30**

Unit-I **(15h)**

1. Nursery: definition, objectives and scope and building up of infrastructure fornursery, planning and seasonal activities - Planting - direct seeding and transplants.
2. 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.
3. 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 glass house.

Unit-II **(15h)**

4. 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.
5. 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.

6.Features of a garden: Garden wall, Fencing,biofencing,Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.Cultivation of Important cut flowers: Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Lilium, Orchids.

* Field trip is essential.

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., Bangalore, Madras.
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., San Francisco, USA.

B.Sc. Botany
II Year: Semester-III
Skill Enhancement Course

SEC-2 **(Credits - 2)**

Biofertilizers and Organic Farming (30h)

UNIT - I: **(15h)**

1. Manures and Biofertilizers: Types of fertilizers, manures. Manure composition. Manures for crop productivity.
2. Differences between fertilizers and biofertilizers: pH changes and water contamination.
3. Bacterial Biofertilizers: General account on the microbes used as biofertilizer.
4. Algal Biofertilizers: Associative effect of different microorganisms. *Azolla* and *Anabaena-azollae* association, nitrogen fixation, factors affecting growth, *Azolla* in rice cultivation.

UNIT - II: **(15h)**

5. Fungal Biofertilizers: Mycorrhizal association, types of mycorrhizal association, occurrence and distribution, phosphorus nutrition, growth and yield, colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.
6. Organic Farming: Green manuring and organic fertilizers, Recycling of bio-degradable municipal, agricultural and industrial wastes, Biocompost making- types, method of vermicomposting, Panchakavya. Biological pest control (neem).

Suggested Readings

1. Dubey R.C. 2005. A Text book of Biotechnology. S.Chand & Co. New Delhi.
2. Kumaresan V. 2005. Biotechnology. Saras Publications. New Delhi.
3. John Jothi Prakash E. 2004. Outlines of Plant Biotechnology. Emkay Publication. New Delhi.
4. Sathe T.V. 2004. Vermiculture and Organic Farming. Daya Publishers. New Delhi.
5. Subha Rao N.S. 2000. Soil Microbiology, Oxford & IBH Publishers. New Delhi.
6. Vayas S.C, Vayas S. and Modi H.A. 1998.Bio-fertilizers and organic Farming Akta Prakashan. Nadiad.

B.Sc. BOTANY
II YEAR: Semester-IV

Paper IV: Cell Biology, Genetics and Plant Physiology

DSC-1D Credits-4

Theory Syllabus (60 hours)

UNIT I: (15h)

1. Plant cell envelops: Ultra structure of cell wall,Models of membrane structure, structure and functions of Semi permeable Plasma membrane.
2. Cell Organelles: Structure and semiautonomous nature of Mitochondria andChloroplast.
3. Nucleus: Ultra structure, types and functions of DNA &RNA. Mitochondrial DNA & Plastid DNA and Plasmids.
4. Chromosomes: Morphology, organization of DNA in a chromosome, Euchromatin and Heterochromatin, Karyotype. Special types of chromosomes: Lampbrush andPolytene chromosomes.
5. Cell division: Cell and its regulation; mitosis, meiosis and their significance

UNIT – II: (15 hours)

6. Mendelism: History, Principles of inheritance, Chromosome theory of inheritance, Autosomes and sex chromosomes, Incomplete dominance and Co-dominance. Multiple alleles, Lethal alleles, Epistasis, Recessive and Dominant traits, Polygenic inheritance.
7. Linkage and crossing over, Recombination frequency, two factor and three factor crosses; Interference and coincidence.Numericals based on gene mapping; Sex Linkage.
8. Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy
9. Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens-physical and chemical (Base analogs, deaminating, alkylating and intercalating agents);

Unit-III (15h)

10. Plant -water Relations: Water potential,osmosis, osmotic andpressure potential, absorption and transport of water.
11. Mineral Nutrition:Essential micro & macro nutrients and symptoms ofmineral deficiency.
12. Transpiration: Stomatal structure and movement.
13. Mechanism of phloem transport.
14. Enzymes: Nomenclature, properties, Classification and factors regulating enzyme activity.

UNIT- IV (15h)

15. Photosynthesis: Photosynthetic pigments, Cyclic and Non-cyclic Photophosphorylation. Carbon assimilation pathways: C3, C4 and CAM.
16. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle and oxidative phosphorylation.
17. Nitrogen Metabolism: Biological nitrogen fixation.
18. Physiological role of Phytohormones: Auxins, gibberellins, cytokinins,ABA, ethylene and Brassinosteroids

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Reference:

1. Sharma, A. K. and A. Sharma. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering. Harward Academic Publishers, Australia.
2. Shukla, R. S. and P. S. Chandel. 2007. Cytogenetics, Evolution, Biostatistics and Plant Breeding. S.Chand & Company Ltd., New Delhi.
3. Verma, P. S. and V. K. Agrawal. 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.1. Hopkins, W. G. 1995.
4. Introduction to Plant Physiology. John Wiley & Sons Inc., New York, USA
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
6. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
7. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.
8. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
9. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
10. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
11. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
12. Russell, P. J. (2010). iGenetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
13. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
14. Jain, J.L., S. Jain and Nitin Jain. 2008. Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.
15. Pandey, B. P. 2007. Botany for Degree Students: Plant Physiology, Biochemistry, Biotechnology, Ecology and Utilization of Plants. S. Chand & Company Ltd., New Delhi.
16. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology. 4th edn. (India Edition), Wordsworth, Thomson Learning Inc.,USA.
17. Taiz, L. and E. Zeiger. 1998. Plant Physiology (2nd Ed.). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
18. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.

B.Sc. BOTANY
II YEAR: Semester-IV

Paper IV: Cell Biology, Genetics and Plant Physiology

DSC-1D Credits-1

Practical Syllabus (60 hours)

1. Demonstration of cytochemical methods: Fixation of plant material and nuclear staining for mitotic and meiotic studies.
2. Study of various stages of mitosis using cytological preparation of Onion root tips.
3. Study of ultra structure of cell organelles using photographs. Chloroplast, Mitochondria, Nucleus,
4. Study of Special types of Chromosomes (Polytene chromosome and Lampbrush chromosomes- Permanent slide)
5. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.
6. Chromosome mapping using test cross data.
7. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4)
8. Determination of osmotic potential of vascular sap by Plasmolytic method using leaves of *Rheodiscolor* / *Tradescantia*.
9. Determination of rate of transpiration using Cobalt chloride method
10. Determination of stomatal frequency using leaf epidermal peelings / impressions
11. Determination of amylase activity using potato tubers by titration method
12. Separation of chloroplast pigments using paper chromatography technique
13. Estimation of protein by Biurette method
14. Mineral deficiency symptoms of Micro and Macro nutrients

Practical Model Question Paper

Time: 3 hrs **Max. marks: 50**

1. Prepare a cytological slide of given material "A" and identify & describe any two stages with well labeled diagrams. (12M)
2. Genetics problem (10M)
3. Physiology Experiment (12M)
4. Identify and Comment on A & B (2x3 =6M)
   A. Micronutrient / Macronutrients Deficiency symptoms
   B. Cell organelles / Special type of Chromosomes
5. Record (5M)
6. Viva (5M)

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B.Sc. BOTANY

II Year: Semester-IV

Skill Enhancement Course

SEC-3 **Credits-2**

Greenhouse Technology(30h)

UNIT – I

(15h)

1. Introduction; scope – classification of greenhouses – construction of greenhouse- heating unit – cooling unit – environmental control (light and temperature).
2. Net- poly houses- low cost green houses. Root media for greenhouses
3. Fertilizers: Organic and inorganic, liquid fertilizers, application of fertilizers.
4. Water in the Greenhouses: Irrigation system in green houses–misting, Drip irrigation-micro irrigation, water quality, water sanitation.

UNIT – II

(15h)

5. Plant Protection in Greenhouses: Diseases of greenhouse plants (bacterial, fungal, nematodes and viral diseases)
6. Management of pest and diseases – integrated pest management.
7. Applications of Greenhouse Technology: Importance of greenhouse technology. Micropropagation and greenhouse planting of tissue culture transplants
8. Advantages and disadvantages of greenhouse technology. Seed production, cut flower gardening.

Suggested Readings

1.Dubey R.C. 2006. A text book of Biotechnology. S.Chand and Company. New Delhi.
2. Sheela V.L. 2011. Horticulture.MJP Publishers. Chennai,
3. Prasad S., Kumar U. 2012. Green House Management for Horticultural Crops. Agrobios India.
4. Pant V. and Nelson. 1991. Green House Operation and Management. Bali Publication. New Delhi.
5. Introduction to soil science: http://www.agrimoon.com/wpcontent/uploads/Introduction-tosoil-science.pdf
6. Greenhouse applications: http://www.lindegas.com/en/products_and_supply/fumigants/carbon_dioxide_in_agriculture/greenhouse_applications/index.html
7. Role of greenhouse technology in agricultural engineering:

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B.Sc. BOTANY

II Year: Semester-IV

Skill Enhancement Course

SEC-4 **(Credits 2)**

Mushroom Culture Technology **Lectures: 30**

UNIT-I **(15h)**

1. Introduction & history. Medicinal value of edible mushrooms;Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus.*
2. 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.
3. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves.
4. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.

UNIT-II **(15h)**

5. Storage: Short-term storage (Refrigeration - upto 24 hours) Long termStorage (canning, pickles, papads), drying, storage in saltsolutions.
6. Nutritional value of Mushrooms: Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.
7. 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.

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, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

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B.Sc. BOTANY

Skill Enhancement Course (SEC)

Time : 2 hrs **Max. Marks: 40**

Theory - Model Question Paper

Draw well-labeled diagrams wherever necessary

I. Write short answer of the following 6 X 4 = 24M

1. Unit-I
2. Unit-I
3. Unit-I
4. Unit-II
5. Unit-II
6. Unit-II

II. Essay Questions: 2 X 8 = 16M

7. a. Unit-I

(OR)

b. Unit-I

8. a. Unit-II

(OR)

b. Unit-II

***

*** Internal Exam carries 10 Marks**

B.Sc. BOTANY

Discipline Specific Core (DSC)

Time :3 hrs **Max. Marks: 80**

Theory - Model Question Paper

Draw well-labeled diagrams wherever necessary

I. Write short answer of the following 8 X 4 = 32M

1. Unit-I
2. Unit-I
3. Unit-II
4. Unit-II
5. Unit-III
6. Unit-III
7. Unit-IV
8. Unit-IV

II. Essay Questions: 4X 12 = 48M

9. a. Unit-I

(OR)

b. Unit-I

10. a. Unit-II

(OR)

b. Unit-II

11. a. Unit-III

(OR)

b. Unit-III

12. a. Unit-IV

(OR)

b. Unit-IV

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*** Internal Exam carries 20 Marks**

B.Sc. BOTANY

III Year: Semester-V

Paper-1A: Biodiversity& Conservation

DSE-1A **Credits-4**

Theory Syllabus(60 hours)

Unit - I: (15h)

1. Plant diversity and its scope: Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa.
2. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies For valuation, Uses of plants, Uses of microbes.

Unit-II: (15h)

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

Unit-III: (15h)

6. Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem Diversity
7. Principles of conservation –*In-situ* and *Ex-situ* conservation. Sacred groove, Botanical garden, Biosphere reserves, Sanctuaries, National parks (*In-situ*) and Tissue culture, Gene / seed / pollen banks and Cryopreservation (*Ex-situ*).

Unit-IV: (15h)

8. Role of plants in relation to Human Welfare; Importance of forestry their utilization and commercial aspects, Avenue trees, Ornamental plants of India.
9. Alcoholic beverages through ages. Fruits and nuts, Important fruit crops and their commercial importance. Wood and its uses.

References:

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2. Bharucha, E. 2005. Textbook of Environmental Studies for Undergraduate Courses. Universities Press (India) Private Limited, Hyderabad.
3. Odum, E. P. 1983. Basics of Ecology. Saunder's International Students Edition, Philadelphia.
4. Sharma, P. D. 1989. Elements of Ecology. Rastogi Publications, Meerut.

B.Sc. BOTANY

III Year: Semester-V

Paper-1A: Biodiversity & Conservation

DSE-1A **Credits-1**

Practical Syllabus (30 hours)

1. Study on local biodiversity: Herbs, shrubs and trees; Seasonal, Annual, biennial and perennial plants.
2. Study of morphological characteristics of plant communities: Hydrophytes (*Eichhornia, Hydrilla, Pistia, Nymphaea, Vallisneria*), Xerophytes: (*Asparagus,Opuntia, Euphorbia milii, Casuarina, Calotropis*).
3. Assessment of biodiversity

i) Avenue trees: *Pongamia pinnata, Butea monosperma, Spathodea* sp., *Delonix regia, Jacaranda mimosifolia, Cassia fistula, Mimusopselengi, Acacia leucophloea*, and *Albizia lebbeck.*

ii) Ornamental Plants: Any five locally available ornamental plants.

iii) Timber Value: *Acacianilotica, Tectona grandis*and *Azardirachta indica*

iv) Fruits: *Mangifera indica*(Mango), *Ziziphusmauritiana, Psidium guajava*(Guava), *Annona squamosa*

v) Nuts: *Anacardium occidentale*(Cashew), *Terminalia catappa*(Badam)

vi) Beverages: *Madhuca indica, Camellia sinensis*(Tea),*Coffea arabica*(Coffee), *Borassus flabellifer* (Toddy palm) and *Caryotaurens*

vii) Medicinal value: *Catharanthus roseus, Tinospora cordifolia*and *Phyllanthus emblica*, *Ocimumsp.*, and *Azardirachta indica*

4. Field trip:Collection of plants from the field, identification and preparation of Herbarium.

Practical Model Question Paper 3 Hours

50 Marks

1. Identify and describe Biodiversity value of a) Medicinal b) Timber c) Fruit.	3x4=12M
2. Any two available ornamental plants and their uses.	2x3=06M
3. Comment on the specimens A, B & C	3x3=09M
4. Identify and describe Biodiversity value of the given slides D & E (Hydrophytes & Xerophytes)	2x4=08M
5. Field trip Herbarium.	05M
6. Record	05M
7. Viva	05M

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B.Sc. Botany
III Year: Semester-VI
Paper-1B: Economic Botany

DSE-1B **Credits-4**

Theory Syllabus 60 hours

UNIT - I

1. Origin of Cultivated Plants: Major plants introduction, Crop domestication and examples of crops / varieties
2. Vegetables: Nutritional and Commercial values of root crops, leafy and fruit vegetables.
3. Millets: Nutrient significance ofSorghum, Finger millet, Pearl millet, Foxtail millet.
4. Cereals: Rice, Wheat and maize - Origin, morphology and uses.

UNIT – II

5. Legumes: General account, importance to man and ecosystem.
6. Fruits and nuts: Commercial and nutritional value of South Indian fruits. Cashew nut, Almond and Walnut.
7. Sugars & Starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.
8. Spices: Listing of important spices, part used, economic importance with special reference to fennel, saffron, clove and black pepper

UNIT - III

9. Beverages: Tea, Coffee (morphology, processing & uses)
10. Edible oils & Fats: General description, extraction, uses and health implications of groundnut, sunflower, coconut, linseed, and mustard.
11. Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.
12. Natural Rubber: Para-rubber - tapping, processing and uses.

UNIT - IV

13. Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis.
14. Tobacco processing, uses and health hazards
15. Timber plants: General account with special reference to teak and pine
16. Fibres: Classification based on the origin of fibres, extraction methods and uses of Cotton and Jute.

Suggested Readings

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. (2003). Plants, Genes and Agriculture. Jones & Bartlett Publishers.
4. B.P. Pandey (2007). Economic Botany, S. Chand & Company Ltd. New Delhi. 17/e.

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B.Sc. Botany
III Year: Semester-VI
Paper-1B: Economic Botany

DSE-2B **Credits-1**

Practical Syllabus 30 hours

1. Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove Tea and Cotton through specimens, sections and microchemical tests.
2. Identification and study on nutrient values of locally available vegetables, millets and cereals.
3. Study on nutrient values and commercial status of Cashew nut, Almond and Walnut.
4. Uses and health implications of groundnut, sunflower, coconut, linseed and Brassica.
5. Identification of starch granules.
6. Quantitative estimation and comparative study of proteins in millets and cereals.
7. Collection of economically important plants / vegetable plants and preparation of Herbarium.

Practical Exam - Model Paper

Time: 3 Hours **Max. Marks: 50**

I. Experiments	
A) Protein test (Major Experiment)	12M
B) Starch granules (Minor Experiment)	6M
II. Spotters	4X3=12M
C) Leafy / Fruity Vegetables,	
D) Fruits / Spices,	
E) Medicinal Plants / Beverages,	
F) Wood / Timber / Fiber	
III. Herbarium	10M
IV. Viva	5M
V. Record	5M

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B.Sc. BOTANY

III YEAR: Semester-V

Paper-1C: Seed Technology

DSE – 1C **Credits-4**

Theory Syllabus (60 hours)

UNIT- I (15h)

1. Seed: Structure and types.
2. Seed development in cultivated plants, seed quality concept, importance of genetic purity of seed. Hybrid seed production and Heterocyst.
3. Cross pollination, Emasculation, role of pollinators and their management.
4. Collection and storage of pollen for artificial pollination.

UNIT-II (15h)

5. Seed germination:Internal and external factors affecting germination.
6. Physiological processes during seed germination; seed respiration, breakdown and mobilization of stored seed reserves.
7. Seed dormancy: Types, causes and methods of breaking dormancy.Role of Phytochrome.

UNIT-III (15h)

8. Cultural practices and harvesting of Seed: Isolation, Sowing, Cultural practices, harvesting and threshing of the following crops: a) Rice b) Cotton c) Sunflower
9. Seed treatment to control seed borne disease –General account
10. Seed testing- Procedures of seed testing, seed testing laboratories and importance of seed testing.

UNIT-IV (15h)

11. Seed viability, factors affecting seed viability and genetic erosion.
12. Seed storage: Long term and short term storage. Orthodox and recalcitrant seeds. Packing of seeds – Principles, practices, bagging and labelling.
13. Seed banks- National, International and Millennium seed banks.
14. Seed certification- History, Seed certification agency, Indian millennium, general and specific seed certification standard.

Reference:

1. Agrawal, P. K. 1993. Hand Book of Seed Technology. Dept. of Agriculture and Cooperation. National Seed Corporation Ltd., New Delhi
2. Balasubramanian, D., C. F. A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman. 2004. Biotechnology. Universities Press (India) Private Limited, Hyderabad.
3. Bedell, Y. E. Seed Science and Technology. Indian Forest Species. Allied Publishers Limited, New Delhi.
4. Channarayappa. 2007. Molecular Biotechnology – Principles and Practices. Universities Press (India) Private Limited, Hyderabad.
5. Chawala, H. S. 2002. Introduction to Plant Biotechnology. Oxford & IBH Publishing Company, New Delhi.
6. Dubey, R. C. 2001. A Textbook of Biotechnology. S. Chand & Company Ltd., New Delhi
7. Edmond, J. B., T. L. Senn, F. S. Adrews and R. J. Halfacre. 1977..
8. Hartman, H. T. and D. E. Kestler. 1976. Plant Propagation: Principles and Practices. Prentice & Hall of India, New Delhi.
9. Jha, T.B. and B. Ghosh. 2005. Plant Tissue Culture – Basic and Applied. Universities Press (India) Private Limited, Hyderabad..
10. Ramawat, K. G. 2008. Plant Biotechnology. S. Chand & Company Ltd., New Delhi.
11. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology. 4th edn. (India Edition), Wordsworth, Thomson Learning Inc., USA..
12. Tiwari, G. N. and R. K. Goal. Green House Technology – Fundamentals, Design, Modelling and Application. Narosa Publishing House, New Delhi.
13. Tunwar, N. S. and S. V. Singh. 1988. Indian Minimum Seed Certification Standards. The Central Seed Certification Board, Govt. of India, New Delhi.

14 Agrawal PK &Dadlani M. (Eds.). 1992. Techniques in Seed Science and Technology. South Asian Publ.

15. Baskin CC & Baskin JM. 1998. Seeds: Ecology, Biogeography and Evolution ofDormancy and Germination. Academic Press. Basra AS. 2006. Handbook of SeedScience and Technology. Food Product Press.
16. Bench ALR & Sanchez RA. 2004. Handbook of Seed Physiology. Food Product Press.

Bewley JD & Black M. 1982. Physiology and Biochemistry of Seeds in Relation to Germination. Vols. I, II. Springer Verlag.

17. Bewley JD & Black M. 1985. Seed: Physiology of Seed Development and Germination. Plenum Press.
18. Copeland LO & Mc Donald MB. 1995. Principles of Seed Science and Technology. 3rd Ed. Chapman & Hall.
19. Khan AA. 1977. Physiology and Biochemistry of Seed Dormancy and Germination. North Holland Co.
20. Kigel J &Galili G. (Eds.). Seed Development and Germination. Marcel Dekker.
21. Murray DR. 1984. Seed Physiology. Vols. I, II. Academic Press. Sadasivam S & Manickam A. 1996. Biochemical Methods. 2nd Ed. New Age.

B.Sc. BOTANY

III YEAR: Semester-V

Paper-1C: Seed Technology

DSE – 1C **Credits-1**

Practical syllabus (30 hours)

Major Experiment

1. Testing of seed viability using 2, 3, 5-triphenyl tetrazolium chloride (TTC).
2. Estimation of amylase activity of germinating seeds (Qualitatively).
3. Demonstration of seed dressing using fungicides to control seed borne diseases.
4. Demonstration of seed dressing using Biofertilizers (BGA) to enrich nutrient supply.

Minor Experiments

5. Emasculation, bagging of flower for hybrid seed production.
6. Dissection of Dicot embryo (bean) and Monocot embryo (maize).
7. Pollen viability test using Evan's blue staining (Hibiscus).
8. Harvesting and Importance of following seeds:

a) Rice
b) Maize
c) Cotton
d) Groundnut and
e) Sunflower.

9. Methods to break Seed dormancy
10. Study visits to research institutes, seed tests and certification laboratories and Places, seedbanks.

Practical Model Question Paper

3 Hours **Max. marks: 50**

1. Major Experiment. (16marks)

a) Estimation of amylase activity in germinating seeds.

(OR)

b) Seed viability test by triphenyl tetrazolium chloride (TTC)

2. Minor Experiment. (12marks)

a)Dissection of Dicot / Monocot embryo

(OR)

b)Methods to break Seed dormancy / Seed dressing.

3. Spotters (3x4=12marks)
   A. Emasculation / Bagging
   B. Germination of seeds.
   C. Importance of following seeds: rice, cotton and sunflower.
4. Record (5marks)
5. Viva (5marks)

B.Sc. BOTANY

III YEAR: Semester-V

Generic Elective (GE)

GE-1 **(Credits: 4)**

Industrial Microbiology

Lectures: 60

Unit I **(15h)**

1. Scope of microbes in industry and environment
2. Bioreactors/Fermenters and fermentation processes
3. Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations.
4. Components of a typical bioreactor, Types of bioreactors-laboratory, pilot scale and production fermenters.

Unit II **(15h)**

5. Constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter. A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations.
6. Microbial production of industrial products: Microorganisms involved, media, fermentation conditions, downstream processing and uses;
7. Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying.
8. Hands on microbial fermentations for the production and estimation (qualitative and quantitative) of Enzyme: amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin).

Unit III **(15h)**

9. Microbial enzymes of industrial interest and enzyme immobilization
10. Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis.
11. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acetylase).
12. Microbes and quality of environment. Distribution of microbes in air; Isolation of microorganisms from soil, air and water.

Unit IV: **(15h)**

13.Microbial flora of water. Water pollution, role of microbes in sewage and domestic waste water treatment systems.

14. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality, check coliform and fecal coliform in water samples.

15. Microbes in agriculture and remediation of contaminated soils.

16. Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots.

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Suggested Readings

1. Pelzar, M.J. Jr., Chen E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. Tata McGraw Hill Education Pvt. Ltd., Delhi.
2. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.

B.Sc. Botany
III Year: Semester-VI

Paper-2A: Plant Molecular Biology

DSE-2A **Credits -4**

Theory syllabus

Lectures: 60

Unit-I: (15 hours)

1. Nucleic acids: Carriers of genetic information, types of genetic material, DNA as the carrier of genetic information.
2. Structures of DNA: Salient features and Types of DNA, Organization of DNA in Prokaryotes. Mitochondrial and chloroplast DNA.
3. Structure of RNA: Structure and Types of RNA's(mRNA, rRNA and tRNA).

Unit-II (15 hours)

4. Nucleosome, Chromatin structure- Euchromatin, Heterochromatin; Constitutive and Facultative heterochromatin.
5. Replication of DNA: Chemistry of DNA synthesis, general principles, Semi-conservative replication of DNA, replication of linear ds-DNA, replication of the 5'end of linear chromosome.
6. Central dogma and genetic code: Central Dogma (Adaptor hypothesis and discovery of mRNA template), salient features of Genetic code.

Unit-III: (15 hours)

7. Mechanism of Transcription: Transcription in prokaryotes and eukaryotes; Split genes-concept of introns and exons, removal of introns, eukaryotic mRNA processing (5' cap, 3' polyA tail).
8. RNA editing and mRNA transport.

Unit-IV: (15 hours)

9. Translation in prokaryotes: Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation.
10. Transcriptional regulation inprokaryotes, Regulation of lactose metabolism (Lac operon) and tryptophan (Trp operon) synthesis in E.coli.

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B.Sc. Botany
III Year: Semester-VI

Paper-2A: Plant Molecular Biology

DSE-2A **Credits -1**

Practical Syllabus

1. Isolation of genomic DNA from E.Coli.
2. DNA isolation from cauliflower head / tomato fruit.
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.
8. Estimation of size of a DNA fragment after electrophoresis using DNA markers (through photographs).

Practical Exam - Model Paper

Time: 3 Hours **Max. Marks: 50**

I. Experiments

1. Major Experiment 15M
2. Minor Experiment 10M

II. Spotters 4X3=12M

A)
B)
C)
D)

III. Identify and describe the photograph 3M

IV. Viva 5M

V. Record 5M

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B.Sc. BOTANY

III Year: Semester-V

Paper-2B: Tissue Culture and Biotechnology

DSE-2B **Credits-4**

Theory Syllabus (60 hours)

UNIT – I: (15 hours)

1. Tissue culture: Introduction, sterilization procedures, explants, culture media - composition and preparation; Nutrient and hormone requirements, Micropropagation.
2. Organ culture: Totipotency, Vegetative Organs-Root, Shoot, Leaf culture Reproductive Organs-Anther, Ovule, Embryo culture
3. Callus culture and isolation and fusion of protoplast culture
4. Organogenesis, Embryogenesis (somatic and zygotic).

UNIT- II: (15 hours)

5. Applications of tissue culture: Production of pathogen free plants and stress resistant plants, somaclonal variants and synthetic seeds.
6. Induction of hairy roots and its applications in production of secondary metabolites.
7. Haploidy and triploids, Cryopreservation and Germplasm Conservation.
8. Somatic hybrids and Cybrids.

UNIT- III: (15 hours)

9. Biotechnology: Introduction, history, scope and applications.
10. rDNA technology: Basic aspect of gene cloning, Enzymes used in gene cloning-Restriction enzymes, Ligases, Polymerases.
11. Gene cloning: Recombinant DNA, Bacterial Transformation and selection of recombinant clones, vectors- cloning vehicles (Plasmid, Cosmids, Bacteriophages, & Phasmids; Eukaryotic Vectors (YAC) Gene Construct; Applications of rDNA technology.

UNIT - IV: (15 hours)

12. Gene Libraries: construction of genomic and cDNA libraries, colony hybridization; Probes-oligonucleotide, Polymerase Chain Reaction (PCR) and its applications.
13. Methods of gene transfer- Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics-selectable marker and reporter genes.
14. Application of transgenics in improvement of crop productivity and quality traits. Pest resistant transgenic crops (Bt-cotton &Bt-brinjal); herbicide resistant plants (Roundup Ready soybean); crops with quality traits (FlavrSavr tomato, Golden rice).

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References:

1. Balasubramanian, D., C. F. A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman. 2004.
2. Biotechnology. Universities Press (India) Private Limited, Hyderabad.
3. Channarayappa. 2007. Molecular Biotechnology – Principles and Practices. Universities Press (India) Private Limited, Hyderabad.
4. Chawala, H. S. 2002. Introduction to Plant Biotechnology. Oxford & IBH Publishing Company, New Delhi.
5. Dubey, R. C. 2001. A Textbook of Biotechnology. S. Chand & Company Ltd., New Delhi
6. Edmond, J. B., T. L. Senn, F. S. Adrews and R. J. Halfacre. 1977.
7. Jha, T.B. and B. Ghosh. 2005. Plant Tissue Culture – Basic and Applied. Universities Press (India). Private Limited, Hyderabad..
8. Ramawat, K. G. 2008. Plant Biotechnology. S. Chand & Company Ltd., New Delhi.
9. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology. 4thedn. (India Edition), Wordsworth, Thomson Learning Inc., USA.
10. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
12. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
13. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
14. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
15. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

B.Sc. BOTANY

III Year: Semester-V

Paper-2B: Tissue Culture and Biotechnology

DSE-2B **Credits-1**

Practical Syllabus **30 Hours**

Major Experiments

1. Isolation of plant DNA. (Tomato)
2. Production of synthetic seeds /Encapsulation of embryo
3. Preparation of plant tissue culture medium - MS medium
4. Isolation of protoplasts.

Minor Experiments

1. Callus induction
2. Demonstration of Micropropagation/multiple shoots
3. Anther culture
4. PCR –Demonstration
5. Study of biotechnology products: Samples of antibiotics and vaccines
6. Photographs of Gene transfer methods.
7. Instruments used in Biotechnology lab- Autoclave, Laminar air flow, Hot air oven and Incubator.
8. Demonstration of In-vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.

Spotting

1. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
2. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
4. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.
5. Restriction digestion and gel electrophoresis of plasmid DNA.

Practical Model Question Paper

3 Hours **Max. Marks: 50**

1. Major Experiment	(18 marks)
Isolation of DNA	
(OR)	
Production of synthetic seeds /Encapsulation of embryo	
2. Minor Experiment	(10 marks)
Callus/ Micropropagation/Multiple shoots	
3. Spotters	(3x4=12 marks)
A. Vaccines	
B. Antibiotics	
C. Gene transfer methods/ instruments	
4. Record	(5 marks)
5. Viva	(5 marks)

B.Sc. Botany
III Year: Semester-VI

Paper-2C: Analytical Techniques in Plant Sciences

DSE-2C **Credits - 4**

Theory Syllabus

Lectures: 60

Unit I:

1. Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy.
2. Use of fluorochromes: Fluorescence-activated cell sorting (FACS); Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting.
3. Transmission and Scanning electron microscopy - sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit II:

4. Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, $CsCl_2$ gradient, analytical centrifugation, ultracentrifugation, marker enzymes.
5. Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment.
6. Spectrophotometry: Principle and its application in biological research.

Unit III:

7. Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ionexchange chromatography; Molecular sieve chromatography; Affinity chromatography.
8. Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids;
9. Electrophoresis: PAGE, SDS-PAGE

Unit IV:

10. Biostatistics: Statistics, data, population, samples, parameters;
11. Representation of Data: Tabular, Graphical; Measures of central tendency:
12. Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGrawHill Publishing Co. Ltd. New Delhi. 3rd edition.

2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

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B.Sc. Botany
III Year: Semester-VI
Paper-2C: Analytical Techniques in Plant Sciences
DSE-2C **Credits - 1**

Practical Syllabus **Lectures: 30**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using PAGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

Practical Exam - Model Paper

Time: 3 Hours **Max. Marks: 50**

I. Experiments

A. Major Experiment 12M

B. Minor Experiment 8M

II. Permanent slide preparation 8M

III. Spotters 4X3=12M

C)
D)
E)
F)

IV. Viva 5M

V. Record 5M

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B.Sc. Botany
Theory Model Question Paper

Discipline Specific Elective (DSE)
&
Generic Elective (GE)

Time :3 hrs **Max. Marks: 80**

Draw well-labeled diagrams wherever necessary

I. Write short answer of the following 8 X 4 = 32M

1. Unit-I
2. Unit-I
3. Unit-II
4. Unit-II
5. Unit-III
6. Unit-III
7. Unit-IV
8. Unit-II

II. Essay Questions: 4X 12 = 48M

9. a. Unit-I

(OR)

b. Unit-I

10. a. Unit-II

(OR)

b. Unit-II

11. a. Unit-III

(OR)

b. Unit-III

12. a. Unit-IV

(OR)

b. Unit-IV

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*** Internal Exam +Assignment carries (15+5) 20 Marks**

B.Sc. Botany
III Year: Semester-VI

Project / Dissertation Work — Credits – 4

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. The Project/Dissertation work will be of 4 credits. Studied subject specific project work can be handled, with a view to develop creative thinking, team spirit and skill. The project work at preliminary level should be assigned to students, in groups.

Project report in the form of dissertation is prepared and submitted by the students. It will be evaluated by the External and Internal Examiners. Head of the Department will chair the evaluation panel and proceedings of viva voce. It carries a maximum of 100 marks.

Project guidelines:

1. Understand the subject broadly.
2. Choose a topic of interest.
3. Refer to the books & interact with subject specific experts.
4. Try to understand the basic principles of Living organisms followed by Plants, with the help of Physics, Chemistry and Statistics.
5. Select the topic applicable locally to know the importance of the subject in daily life. Preferably choose, vegetation around the institution, around home, agricultural crops, vegetable markets and nearby relevant industries.
6. Put together, latest technology and methods, basic knowledge on selected theme, Importance / need, locally applicable.
7. Summarize three years knowledge on the subject, go through Skill enhancement course, correlate to real life and choose the project work.
8. Laboratory facilities, books to refer and faculty with research experience are essential to handle Project.
9. Analyze your Data and Draw a Conclusion
10. Communicate the Results
11. Work division among the group members should be followed
12. Maximum number of students in a group should not exceed 5.

Project Examination — **Max. Marks: 100**

1. Project Report	75 M
3. Seminar Presentation	25 M

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