

**Scheme of Teaching, Learning & Examination leading to the Degree in Bachelor of Science in the Programme Botany Science
(Three years- Six Semester Degree Programme- C.B.C.S.) (B.Sc. Part I) Semester I**

Sr.	Subject	Subject code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	T/T	Practical	Total		Theory + MCQ External	Skill Enhancement Module	Internal	External		Marks	Grade
1	DSC I Diversity of Microbes , Phycology, Mycology & Phytopathology	BOT (1S)	6	-	-	6	4.5	-	4.5	03	80	20	-	-	100	40	P
2	Lab	BOT 1S PR	-	-	6	6	-	2.25	2.25	04	-	-	25	25	50	25	P
3	Total		6	-	6	6	4.5	2.25	6.30	07	80	20	25	25	150	65	P

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience from Second to Fifth semester of Bachelor of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester II to V This will carry 5 credits for learning of 150 hours. Its credits and grades will be reflected in final semester VI credit grade report.

Faculty: Science and Technology

Programme: B.Sc. (Botany)

Syllabus Prescribed for Three-Year UG Programme

Programme: B.Sc I Semester 1

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
BOT(1S)/Botany	DIVERSITY OF MICROBES, PHYCOLOGY, MYCOLOGY ANDD PHYTOPATHOLOGY	72

Cos

After completion of this course successfully, the students would be able to

1. **understand** microbial diversity, reproduction and economic importance.
2. **differentiate** the microbes, algae and fungi on the basis of morphology, cellular organization, nutrition and metabolic activities.
3. **classify** and **identify** the various algal genera.
4. **classify** and **identify** the various fungal genera.
5. **Systematize** the plant diseases and their pathogens
6. **Apply** understanding of microbial diversity, phycology and mycology for teaching primary to high school students

	Unit	Content
UNIT-I	Introduction to Microbial World 1.1 General characteristics, cell structure, and reproduction in Archaeobacteria cyanobacteria. and Eubacteria 1.2 Viruses – General characteristics and Morphological types of viruses, Structure of TMV, Replication of viruses- lytic & lysogenic cycle. 1.3 Economic importance of viruses with reference to vaccine production, bacteria with reference to industry (Agriculture and Fermentation) 1.4 Cyanobacteria with reference to soil fertility.	12
UNIT-II	Cryptogams and Algae 2.1 Introduction to Cryptogams. 2.2 General characteristics of algae with reference to habitat, thallus organization, pigmentation, reserve food and reproduction. 2.3 Classification according to F.E. Fritsch 1935 up to the classes. 2.4 Economic importance of algae as food and in industry.	12
Unit-III	Algae General characteristics of following Classes and life cycle of respective genera. 3.1 Chlorophyceae - <i>Oedogonium</i> 3.2 Charophyceae - <i>Chara</i> (only Morphology and Sex organs) 3.3 Xanthophyceae - <i>Vaucharia</i> 3.4 Phaeophyceae - <i>Ectocarpus</i> 3.5 Rhodophyceae - <i>Batrachospermum</i>	12

UNIT-IV	Introduction to Fungi 4.1 General Characteristics of Fungi 4.2 Classification of fungi (Ainsworth-1973) 4.3 General characteristics of following Subdivisions and 4.4 life cycle of respective genera 4.4.1 Mastigomycotina - <i>Albugo</i> 4.4.2 Zygomycotina - <i>Rhizopus</i> 4.4.3 Ascomycotina - <i>Aspergillus</i>	12
UNIT-V	Fungi and Applied Mycology 5.1 General characteristics of following Subdivisions and life cycle of respective genera 5.1.1 Basidiomycotina - <i>Puccinia graminis tritici</i> 5.1.2 Deuteromycotina - <i>Alternaria</i> 5.2 Lichen –Types and Economic Importance 5.3 Mycorrhiza – structural and Functional aspect 5.4 Applied mycology - Application of fungi in industry, medicines and agriculture	12
UNIT-VI	Phytopathology 6.1 Introduction to Phytopathology and General symptoms 6.2 Symptoms, Pathogen biology and disease management of Bacterial diseases- 6.2.1- Citrus canker 6.2.2- Angular leaf spot of cotton 6.3 Symptoms, pathogen biology and disease management of viral diseases- 6.3.1-Yellow vein mosaic of Bhindi 6.3.2-Curl leaf of papaya 6.4 Symptoms, pathogen biology and disease management of fungal diseases 6.4.1 Tikka disease of groundnut 6.4.2 Powdery mildew of <i>Abelmoschus esculentus</i> (Bhindi)	12
	*SEM-- Mycotechnology and Phytopathology 1. Mycorrhizal technology – 1.1 Definition, types and application of Mycorrhiza 1.2 Arbuscular Mycorrhizal Fungi (AMF) - Isolation technique of AMF spores and identification. 1.3 Soil trap culture, Monoculture, Mass multiplication and Biofertilizer. Or 2. Mushroom cultivation technology 2.1 Nutritional and medicinal value of edible mushroom 2.2 Types of edible mushroom available in local area- <i>Agaricus bisporus</i> , <i>Pleurotus</i> . 2.3 Cultivation technology – infrastructure , substrate, polythene bags, vessels, sterilization ,preparation of spawn, bed preparation ,paddy straw (or locally available), etc. 2.4 Storage and marketing. Or 3. Study of plant pathology of local crop plants. 1.1 Symptomology 1.2 Diseases of locally cultivated Plants. 1.3 Control measures (Chemical & Biological) against diseases of locally cultivated Plants.	

	<p>COs:- After completion of skill enhancement module learner will be able to</p> <ol style="list-style-type: none"> 1. Acquire skill of isolation of Arbuscular Mycorrhizal Fungal and also able to classify the various species of mycorrhiza. 2. Evaluate the AMF spore in the soil sample of crop plants.
	<ol style="list-style-type: none"> 3. Establish own production unit of mushroom cultivation 4. Asses the economy of mushroom cultivation 5. Diagnosed the local crop diseases. 6. Advise the proper fungicides or other measures to prevent crop diseases.
	<p>** Activities-</p> <ol style="list-style-type: none"> 1. Collection of rhizosphere soils from different locations and isolation of AMF spores from these soil samples and identification Submission of skill enhancement report with microphotographs of AMF species its culture. <p style="text-align: center;">OR</p> <ol style="list-style-type: none"> 2. Hands on training to students on mushroom cultivation outside institution 3. Visit to local mushroom cultivation center and submission of its report / Internship in mushroom cultivation center 4. Arranging workshop of mushroom cultivation for hands on training within institution. 5. Submission of activity report. OR <ol style="list-style-type: none"> 1. Collection of diseased plant parts of locally cultivated Plants. 2. Diagnosis of disease on the basis of symptoms and micro-examination or culturing of pathogen. 3. Suggestion of Chemical or biological control. 4. Report submission including Herbarium or photographs or of host and pathogen.

Suggested Reading

Text books:

1. Dube, H. C. (1990). An Introduction to Fungi. Vikas Pub. House Ltd. New Delhi.
2. Gangulee, H. C. and Kar, A.K. (2001). College Botany Vol. II. Books and Allied Press Ltd. Kolkata.
3. Krushnamurthy, K. V. (2007). An advanced Text Book on Biodiversity: Principles and Practice. Oxford and IBH Publishing Kumar, H.D. (1988). Introductory Phycology. Affiliated East-West Pres Ltd. New Delhi.
4. Kumar, H. D. and Singh, H.N. (1976). A Text Book of Algae. Affiliated East-West Pres Ltd. New Delhi.
5. Mehrotra, R. S. and Aneja, C.R. (1990). An Introduction To Mycology, Wiley Eastern Ltd. New Delhi.
6. Pandey, B.P. (1994). A Text Book of Botany-Algae. S.Chand and Co. Ltd. New Delhi.
<https://microbiologynote.com/12-best-books-for-plant-pathology/>
7. Pandey, S.N. and Trivedi, P.S. (1997). A Text Book of Botany Vol. II, Vikas Publishing House (P.) Ltd. New Delhi.
8. Pandey, S.N. and Trivedi, P.S. (1997). A Text Book of Botany Vol. I, Vikas Publishing House (P.) Ltd. New Delhi.
9. Pandey, S.N., Trivedi, P.S. and Mishra, S.P. (1995). A Text Book of Algae, Vikas Publishing House (P.) Ltd. New Delhi.
10. Parihar, N.S. (1977). Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
11. Parihar, N.S. (1984). An Introduction To Embryophyta Vol. I Bryophyta. Central Book Depot, Allahabad
12. Rashid, A. (1996). An Introduction To Bryophyta. Vikas Publishing House Ltd. New Delhi.
13. Saxena, A.K. and Sarbhai, R.M. (1992). A Text Book of Botany Vol. II Embryophyta. Ratan Prakashan Mandir, Agra.
14. Sharma, O.P. (1989). A Text Book of Fungi. Tata McGraw-hill Publishing Company Limited, New Delhi.
15. Sharma, O.P. (1990). A Text Book of Algae. Tata McGraw-hill Publishing Company Limited, New Delhi.
16. Smith, G.M. (1995). Cryptogamic Botany. Vol. II (Bryophytes and Pteridophytes). McGraw-Hill Book Company, New York and London
17. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
18. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.
19. A Text book of microbiology – R.C. Dubey, S.Chand publication pvt ltd.
20. A Text book of microbiology – D.R. Arora, CBC, publication
21. A Textbook of Botany – Diversity of microbes and cryptogams – Singh, Pande, Jain Rastogi publication Meerut.
22. A Text book of Botany – Diversity of Microbes, Phycology, Mycology and Phytopathology, Dnyanpath Publication.

Reference Books:

1. Lee, R.E. (2008), Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Agrios, G.N. (1997), Plant Pathology, 4th edition, Academic Press, U.K.
3. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, 4th edition.
4. Prescott's microbiology - Christopher, J. Woolverton, Joanne M. Wiley-McGraw Hill
5. Webster, J. and Weber, R. (2007). Introduction to Fungi. 3rd edition. Cambridge University Press,
6. The Algae World - Dinabandhu Sahoo • Joseph Seckbach Editors Springer 2016

Weblink to Best Reference Books- https://www.bioexplorer.net/microbiology-textbooks.html/#Best_Microbiology_Textbooks

<https://microbiologynote.com/12-best-books-for-plant-pathology/>

Weblink to Equivalent MOOC on SWAYAM if relevant

<https://swayam.gov.in/explorer>

Weblink to Equivalent Virtual Lab if relevant:

<https://youtu.be/9JwkHjCTKtQ>

(<https://youtu.be/zIVvObvfXdw> https://youtu.be/0OF8n_sY8as)

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Syllabus Prescribed for Three Year UG

Programme: B.Sc. I Semester 1

Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)	(No. of Periods/Week)
BOT(1S)/BOTANY	Practical	2

Cos:

After completion of this course successfully, the students would be able to 1.

Identify and classify the algae on the basis of morphology and other characters.

2. Create monograph of Algae and Fungi.

3. Demonstrate the structural details of viruses and bacteria included in practical work.

4. Evaluate the plant diseases of local plants and diagnosed the diseases on the basis of symptomatology.

*** List of Practical/Laboratory Experiments/Activities etc.**

1	Study of types of bacteria from temporary / permanent slides / photographs.
2	Study of Bacterial Staining (Gram staining)
3	Study of TMV from Models/ Photographs.
3	Algae - Preparation of temporary mount, identification with reasons of following algal materials : <i>Nostoc, Oedogonium, Chara, Vaucheria, Ectocarpus, Batrachospermum</i>
4	Fungi and Plant Pathology : 1. Study of following Genera - <i>Albugo, Rhizopus, Aspergillus, Puccinia, Cercospora,</i> 2. Study of Crustose, Fruticose and Foliose lichen. 3. Study of symptoms of fungal, viral, bacterial diseases. Photographic herbarium of diseased plant parts from local region
Additional Activities	1. Botanical Excursion (short/long) 2. Visit to any biodiversity-rich area to study the plant diversity in natural habitat. The botanical excursion is compulsory for all students and the report of the excursion should be submitted at the time of practical examination
Submission	1. Photographic herbarium of diseased plant plants. 2. Tour reports or field visit report

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

PRACTICAL EXAMINATION (Botany) , SEMESTER II –(CBCS New)

Practical – I - DIVERSITY Of MICROBES, PHYCOLOGY, MYCOLOGY AND PHYTOPATHOLOGY

Practical – I (Internal Practical Examination)

Marks-25

1. Attendance 05

2. Performance (Bacteria, Algae, Fungi, Phyto pathological) 05

3. Activity

Botanical Excursion/Short/Long- Report Submission.

Visit to any Biodiversity Area to study the diversity in natural habitat Report submission.

05

4. Record Book

05

5. Internal Viva-Voce

05

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
PRACTICAL EXAMINATION (Botany), SEMESTER I –(CBCS New)

Practical-I- DIVERSITY Of MICROBES, PHYCOLOGY, MYCOLOGY ANDD PHYTOPATHOLOGY

Practical – II (External Practical Examination)
Time – 4 Hours

Max Marks-25

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|--|----|---------------------|
| Q.1. Temporary mount and identification of Algal material (Any One) | 05 | |
| Q.2. Temporary mount and identification of Fungal material (Any One) | 05 | |
| Q.3. Description and identification of given Bacterial, Viral or Fungal diseases (Any one)
(Virus, Fungi, bacterial, Algae or Lichen) | 05 | Q.4. Spotting
05 |
| Q.5. External Viva voce | | 05 |

Scheme of Teaching, Learning & Examination leading to the Degree in Bachelor of Science in the Programme Botany Science

(Three years- Six Semester Degree Programme- C.B.C.S.) (B.Sc. Part I) Semester II

Sr.	Subject	Subject code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	T/T	Practical	Total		Theory+ MCQ External	Skill Enhancement Module	Internal	External		Marks	Grade
1	DSC -2 Bryophytes, Pteridophytes, Gymnosperms and Morphology of Angiosperms	BOT (2S)	6	-	-	6	4.5	-	4.5	03	80	20	-	-	100	40	P
2	Lab	2S BOT PR	-	-	6	6	-	2.25	2.25	04	-	-	25	25	50	25	P
3	Total		6	-	6	6	4.5	2.25	6.30	07	80	20	25	25	150	65	P

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience from Second to Fifth semester of Bachelor of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester II to V This will carry 5 credits for learning of 150 hours. Its credits and grades will be reflected in final semester VI credit grade report.

Faculty: Science and Technology

Programme: B.Sc. (Botany)

Syllabus Prescribed for Three Year UG/PG Programme: B.Sc. Semester- II

Code of the Course/Subject	Title of the Course/Subject	(Number of Periods per week)
BOT(2S)/Botany	Bryophytes, Pteridophytes, Gymnosperms and Morphology of Angiosperms	6

COs: After completion of this course successfully, the students would be able to-

1. Demonstrate an **understanding** of Archegoniate, Bryophytes, Pteridophytes and Gymnosperms, morphology of angiosperm and medicinal plants
2. **Identify** and **classify** plants from Bryophytes, Pteridophytes and Gymnosperms
3. Develop **critical thinking** on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms and on morphology of angiosperm.
4. Acquire **skill** of collection and preservation of Bryophytes, Pteridophytes and Gymnosperms

Units	
Unit I: Bryophytes 1.1 General characteristics and Classification of Bryophytes by G. M. Smith 1.2 Morphology, Anatomy and Reproduction of i) Hepaticopsia : <i>Marchantia</i> ii) Bryopsida : <i>Funaria</i> 1.3 Affinities of Bryophytes with algae and Pteridophytes 1.4 Ecological and Economical Importance of Bryophytes	
Unit II: Pteridophytes 2.1 General Characteristics & Classification of Pteridophytes by G. M. Smith of Pteridophytes 2.2 Types of Stele in Pteridophytes 2.3 Morphology, Anatomy and Reproduction of i) Sphenopsida : <i>Equisetum</i> ii) Filicopsida : <i>Marsilea</i> 2.4 Heterospory & Seed Habit	
Unit III: Gymnosperms 3.1 General characteristics and Classification of Gymnosperms by D. D. Pant 3.2 Morphology, Anatomy and Reproduction of i) Coniferopsida : <i>Pinus</i> ii) Gnetopsida : <i>Gnetum</i> 3.3 Affinities of Gymnosperms with Angiosperms 3.4 Economic importance of Gymnosperms	
Unit IV: Morphology of Angiosperms (Vegetative) 4.1 Habit and habitat 4.2 Root: Types and Modifications (Tap root and adventitious root) 4.3 Stem: Forms, Characters and Modifications (Underground, sub-aerial and aerial) 4.4 Leaf: Phyllotaxy, Stipule, Parts of leaf- Petiole, Lamina, Margin, Apex, Venation, Types and Modifications	
Unit V: Morphology of Angiosperms (Reproductive) 5.1 Inflorescence: Racemose, Cymose and Special Types (Verticillaster, Capitulum and Cyathium) 5.2 Flower: Structure of Flower- Calyx, Corolla, Androecium, Gynoecium and Placentation 5.3 Fruits: Types (Simple, Aggregate and Multiple)	

<p>Unit VI : Utilization of plants and Medicinal Plants</p> <p>6.1 Morphology, variety and economic importance of</p> <p>6.1.1 Food plant: Cereal- Wheat (<i>Triticum aestivum</i>)</p> <p>6.1.2 Oil yielding plants : <i>Arachis hypogaea</i> (Groundnut)</p> <p>6.1.3 Fiber Plants: Cotton (<i>Gossypium sp.</i>),</p> <p>6.2 Morphology, cultivation, phytochemicals and medicinal uses of</p> <p>6.2.1 <i>Adhatoda vasica</i></p> <p>6.2.2 <i>Asparagus racemosus</i></p> <p>6.2.3 <i>Catharanthus roseus</i></p> <p>6.2.4 <i>Ocimum sanctum</i></p> <p>6.2.5 <i>Rauwolfia serpentina</i></p> <p>6.2.6 <i>Withania somnifera</i></p> <p>6.2.7 <i>Tinospora cordifolia</i></p>	
<p>*SEM : Skill Enhancement Module-</p> <p>Herbal Technology</p> <p>1. Introduction and Scope of Herbal Technology</p> <p>2. Overview of “AYUSH”</p> <p>3. Cultivation techniques of medicinal plants</p> <p>4. Microscopic Examination and Preliminary Phytochemistry of</p> <p style="padding-left: 40px;"><i>Adhatoda vasica</i></p> <p style="padding-left: 40px;"><i>Catharanthus roseus</i></p> <p style="padding-left: 40px;"><i>Ocimum sanctum</i></p> <p style="padding-left: 40px;"><i>Tinospora cordifolia</i></p> <p>COs: On completion of this course the students will able to-</p> <ol style="list-style-type: none"> 1. Understand the herbal technology. 2. Develop the skill for cultivation of plants. 3. Acquire the skill of morphological and microscopic examination of herbal plants. 4. List the major herbs, their Botanical names and chemical constituent's. 	
<p>**Activities</p>	<ol style="list-style-type: none"> 1. Cultivation of herbal medicinal plants in college garden. 2. Preliminary phytochemical analysis of mentioned medicinal plants. 3. Micro-preparation (anatomy) of mentioned medicinal plants and its microphotography. 4. Project report on entire activities to be submitted at the end of session.

Course Material/Learning Resources

Textbooks:

- 1) A.C. Dutta : Text Book of Botany.
- 2) Bhatnagar S.P. and Moitra A., 1996 : Gymnosperms, New Age International Limited, New Delhi.
- 3) Bhojwani & Bhatnagar : Embryology of Angiosperms.
- 4) B. P. Pandey : Economic Botany, S. Chand publication
- 5) Coulter M.J. & Chamberlain C.J. : Morphology of Gymnosperms.
- 6) Cutter E.G. 1971 : Plant Anatomy Experiment and Interpretation Part-II, Organs, Edward Arnold, London.
- 7) Cutter E.G. 1969 : Part-I, Cells and tissues, Edward, Arnold, London.
- 8) Davis P.H. and Heywood V.H. 1993 : Principles of Angiosperm Taxonomy: Oliver and Boyd, London.
- 9) Eames E.J. : Morphology of vascular Plants.
- 10) Gangulee & Kar : College Botany Vol. II.
- 11) Gangulee Das and Dutta : College Botany, Vol. I.
- 12) Gifford E.M. and Foster A.S., 1988 : Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
- 13) Hartmann H.T. and Kestler D.E., 1976 : Plant Propagation Principles and practices, 3rd edition, prentice Hall of India Pvt. Ltd. New Delhi.
- 14) Heywood V.H. and Moore D.M. (Eds) 1984 : Current concepts plant Taxonomy. Academic Press, London.
- 15) Jeffrey C. 1982: An introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.
- 16) Pande B.P. : A Text Book of Angiosperms.
- 17) Radford A.E. 1986 : Fundamentals of Plant Systematics, Harper and Row, New York.
- 18) Rendle A.B. : Classification of flowering plants, Vol.I&Vol.II.
- 19) S. Sundar Rajan : College Botany, Vol.II & Vol.III.
- 20) Saxena and Sarabhai : A Text Book of Botany, Vol.II
- 21) Sharma O.P. : Gymnosperms.

- 22) Singh and Jain: Taxonomy of Angiosperms.
- 23) Singh 4. 1999, Plant Systematics - Theory and Practices, Oxford and IBH Pvt. Ltd., New Delhi.
- 24) Sporne K.R.: Morphology of Gymnosperms.
- 25) Sporne K.R. 1965: The Morphology of Gymnosperms, Hutchinson & Company, (Publisher) Ltd. London.
- 26) Stace C.A. 1989: Plant Taxonomy and Biosystematics (2nd Edition Edward Arnold, London.
- 27) Stewart W.N. 1983 : Paleobotany and Evolution of Plants, Cambridge University Press, Cambridge.
- 28) Thomas P. 2000: Trees - Their natural history, Cambridge University Press, Cambridge.
- 29) Trivedi B.S. & Sharma B.B. : Introductory Taxonomy.
- 30) Tyagi& Kshetrapal : Taxonomy of Angiosperms.
- 31) Vasistha P. C.: Gymnosperms.
- 32) Vasistha B. R. : Botany for degree students – Bryophytes, S.Chand Publication
- 33) Vasistha P. C.: Botany for degree students – Pteridophytes, S.Chand Publication
- 34) Vasistha P. C.: Taxonomy of Angiosperms.
- 35) Vyas, Purohit, Garg : A Text Book of Gymnosperms.
- 36) Modern Practical Botany, Volume-I, Dr. B. P. Pande, S. Chand Pub., N.W.
- 37) Modern Practical Botany, Volume-II, Dr. B. P. Pande, S. Chand Pub., N.W.
- 38) Modern Practical Botany, Volume-III, Dr. B. P. Pande, S. Chand Pub., N.W. Sahni, K.C. 2000.
- 39) The Book of Indian Trees, 2nd edition. Oxford University Press, Mumbai.
- 40) Schery R.W. 1972. Plant for Man. 2nd Ed. Englewood Cliffs, New Jersey. Prentice Hall.
- 41) Sharma O.P. 1996. Hill's Economic Botany (Late Dr.A.F.Hill, adapted by O. P. Sharma) Tata McGraw Hill Co. Ltd., New Delhi.
- 42) Swaminathan M. S. and Kocchar S. L. (Eds) 1989. Plants and Society. Macmillan Publication Ltd., London.
- 43) Thakur R.S., Puri, H.S. and Husain, A. 1989. Major and Aromatic Plants, CSIR, Lucknow.
- 44) Thomas P. 2000. Trees : Their National History, Cambridge University Press, Cambridge.
- 45) Wagner H., Hikino, H. and Farnsworth, N. 1989. Economic and Medicinal Plant Research, Vols. 1-3. Academic Press, London.
- 46) Walter K.S. and Gillett, H.J. 1998. 1997 IUCN Red List of Threatened Plants. IUCN, the World Conservation Union, IUCN, Gland, Switzerland, and Cambridge, U.K.
- 47) V. L. Chopra and S. K. Vats: Medicinal and Nutraceuical Plants from Himalayas, New India Publishing Agency Nipa.
- 48) A Text Book of Botany –Paleobotany, Gymnosperms, Morphology and Utilization of Plants (2014), Dr. P. W. Deotare, Dr. M. A. Shahezad, Dr. Mrs. U. G. Malode, Dr. U. S. Patil, Dr. Mrs. P. S. Kokate, Dr. Mrs. S. P. Khodke, Published by Nabh Prakashan, Amravati.
- 49) Morphology of Angiosperms and Utilization of Plants, Dr. Shubhangi Ingole, Published by Paygun Publishers, Amravati.

Reference Books:

<https://www.sanfoundry.com/best-reference-books-bryophyta-pteridophyta-gymnosperm-palaeobotany/>

[https://link.springer.com/chapter/10.1007/978-3-662-02604-](https://link.springer.com/chapter/10.1007/978-3-662-02604-5)

[5 https://books.google.com/books/about/An_Introduction_to_Archegoniate_Plants.html?id=0Uh1DwAAQBAJ](https://books.google.com/books/about/An_Introduction_to_Archegoniate_Plants.html?id=0Uh1DwAAQBAJ)

Weblink to Equivalent MOOC on SWAYAM if relevant: <https://swayam.gov.in/explorer>

Weblink to Equivalent Virtual Lab if relevant: Any pertinent media (recorded lectures, YouTube, etc.) if relevant:

<https://youtu.be/Ru96iXsWpyg>

<https://youtu.be/IczPZPt281E>

<https://youtu.be/5GsUlbnVnPo>

<https://youtu.be/mjZMAORT10U>

<https://youtu.be/mwdgOj8xDBc>

<https://youtu.be/jAR69ULus24>

Sant Gadge Baba Amravati University, Amravati
Syllabus Prescribed for Three Year UG/PG Programme Programme:
B.Sc. Semester II

Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)	(No. of Periods/Week)
BOT(2S)/Botany	Bryophytes, Pteridophytes, Gymnosperms and Morphology of Angiosperms and Utilization of Plants	02

COs: By the end of the Lab/Practical Course, generally students would be able to-

- 1) Understand forms of Bryophytes, Pteridophytes and Gymnosperms.
- 2) Acquire the skill of preparation of slides of plant body and reproductive organs.
- 3) Classify and identify different plant parts on the basis of external morphology.
- 4) Describe the plants in technical language.
- 5) develop critical understanding on morphology, botanical names and cultivation practices of economically important plants..

***List of Practical /Laboratory Experiments/Activities etc.**

1	Bryophyta: Study of morphology and anatomy of vegetative and reproductive parts of following genera – <i>Marchantia and Funaria</i>
2	Pteridophyta: Study of morphology and anatomy of vegetative and reproductive parts of following genera – <i>Equisetum and Marsilea</i>
3	Gymnosperms: Study of morphology and anatomy of vegetative and reproductive parts of following genera – <i>Pinus and Gnetum</i>
4	Morphology: Detail morphological study of following types of plant parts - Root, Stem, Leaves, Inflorescence, Flower, Placentation and Fruits
5	Utilization of plants: Morphology varieties and economic importance of following plants Food plant : Wheat Oil yielding plant: Groundnut Fiber yielding : Cotton
6	Medicinal plants- <i>Adhatoda vasica, Asparagus racemosus, Catharanthus roseus, Ocimum sanctum, Rauwolfia serpentina, Withania somnifera, Tinospora cordifolia</i>
Additional Activities	Botanical Excursion (short/long) Visit to any biodiversity rich area to study the plant diversity in natural habitat. The botanical excursion is compulsory for all students and the report of excursion should be submitted at the time of practical examination. Photographic collection of bryophytic, pteridophytic and gymnospermic plants specimens
Submission	1. Photographic herbarium of Bryophytes, Pteridophytes, Gymnosperms etc. 2. Botanical excursion report

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

PRACTICAL EXAMINATION (Botany) , SEMESTER II –(CBCS New)

Practical – I -Bryophytes, Pteridophytes, Gymnosperms and Morphology of Angiosperms

Practical – I (Internal Practical Examination)	Marks-25
1. Attendance	05
2. Performance (Bryophyte /Pteridophyte /Gymnosperm Slide preparation)	09
3. Activity Botanical Excursion/Short/Long- Report Submission. Visit to any Biodiversity Area to study the plant diversity in natural habitat Report submission.	03
4. Record Book	05
5. Internal Viva-Voce	03

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

PRACTICAL EXAMINATION (Botany) , SEMESTER II –(CBCS New)

Practical-II- Bryophytes, Pteridophytes, Gymnosperms and Morphology of Angiosperms

Practical – II (External Practical Examination)	Max Marks-25	Time –
4 Hours		
Q.1. Salient features and identification of Bryophytic material (Any One)	05	
Q.2. Salient features and identification of Pteridophytic material (Any One)	05	
Q.3. Salient features and identification of Gymnospermic material (Any one)	05	
Q.4. Spotting (Root/Stem/Leaf/Inflorescence/Flower/ Placentation/Fruit) (Any Three) (Utilization of Plants/Medicinal plants Identification) (Any Two)	03 02	
Q.5. External Viva voce	05	

**Scheme of Teaching, Learning & Examination leading to the Degree in Bachelor of Science in the Programme Botany Science
(Three years- Six Semester Degree Programme- C.B.C.S.) (B.Sc. Part II) Semester III**

Sr.	Subject	Subject code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	T/T	Practical	Total		Theory+ MCQ External	Skill Enhancement Module	Internal	External		Marks	Grade
1	DSC III Angiosperms Systematics, Anatomy & Embryology	BOT(3S)	6	-	-	6	4.5	-	4.5	03	80	20	-	-	100	40	P
2	Lab	BOT 3S PR	-	-	6	6	-	2.25	2.25	04	-	-	25	25	50	25	P
3	Total		6	-	6	6	4.5	2.25	6.30	07	80	20	25	25	150	65	P

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience from Second to Fifth semester of Bachelor of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester II to V. This will carry 5 credits for learning of 150 hours. Its credits and grades will be reflected in final semester VI credit grade report.

Syllabus Prescribed for Three Year UG Programme

Programme: B.Sc. Semester III

Code of the Course/Subject Title of the Course/Subject Number of Periods per week

BOT (3S)/Botany ANGIOSPERM SYSTEMATICS, 06
ANATOMY, EMBRYOLOGY

Cos

After completion of this course successfully, the students would be able to

1. **Understand** the basic principles involved in identification, naming and classification of flowering plants.
2. **Know** the systematic study and economic importance of plants belonging to the various families.
3. **Differentiate** various tissue systems.
4. **Understand** the normal and anomalous secondary growth in plants and their causes.
5. **Understand** developmental stages in plant embryo and seed formation.
6. **Apply** understanding this knowledge to explain the taxonomic diversity of plants and Imply the embryological and anatomical knowledge to differentiate the plant taxa.

Unit	Content	Peroids
Unit- I	<p>Angiosperms Systematics and Biodiversity</p> <p>1.1 Phylogeny – Origin and Evolution of angiosperms. (Pteridospermean and Bennititalean theory).</p> <p>1.2 Taxonomic Hierarchy –Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).</p> <p>1.3. Botanical Nomenclature- Principles and rules of ICBN (ranks and names; principle of priority, binomial system; type method, author citation, valid-publication).</p> <p>1.4 Biodiversity – Definition and types, concept, significance and conservation.</p>	12
Unit- II	<p>Classification and Angiosperm Systematics 2.1.</p> <p>Types of classification- Artificial, Natural and Phylogenetic.</p> <p>2.2. Bentham & Hooker’s system of classification with Merits and demerits.</p> <p>2.3 Systematic study and economic importance of the following families: Dicotyledons –(Polypetalae) Malvaceae, Brassicaceae, Leguminosae and Apiaceae.</p>	12
Unit- III	<p>Angiosperm Systematics</p> <p>3.1 Systematic studies & economic importance of following Families dicotyledons (Gamopetalae): Asteraceae, Asclepiadaceae, Apocynaceae, Solanaceae, Verbenaceae, Lamiaceae.</p> <p>3.2 Dicotyledons (Monoclamydeae): Euphorbiaceae.</p> <p>3.3 Monocotyledons: Liliaceae, Poaceae</p>	12

Unit-IV	<p>Anatomy</p> <p>4.1 Types of Tissues: Meristematic – Types of meristems Permanent – Simple and complex.</p> <p>4.2 Anatomy of Root: Primary structure in Dicot and Monocot root</p> <p>4.3 Secondary growth in Dicot root.</p> <p>4.4 Characteristics of growth rings, Sapwood and heartwood.</p>	12
Unit-V	<p>Anatomy</p> <p>5.1 Anatomy of stem: Primary structure in monocot and dicot stem, normal secondary growth in dicot stem.</p> <p>5.2 Anatomy and Anomalies in structure in <i>Boerhavia</i> stem, <i>Bignonia</i> and <i>Dracaena</i> stem.</p> <p>5.3 Leaf Anatomy: Internal structure in Nerium and Maize leaf.</p>	12
Unit-VI	<p>Embryology</p> <p>6.1 Microsporangium, microsporogenesis, development of male gametophyte.</p> <p>6.2 Megasporangium, types of ovules, megasporogenesis, development of female gametophyte (monosporic)- Detail structure of Polygonum type of embryo sac.</p> <p>6.3 Double fertilization and triple fusion.</p> <p>6.4 Development of Dicot Embryo.</p> <p>6.5 Endosperm types & significance.</p>	12
	<p>Skill Enhance Module (SEM)</p> <p>Plant Identification and Preparation of Herbarium Sheet</p> <p>Cos- After completion of skill enhancement module, learner will be able to:</p> <ol style="list-style-type: none"> 1. Gain Practical skills in plant identification. 2. Learn how to assemble and properly documentation of collected Plants. 3. Identify the taxonomic diversity of useful plants. 4. Provide scientific information to the public regarding the plants. 	
	<p>SEM – Plant Identification and Preparation of Herbarium Sheet</p> <p>1.1 Introduction of plant identification</p> <p>1.2 Morphological characters used for identification</p> <p>1.3 Definition and Importance of Herbarium</p> <p>1.4 Techniques of Herbarium preparation – collection, instruments, pressing, Drying, labelling, storage and maintains.</p>	
	<p>ACTIVITIES (Any Two Activities)</p> <ol style="list-style-type: none"> 1. Workshop or Hands on Training for Herbarium technique. 2. Visit to any biodiversity rich area to study the plant diversity in natural habitat. 3. Key Preparation 4. Identify and classify the plants. 5. Submission of photographic (Geotagged) herbarium of plants. 6. Submission of report including photographs at end of the session. 	

Programme: B.Sc. II

Semester III

Code of the Course/Subject	Title of the Course/Subject	(No.of Periods/week)
BOT (3S)/BOTANY	Practical	2 Practicals per week

*** List of Practical/Laboratory Experiments/Activities etc**

1.	Taxonomy: Description of ten plants belonging to different families in technical language and identification up to family level. Brassicaceae- <i>Brassica</i> , Malvaceae- <i>Hibiscus</i> , <i>Sida</i> , <i>Malvastrum</i> , Fabaceae- <i>Crotalaria</i> , <i>Indigofera</i> , <i>Tephrosia</i> , Caesalpinoideae - <i>Caesalpineae</i> , <i>Cassia</i> , Mimosoideae- <i>Prosopis</i> , <i>Acacia</i> , Apiaceae- <i>Corindrum</i> , Apocynaceae- <i>Vinca</i> , <i>Thevetia</i> , Asclepiadaceae- <i>Cryptostegia</i> , <i>Calatropis</i> , Solanaceae- <i>Datura</i> , <i>Solanum</i> , <i>Withania</i> , Euphorbiaceae- <i>Jatropha</i> , <i>Euphorbia</i> , <i>Croton</i> Lamiaceae- <i>Oscimum</i> , <i>Hyptis</i> , Asterceae- <i>Tridax</i> , <i>Lagasca</i> , Verbenaceae- <i>Lantana</i> , <i>Clerodendron</i>
2.	Anatomy of angiosperms: Preparation of double stained permanent slides of stem (<i>Boerhavia</i> , <i>Bignonia</i> and <i>Dracaena</i>) and leaves (<i>Nerium</i> , Maize) of angiospermic plants.
3.	1) Embryology of Angiosperms: i) Observation of wide range of flowers available in the locality and methods of their pollination. ii) Study through permanent slides of T.S. of anther, microsporogenesis, L.S. of ovule, types of endosperms and embryo of <i>Capsella</i> . iii) Mounting of T.S. of anther, Pollen grains and pollinia.
4.	Long and short excursion is essential. Note : Field tour reports should be supported by exhaustive field notes and photographic representation of plant species studied

Books Recommended:

- 1) A.C.Dutta: Text Book of Botany.
- 2) Andrews A.N.: Studies in Paleobotany.
- 3) Arnold C.A.: Introduction of Paleobotany.
- 4) Bhojwani & Bhatnagar: Embryology of Angiosperms.
- 5) Chandurkar: Plant Anatomy
- 6) Cutter E.G., 1971: Plant Anatomy Experiment and Interpretation Part-II, Organs, Edward Arnold, London.
- 7) Davis P.H., and Heywood V.H., 1993: Principles of Angiosperm Taxonomy: Oliver and Boyd, London.
- 8) Eames E.J.: Morphology of Vascular Plants. Edition, Prentice Hall of India Pvt. Ltd. New Delhi.
- 9) Esau K.: 1977, Anatomy of seed plant, 2nd Edition, John Wiley and Sons, New York.
- 10) Gangulee and Kar: College Botany Vol.II
- 11) Gangulee Das and Dutta: College Botany, Vol.I
- 12) Gifford E.M. and Foster A.S., 1988: Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
- 13) Hartmann H.T. and Kestler D.E., 1976: Plant Propagation Principles and practices, 3rd

- 14) Heywood V.H. and Moore D.M. (Eds) 1984: Current concepts in plant Taxonomy. Academic Press, London.
- 15) Jeffrey C., 1982: An introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.
- 16) Maheshwari P.: Introduction of Embryology of Angiosperms.
- 17) Pande B.P.: A Text Book of Angiosperms.
- 18) Radford A.E., 1986 : Fundamentals of Plant Systematics, Harper and Row, New York.
- 19) Rendle A.B.: Classification of flowering plants, Vol.I & Vol.II.
- 20) S. Sundar Rajan: College Botany, Vol. II & Vol. III.
- 21) Shukla and Mishra: Paleobotany.
- 22) Singh and Jain: Plant Anatomy.
- 23) Singh and Jain: Taxonomy of Angiosperms. 2
- 24) Singh, F. 1999, Plant Systematics - Theory and Practices, Oxford and IBH Pvt. Ltd., New Delhi.
- 25) Stace C.A., 1989. : Plant Taxonomy and Biosystematics (2nd Edition) Edward Arnold, London.
- 26) Stewart W.N., 1983: Paleobotany and Evolution of Plants, Cambridge University Press, Cambridge.
- Cutter, E.G. 1969: PartI, Cells and tissues, Edward, Arnold, London.
- 27) Trivedi B.S. & Sharma B.B.: Introductory Taxonomy.
- 28) Tyagi and Kshetrapal: Taxonomy of Angiosperms.
- 29) Vashistha P.C.: Plant Anatomy.
- 30) Vashistha P.C.: Taxonomy of Angiosperms.
- 31) Walton: An Introduction & Study of fossil.
- 32) Modern Practical Botany, Volume-I, Dr. B. P. Pande, S. Chand Publication, New Delhi.
- 33) Modern Practical Botany, Volume-II, Dr. Dr. B. P. Pande, S. Chand Publication, New Delhi.
- 34) Modern Practical Botany, Volume-III, Dr. Dr. B. P. Pande, S. Chand Publication, New Delhi.

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

PRACTICAL EXAMINATION (Botany)

SEMESTER III (CBCS New)

Angiosperm Systematics, Anatomy and Embryology

External Practical Examination

Time - 4 Hours

25 Marks

- | | |
|--|----------|
| Q. 1 Description of given angiospermic plant in technical language, identification up to family, floral formula, floral diagram. (Any one plant) | 10 Marks |
| Q. 2 Preparation of double stained permanent slide of given angiospermic material identification with description - | 8 Marks |
| Q. 3 Spotting (Anatomy-2, Embryology -2) | 4 Marks |
| Q. 4 Viva voce | 3 Marks |

Internal Practical Examination**25 Marks**

Q.1 Attendance

5 Marks

Q.2 Student Performance – Submission of double stained permanent slides of stem and leaves of angiospermic plants mentioned in the syllabus. OR Any other activity performed by students related to the syllabus.

5

Marks

Q.3 Activity report – Botanical Excursion / Tour reports or field visit report/ Any Activity report related the syllabus.

5 Marks

Q.4 Practical Record

5 Marks

Q.5 Viva-voce (Internal Examiner)

5 Marks

GENERAL INTEREST COURSE - III**Programme: B.Sc. Semester III****Code of the Course/Subject****Title of the Course/Subject****Total Number of Periods****BOT (3S) / Botany****GIC-3 NURSERY TECHNIQUES****30****AND MANGEMENT****Cos**

After completing this course, the students will be able to

- Understand the importance of a plant nursery and basic infrastructure to required.
- Explain the preliminary materials, tools and techniques required for nursery.
- Demonstrate expertise related to various practices in a nursery.
- Apply comprehend skills and knowledge to become Nursery entrepreneur or worked as nursery supervisor, assistants.

Unit	Content
Unit-I : Nursery Management 1.1 Introduction, Importance and Types of Nurseries. 1.2 Establishment of a Nursery – Selection of the nursery site, Layout of a Nursery, Preliminary operation for Raising Nursery. 1.3 Media for Propagation. 1.4 Tools and Accessories for Nursery. 1.5 Plant Propagation Structures in Plant Nursery- Green house, shade net house 1.6 Regular Nursery Operations – soil sterilization, seed sowing, planting, transplanting of seedlings, transplanting of potted plants, mulching, staking, shading, pricking, defoliation, disbudding, de-shooting, Pruning, watering. Seed Propagation – By seed bed, in seed pan, in polythene bag, In situ, in poly house	(15 L)
Unit-II: Management and Marketing Strategy	(15 L)

1.1 Nursery Disease and their Management 1.2 Plant Nutrients and their Requirement 1.3 Water Management in Nursery 1.4 Lifting, Packing, storage and sale of Nursery plants. 1.5 Branding of Nursery 1.6 Marketing and Export of Nursery plants.	
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Reference Books:

1. Nursery Raising : S.N. Das
2. Objective Floriculture and Landscaping : Desh Raj
3. Physical and economic requirements for pot-in-pot nursery production. 2002. Robert McNeil, Department of Horticulture and Landscape Architecture, University of Kentucky.
4. Plant Nursery Management : P.K.Ray
5. Plant Nursery Development & Management - An Innovative Way of Self Employment Priya Lokare & Dr Keshamma Ee.
6. Plant Propagation and Nursery Management Dr.Arun Kumar Singh & Abhinav Kumar
7. <https://hindi.icfre.gov.in/UserFiles/File/Books/Nursery%20Technology.pdf>
8. Indian Council of Forestry Research & Education New Forest, Dehradun - 248 006 (Uttarakhand) (An autonomous body of Ministry of Environment, Forest & Climate Change, Government of India) www.icfre.gov.in
9. Textbook of plant propagation and Nursery Management – Sharma R.R. & Hare Krishna
10. <http://cazri.res.in/publications/PRathaKrishnan.pdf>

Scheme of Teaching, Learning & Examination leading to the Degree in Bachelor of Science in the Programme Botany Science

(Three years- Six Semester Degree Programme- C.B.C.S.) (B.Sc. Part II) Semester IV

Sr.	Subject	Subject code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	T/T	Practical	Total		Theory+ MCQ External	Skill Enhancement Module	Internal	External		Marks	Grade
1	DSC IV Cell Biology, Genetics and Plant Breeding	BOT 4S	6	-	-	6	4.5	-	4.5	03	80	20	-	-	100	40	P
2	Lab	BOT 4S PR	-	-	6	6	-	2.25	2.25	04	-	-	25	25	50	25	P
3	Total		6	-	6	6	4.5	2.25	6.30	07	80	20	25	25	150	65	P

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience from Second to Fifth semester of Bachelor of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester II to V This will carry 5 credits for learning of 150 hours. Its credits and grades will be reflected in final semester VI credit grade report.

Part B
Syllabus Prescribed for 2022 Year UG

Syllabus Prescribed for Three Year UG Programme

Programme: B.Sc. II

Semester III

Code of the Course/Subject	Title of the Course/Subject	Total Number of Periods
BOT (4S)	Cell Biology, Genetics and Plant Breeding	72

COs:

After completion of this course successfully, the students would be able to

1. **Understand** the structure and purpose of basic components of prokaryotic and eukaryotic cells.
2. **Identify** the concept that explains chemical composition and structure of cell wall and membrane
3. **Differentiate** cell organelles on the basis of structure and function.
4. **Comprehend** the effect of chromosomal abnormalities in numerical as well as structural changes.
5. Have **conceptual understanding** of laws of inheritance, genetic basis of loci, alleles, their linkage and crossing over.
6. **Understand** the basic concepts of plant breeding.
7. **Analyse** the different selection and breeding methods applied in crop improvement.

	Unit	Content
UNIT-I	Cell Biology- Ultrastructure and functions of cell 1.1 The cell: Cell as a unit of structure and function, Characteristics of Prokaryotic and Eukaryotic cell 1.2 The cell wall-chemical structure and function 1.3 Plasma membrane –Structure (models) and Functions 1.4 Cell Organelles: Structure and function of the following: Endoplasmic Reticulum, Golgi complex, Vacuole, Ribosome, Peroxisome.	12
UNIT-II	Cell Biology-Cell Cycle 2.1 Nucleus – Ultra structure and functions (nuclear membrane, nuclear pore complex and nucleolus) 2.2 Chloroplast- Structure and functions 2.3 Mitochondria- Structure and functions 2.4 Cell Cycle- G ₁ ,S,G ₂ and M phases, Mitosis stages and significance, Meiosis- stages and significance, Amitosis,	12
UNIT-III	Physical Basis of Inheritance 3.1 Chromosome- Morphology, Types, Primary & Secondary constriction, Centromere & Telomere 3.2 Special types of chromosomes- Ex. Polytene 3.3 Chromosomal aberrations – 3.3.1 Structural aberrations: Deletion (Terminal, Interstitial) Duplication (Tandem, Reverse tandem and Displaced), Inversion (Pericentric and Paracentric) and Translocation (Simple, Isochrome, Reciprocal, Displaced)	12

	3.3.2 Numerical aberrations: Euploidy and aneuploidy 3.4 Significance of chromosomal aberrations.	
UNIT-IV	Mendelian Genetics 4.1 Concepts of Phenotype, Genotype, Heredity, Variation, Mendel's experiments on Pea plants. 4.2 Mendelism: Mendel's law of Dominance, Back cross and Test cross, Segregations and Independent assortment, Incomplete dominance and co-dominance. 4.3 Interaction of genes- Complimentary, Supplementary and Epistasis (Dominant and Recessive) 4.4. Problems based on Mendelism and Interaction of Genes	12
UNIT-V	Neo Mendelian Genetics 5.1 Linkage – Concept, Linkage group, Types and Theories-Sutton and Bovary theory 5.2 Crossing over- Concept, Types and mechanism of crossing over 5.3 Gene mutations- Spontaneous and Induced-physical and chemical mutagens 5.4 Cytoplasmic Inheritance- Chloroplast DNA	12
UNIT-VI	Plant Breeding 6.1 Historical account, objectives and scope of plant breeding, 6.2 Inbreeding depression and heterosis 6.3 Selection methods for self and cross pollinated crops 6.4 Recent advances in plant breeding- cultivar development, tissue Culture based approaches.	12
	<p>*SEM : Skill Enhancement Module</p> <p>1. Microscopic techniques-</p> <p>1.1 Introduction to the Microscope 1.2 Optical microscopy (conventional light microscopy (LM), fluorescence microscopy (FM), confocal and Phase contrast microscopy 1.3 Scanning and Transmission Electron Microscopy 1.4 Microscope Maintenance: Best Practices 1.5 Applications of Microscopy in Biological Sciences</p> <p>2. Plant Breeding techniques-</p> <p>2.1 Collection of Variability 2.2 Evaluation and Selection of Parents 2.3 Hybridization and mutation breeding 2.4 Selection and Testing of Superior germplasm 2.5 Commercialization of New Cultivars</p> <p>3. Plant propagation-</p> <p>3.1 Need and potentialities for plant multiplication 3.2 Sexual and asexual methods of propagation 3.3 Advantages and disadvantages. 3.4 Micro grafting, hardening of plants 3.5 Tissue culture propagation (Media preparation, Sterilization, culture initiation)</p> <p>COs: On completion of this course the learner will be able to</p> <ol style="list-style-type: none"> 1. enhance sense of sight by microscopic techniques 2. to describe the principle, construction and working of various microscopes 3. allow to follow curiosity outdoors and explore hands-on, experiential learning 4. to achieve an increase in numbers and preserve the essential characteristics of the plant. 5. Excellent research skills 	

	ACTIVITIES <ol style="list-style-type: none"> 1. Botanical Excursion/Short/Long Tour- Report submission 2. Collection and observation of Chironomus larvae. 3. Visit to krushi kendra for variety of crop plant seeds 4. Germplasm collection of locally available crops 5. Visit to Research Institutes/Industries 	

Suggested Readings:

1. Biology: The Dynamic Science, 2nd Edition, Peter J. Russell, Paul E. Hertz.. Beverly Mc Millan publications. 2012
5. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
6. Cell and Molecular Biology, 4th Edition, P.K. Gupta. 2014
7. Cytogenetics, 1st Edition, P.K. Gupta. 2013
8. Cell Biology, 10th Edition, S.P. Singh and B. S. Tomar. 2014.
9. Principles of Genetics, 7th Edition, Robert H. Tamarin. 2002. Tata- Mc Graw Hill publications.
10. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & Sons, India.
11. Strickberger, M.W. (1985) Genetics, 3rd Edition. Pearson Printice Hall (printed in India by Anand Sons).
12. Ahluwalia K.B 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
13. Gupta, P.K. (2018) Genetics. 5th Edition, Rastogi Publications, Meerut.
14. Theory and Problems of Genetics. W. D. Stansfield. 2002. Mc Graw Hill publications.
15. Genes- IX, 9th Ed., Benjamin Lewin. Jones and Bartlett Publishers, 2008.
16. Chromosomal Aberrations: Basic and Applied aspects by Obe.G. and A.T. Natarajan (1990) Springer Verlag, Berlin.
17. Cytogenetics, Plant Breeding and evolution by U.Sinha and Sunita Sinha , Vikas Publishing House Private, Limited, 1998.
18. Principles of Plant Breeding Allard R. W. Wiley & Sons
19. Plant Breeding Theory and Practice Stoskopf N. C., Tomes D. T. & Christie, B. R. Westview Press

PRACTICAL

Cell Biology, Genetics and Plant Breeding

1.	Cell Biology <ol style="list-style-type: none"> 1. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo 2. Study of polytene chromosome either by slide preparation or photographs. 3. Study of various stages of mitosis (Squash preparation) 4. Study of various stages of meiosis (Smear preparation) 5. Study of chromosomal aberrations by using Photographs/Permanent Slides 6. Study of Chromosome Morphology using Permanent Slide/ Photograph
2.	Genetics <ol style="list-style-type: none"> 7. To prove Mendel's Monohybrid ratio. 8. To prove Mendel's Dihybrid ratio. 9. Problems based on Interaction of genes (Complementary/ Supplementary/Epistasis) 10. Study of polyploides using photographs.

3.	Plant Breeding
	11. Study of vital floral structures for plant breeding. 12. To perform Emasculation in various plants. 13. To demonstrate hybridization techniques in plants. 14. To study pollen viability. 15. To study seed viability percentage in various crops

**SANT GADGE BABA AMRAVATI UNIVERSITY,
AMRAVATI PRACTICAL EXAMINATION
B. Sc. II (Botany) SEMESTER – IV**

(CBCS New)

Practical –IV- Cell Biology, Genetics and Plant Breeding

Schedule- External Practical

Time: 4 hours	Marks: 25
Q. 1: Cell Biology: To perform given experiment (Any one)	05 Marks
Q. 2: Genetics: To perform given experiment (Any one)	05 Marks
Q. 3: Plant Breeding: To perform given experiment (Any one)	05 Marks
Q. 4: Spotting	05 Marks
Q. 6: Viva-voce by External Examiner	05 Marks

**SANT GADGE BABA AMRAVATI UNIVERSITY,
AMRAVATI PRACTICAL EXAMINATION
B. Sc. II (Botany) SEMESTER – IV**

(CBCS New)

Practical –IV- Cell Biology, Genetics and Plant Breeding

Schedule- Internal Practical

Time: 4 hours	Marks: 25
Q. 1: Student Attendance	05 Marks
Q. 2: Student Performance	05 Marks
Q. 3: Viva-voce by Internal Examiner Marks	05
Q. 4: Botanical Excursion/Short/Long Tour: Report submission	05 Marks
Q. 5: Class record	05 Marks

Scheme of Teaching, Learning & Examination leading to the Degree in Bachelor of Science in the Programme Botany Science

(Three years- Six Semester Degree Programme- C.B.C.S.) (B.Sc. Part III) Semester V

Sr.	Subject	Subject code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	T/T	Practical	Total		Theory+ MCQ External	Skill Enhancement Module	Internal	External		Marks	Grade
1	DSC V Plant Physiology and Ecology	BOT 5S	6	-	-	6	4.5	-	4.5	03	80	20	-	-	100	40	P
2	Lab	BOT 5S PR	-	-	6	6	-	2.25	2.25	04	-	-	25	25	50	25	P
3	Total		6	-	6	6	4.5	2.25	6.30	07	80	20	25	25	150	65	P

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience from Second to Fifth semester of Bachelor of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester II to V This will carry 5 credits for learning of 150 hours. Its credits and grades will be reflected in final semester VI credit grade report.

Syllabus Prescribed for Three-Year UG Programme

Programme: B.Sc. III

Semester V (CBCS Scheme)

Code of the Course/Subject BOT(5S)/Botany	Title of the Course/Subject Plant Physiology and Ecology	Total Number of Periods 72
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COs:

1. Students will be able to understand various aspects of plant physiology like plant water relation, photosynthesis, respiration, and metabolism
2. Students will understand the aspects of plant ecology like various factors and ecosystem composition and function.
3. Students will be able to design various experiments/ models on plant physiology and plant ecology.

Unit	Detail Description / Content	Periods require
Unit - I:	Plant Water Relations 1.1 Importance of water to plant life; Imbibition, Diffusion, Osmosis, Plasmolysis. 1.2 Active and passive Absorption of water. 1.3 Ascent of sap - Root Pressure and Transpiration Pull Theory. 1.4 Transpiration - Types of transpiration, Stomatal movements, Mechanism of transpiration (Starch - sugar hypothesis), Significance. Anti-transpirant, Guttation. 1.5 Mineral uptake - Active uptake - Carrier Concept, Passive up take - Ion Exchange.	12
Unit - II:	Plant Metabolism 2.1 Photosynthesis - Introduction, Role of Light, Photosynthetic Apparatus and Pigments (Antenna and accessory pigments), Pigment Systems I and II, Photophosphorylation, C3 and C4 cycle, CAM Pathway. 2.2 Respiration - Introduction, Mitochondria as a Respiratory center, Types of Respiration - Aerobic and Anaerobic, Mechanism of aerobic respiration- Glycolysis, Krebs cycle, Electron transport system and Chemiosmotic ATP generation, Respiratory Quotient.	12
Unit - III:	Metabolism and growth 3.1 Nitrogen Metabolism- Sources of nitrogen, Symbiotic nitrogen fixation, Role of Nitrate reductase. 3.2 Growth - Phases of growth, Growth curve, Physiological role of growth hormones (Auxins, Gibberellins, Cytokinins, Abscisic acid, and Ethylene). 3.3 Physiology of Senescence and Abscission.	12

Unit – IV:	Plant responses : 4.1 Photoperiodism – SDP, LDP, DNP, Concept of Florigen, Role of Phytochrome, 4.2 Vernalization- Concept and Significance. 4.3 Plant movement- Tropic (Phototropic, Hydrotropic and Geotropic) and Nastic (Epinasty, Hyponasty, and Seismonasty)	12
Unit – V:	Ecology and Environment: 5.1 Concept of environment, Concept and scope of ecology. 5.2 Ecological factors- Climatic- Light, Temperature and Water. 5.3 Atmosphere and its Composition. 5.4 Edaphic factor- Process of soil formation, soil profile, soil biota and their role. 5.5 Ecological Adaptations - Morphological and Anatomical Adaptation in Hydrophytes, and Xerophytes.	12
Unit – VI:	Ecosystem: 6.1 Population Ecology- Natality and Mortality, Community characteristics – Frequency, Density and Abundance 6.2 Ecological Succession - Hydrosere and Xerosere 6.3 Ecosystem – Definition, Structure and Function, Food chain, Food web, Energy flow model (Single channel model) 6.4 Types of Ecosystem- Pond ecosystem, Desert ecosystem	12

Skill Enhancement Module (SEM): Plant Biochemistry and Stress Physiology

Unit	Detail Description / Content
Unit - I:	Plant Biochemistry and Stress Physiology 1. Plant Biochemistry and Enzymology 1.1 Introduction to Biomolecules with their uses 1.2 Primary and secondary metabolites 1.3 Fundamentals of Enzymes and their classification 1.4 Mechanism of enzyme action 2. Stress Physiology 2.1 Concept of Biological Stress 2.2 Types of stresses (Biotic and abiotic) 2.3 Response of plants to various abiotic stress conditions (Water, Salinity and drought)
	CO's: 1. Students will be acquainted with the concept of plant biochemistry and enzymology 2. Students will be skilled in biochemical analysis of plant material 3. Students will understand the fundamentals of enzymes and enzyme action. 4. Students will explore the concept of biological stress

	5. Students will be experts in identification of plants under stress conditions.
	<p>Activities:</p> <ul style="list-style-type: none"> • Hands on training to students on plant biochemistry and enzymology to demonstrate various biomolecules, their roles, primary and secondary metabolites their identification, effect of various parameters on enzyme activity. <p>OR</p> <ul style="list-style-type: none"> • Survey and collection of plants/ crops under stress conditions from local fields (preparation of a report) (explore winter stress, high-temperature stress, terminal drought etc.) • Diagnosis/ identification of stress condition on the basis of specific symptoms and submission of report with photographic evidence

Books Recommended:

Chapman. J. L. and Reiss. M.J. (1995). Ecology: Principles and Applications, Cambridge University Press. College Publishers, USA.

Chaudhari M.A. and Gupta K.K. (2009). Practical plant physiology. New Central Book Agency Ltd. Kolkata.

Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) (1997). Plant Metabolism (Second Edition) Longman, Essex, England.

Galston, A. W. (1989): Life processes in plants. Scientific American Library, Springer

Galstone A.W. (1989). Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA

Hopkins, W. G. and Hunner, N. P. A. (2008) Introduction to plant physiology, John Wiley and Sons.

Jain V.K.: Fundamental of Plant Physiology. S. Chand Publication New Delhi.

Kochhar, S. L. and Gujjar, S. K. (2020) Plant Physiology: Theory and Applications, Cambridge Publications.

Kumar. H. D. (1997). General Ecology. Vikas Publishing Pvt. Ltd., Delhi. 32.

Lincoln Taiz and Eduardo Zeiger (2003). Plant Physiology (3rd edition), Published by Panima Publishing Corporation

Miller.W.R. and Donahue. R.L. (1992). Soils-An Introduction to Soil and Plant Growth (6th edition). Prentice Hall of India Pvt. Ltd., New Delhi. 33.

Mohr, H. and Schopfer, P. (1995) : Plant Physiology 4th : Edition, Wordsworth

Odum. E.P. (1996). Fundamentals of Ecology. Natraj Publishing, Dehradun.

Salisbury F.B and Ross C.W. (1992). Plant Physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.

Sharma P. D. (2003). Ecology and environment. Rastogi publication.

Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee (1999). Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi

Smith. L.R. (1996). Ecology and Field Biology (5th edition). Harper Collins

Varma, S. K. and Verma, M. (2014) Plant Physiology, Biochemistry and Biotechnology, 4th Edition, S Chand Publication.

Verma S.K. and Verma Mohit (2007). A Text Book of Plant Physiology, Biochemistry and Biotechnology, S. Chand Publications.

Weaver. J.E. and Clements. S.E. (1966). Plant Ecology. Tata McGraw Publishing Co. Ltd. Bombay.

William G. Hopkins. (1995): Introduction to Plant Physiology, Published by – John Wiley and Sons, Inc.

Syllabus Prescribed for Three Year UG

Programme: B.Sc. III

Semester V

Code of the Course/Subject	Title of the Course/Subject	(No.of Periods/week)
BOT (5S)/BOTANY	Practical	2 Practicals per week

1.	Plant Physiology: Major experiment (Any Seven) 1. To study the effect of temperature and organic solvent on the permeability of the plasma membrane. 2. To study the osmotic pressure of cell sap by plasmolytic method. 3. To determine the water potential of plant tissue. 4. To determine the path of water (ascent of sap) 5. To determine the rate of transpiration by Ganong's photometer. 6. To determine rate of photosynthesis under varying quality of light and CO ₂ concentration. 7. To study the rate of photosynthesis in terrestrial plants with the help of Ganong's Photosynthometer. 8. Separation of chloroplast pigments by paper chromatography/ solvent extraction method. 9. Separation of amino acids by paper chromatography method. 10. To determine R.Q. using different substrates. 11. To determine the rate of respiration by Ganong's respirometer. 12. To study the antagonism of salts. 13. To study the phenomenon of adsorption. 14. To study the effect of IAA and Gibberellins on seed germination. 15. Test for secondary metabolites- Alkaloids, Phenolics, Tannin, Flavonoids and Lignin
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	<p>16. To study Endo and Exo-osmosis by egg membrane osmoscope</p> <p>Plant Physiology: Minor experiment- (Any Three)</p> <ol style="list-style-type: none"> 1. To demonstrate fermentation. 2. To demonstrate exo and endosmosis 3. To demonstrate transpiration by Bell jar. 4. To demonstrate light is necessary for photosynthesis 5. To demonstrate anaerobic respiration in germinating seeds. 6. To demonstrate the evolution of CO₂ in respiration. 7. To demonstrate the phenomenon of nastic movement with the help of <i>Mimosa pudica</i> / or <i>Biophytum sensitivum</i>.
2.	<p>Ecology: Major experiment (Any Three)</p> <ol style="list-style-type: none"> 1. Study of morphological and anatomical adaptations in hydrophytes – <i>Hydrilla</i>, <i>Eichhornia</i>, <i>Typha</i>, <i>Vallisneria</i> and <i>Nymphaea</i> (any two) 2. Study of morphological and anatomical adaptations in xerophytes -Asparagus, Nerium, Casuarina, Euphorbia, Cycas, Opuntia (any two) 3. Study of community characteristics by quadrat method. 4. Determination of water holding capacity of different soils. 5. To determine the texture of different soils by sieve method. <p>Ecology: Minor experiment (Any Two)</p> <ol style="list-style-type: none"> 1. To determine the porosity of soil. 2. To determine the transparency and temperature of water bodies. 3. Estimation of salinity of different water samples 4. Determination of pH of different soils and water samples by pH papers/ pH meter. 5. Study of meteorological instruments -Rain gauge, Hygrometer, Barometer

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

PRACTICAL EXAMINATION / Lab- 5

Plant Physiology and Biochemistry

Time: 3 hrs.

Max. Marks: 50

Internal examination Marks : 25

External Examination Marks : 25

Internal Practical Examination

1. Attendance/ Regularity	5
2. Student performance - Seminar/ Group Discussion and other formative assessment related to the subject.	5
3. Activity report- Academic /Institute/Industrial/Field visit or any report activity related to the subject.	5

4. Class record	5
5 - Viva – voce	5
Total :	25

External Practical Examination

Q. 1 - Physiology- major experiment-	07
Q. 2 - Comment one Minor Physiology experiment-	03
Q. 3 - Ecology major experiment.	07
Q. 4 - Ecology minor experiment.	03
Q. 5 - Viva – voce	05
Total :	:25

Scheme of Teaching, Learning & Examination leading to the Degree in Bachelor of Science in the Programme Botany Science

(Three years- Six Semester Degree Programme- C.B.C.S.) (B.Sc. Part III) Semester VI

Sr.	Subject	Subject code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	T/T	Practical	Total		Theory+ MCQ External	Skill Enhancement Module	Internal	External		Marks	Grade
1	DSC VI Molecular Biology and Plant Biotechnology	BOT 6S	6	-	-	6	4.5	-	4.5	03	80	20	-	-	100	40	P
2	Lab	BOT 6S PR	-	-	6	6	-	2.25	2.25	04	-	-	25	25	50	25	P
3	Total		6	-	6	6	4.5	2.25	6.30	07	80	20	25	25	150	65	P

L: Lecture, T: Tutorial, P: Practical

Student may complete their Internship/ Field Work/ Work experience from Second to Fifth semester of Bachelor of Science in the Programme, according to their convenience; @ denotes Non-Examination credits.

Note: Internship/ Apprenticeship/ Field Work Experience (during vacations of semester II to V This will carry 5 credits for learning of 150 hours. Its credits and grades will be reflected in final semester VI credit grade report.

Syllabus Prescribed for Three-Year UG Programme

Programme: B.Sc. III

Semester VI (CBCS Scheme)

Code of the Course/Subject	Title of the Course/Subject	Total Number of Periods
BOT(6S)/Botany	Molecular Biology and Plant Biotechnology	72

COs:

- Students will be able to understand various aspects of plant physiology like plant water relation, photosynthesis, respiration, and metabolism
- Students will understand the aspects of plant ecology like various factors and ecosystem composition and function.
- Students will be able to design various experiments/ models on plant physiology and plant ecology.

Unit	Detail Description / Content	Periods require
Unit - I:	DNA the genetic Material : 1.1 Historical account – Giffith’s Experiment, Hershey and Chase Experiment. 1.2 DNA– Chemical composition and Double Helical model, 1.3 DNA replication in Eukaryotes; 1.4 DNA Packaging - Nucleosome and Solenoid 1.5 Satellite, Repetitive DNA, and Transposable element in plants (AC-DS system)	12
Unit - II:	Gene Structure and Expression 2.1 Concept of gene, Fine structure of Gene 2.2 Gene Expression – Central Dogma, Types of RNA, Genetic code, Ribosome as a translation machine 2.3 Transcription in Eukaryotes – Mechanism of Transcription and RNA Processing 2.4 Translation in Eukaryotes. 2.5 Endomembrane system (Flow of Peptide)	12
Unit - III:	Regulation of Gene Expression 3.1 Regulation of Gene Expression in Prokaryotes – Operon concept with special reference to Lac Operon 3.2 Regulation of gene expression of Eukaryotes – Britton Davidson Model 3.3 Protein Folding Mechanism and Structure (Primary, Secondary, Tertiary, and Quaternary) 3.4 Protein Sorting – Targeting to proteins to organelles 3.5 Protein Trafficking	12
Unit – IV:	Recombinant DNA Technology 4.1 Tools and techniques of recombinant DNA technology,	12

	<p>4.2 Restriction Enzymes – Nomenclature and Types</p> <p>4.3 Cloning vectors – Plasmids, Phages, Cosmids</p> <p>4.4 Gene Transfer Techniques – Direct - (1) Chemical method, (2) Electroporation, (3) Gene gun method Indirect – Agrobacterium-mediated gene transfer</p> <p>4.5 Gene Amplification - _Polymerase Chain Reaction (PCR)</p>	
Unit – V:	<p>Plant Tissue Culture –</p> <p>5.1 Basic aspects of plant tissue culture</p> <p>5.2 Laboratory Requirement – Infrastructure, Instruments (laminar air flow, autoclave, growth chamber), Culture Media (MS Media), Growth Hormone (Auxin, Cytokinin and Gibberellins) Sterilization Techniques</p> <p>5.3 Tissue Culture Technique - Cellular totipotency, differentiation and morphogenesis; Callus Culture; Micropropagation</p>	12
Unit – VI:	<p>Applications of Plant Biotechnology –</p> <p>6.1 Agriculture – Haploid plant production (Anther and Pollen Culture); Protoplast Culture and Somatic Hybridization; Transgenic Plant - BT Cotton, Synthetic Seed. Salient achievements of crop biotechnology</p> <p>6.2 Industry – Fermentation Technology- Bakery Products and Alcohol Productions.</p> <p>6.3 Health Care – Edible Vaccines</p> <p>6.4 Conservation – Cryopreservation, Genetically Modified Organisms: - Pros and Cons</p>	12

Skill Enhancement Module (SEM): Bioinformatics Tools and Techniques

Unit	Detail Description / Content
Unit - I:	<p>Bioinformatics Tools and Techniques</p> <p>1.1 Introduction to Bioinformatics and its scope</p> <p>1.2 Exploring databases like NCBI and PDB</p> <p>1.3 Sequence alignment tools like BLAST, FASTA, ClustalW</p> <p>1.4 Tools for Phylogenetic analysis like PAUP and MrBayes</p> <p>1.5 Applications of Bioinformatics</p>
	<p>CO's:</p> <ul style="list-style-type: none"> • The students will learn the fundamental concept of bioinformatics and its scope and applications • They will explore various nucleic acid and protein databases and learn sequence alignment • They will acquire knowledge about sequence alignment tools and create phylogenetic tree using various related tools.
	<p>Activities:</p> <ol style="list-style-type: none"> 1. Retrieval of DNA/RNA/protein sequences from databases 2. Exploring the integrated database system at NCBI server and querying the PUBMED and GenBank databases using the ENTREZ search engine 3. Sequence alignment: database searches (BLAST, FASTA etc.)

Books Recommended :

Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, I. D. (1999). *Molecular Biology of Cell* - Garland Publishing Co. Inc New York, U.S.A.

Bhojwani, S. S. (1990). *Plant Tissue Culture: Applications and Limitations*, Elsevier Science Publishers, New York. U.S.A

Devi, P. (2000). *Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics*, Agrobios, Jodhpur, India.

Dubey, R. C. (2018) *A Text Book of Biotechnology*, S. Chand Publication.

Fakui, K. and Nakayama S. (1996). *Plant Chromosomes. Laboratory Methods*. CRC Press, Boca Raton, Florida.

Gupta P. K. (2018) *Molecular Biology and Biotechnology*, Rastogi Publication.

Gupta, P. K. (1999). *A Text book of Cell and Molecular Biology*, Rastogi Publication, Meerut, India.

Kumar, S. and Singh, H. (2008) *Molecular Biology and Biotechnology*, Pragati Prakashan.

Lea, P. J. and Leegood, R. C. (1999). *Plant Biochemistry and Molecular Biology*. John Wiley & Sons, Chichester, England.

Old, R. W. and Primrose, S. B. (1989). *Principles of Gene Manipulation*. Blackwell Scientific Publications, Oxford, U.K.

Reneberge, R. and Berkling V (2017) *Biotechnology for Beginners*, Academic Press

Satyanarayana, U. and Chakrapani, U. (2022) *Biotechnology*, Books and Allied Publication Limited.

Sharma, A. K. and Sharma, A. (1999.) *Plant Chromosomes: Analysis; Manipulation and Engineering*. Harwood Academic Publishers, Australia.

Sharma, S. K. (2004) *A Text Book of Biotechnology (Fundamentals of Molecular Biology)*

Singh, B. D. (2010) *Biotechnology*, Kalyani Publisher

Smith, R. H. (2000). *Plant Tissue Culture; Techniques and Experiments*. Academic Press, New York.

Vasil, I. K. and Thorpe, T. A. (1994). *Plant Cell and Tissue Culture*, Kluwer Academic Publications, the Netherlands.

Wolfe, S. L. (1993). *Molecular and Cell Biology*. Wordsworth Publishing Co., California, U.S.A.

Syllabus Prescribed for Three Year UG

Programme: B.Sc. III

Semester VI

Code of the Course/Subject	Title of the Course/Subject	(No.of Periods/week)
BOT (6S)/BOTANY	Practical	2 Practicals per week

1.	Molecular biology (Major) (Any One) <ol style="list-style-type: none">1. Isolation of DNA by crude method2. Estimation of DNA by Diphenylamine method3. Estimation of RNA by Orcinol method Molecular biology (Minor) (Any One) <ol style="list-style-type: none">1. Demonstration of DNA Electrophoresis,2. Demonstration of double helical model of DNA3. Demonstration of AC-DS System in Maize kernel4. Demonstration of Centrifugation
2.	Biotechnology experiments (Any Six) <ol style="list-style-type: none">1. Working Principle and application of Autoclave2. Working Principle and Application of Laminar Air Flow3. Cleaning and Sterilization of Glassware4. Sterilization of Explant5. Inoculation of Explant6. Demonstration of in vitro culture techniques – anther and pollen culture7. Isolation of Protoplast by Mechanical Method8. Isolation of Protoplast by Enzymatic Method9. Demonstration of the technique of Micropropagation10. Preparation of Artificial Seed11. Demonstration of hardening of tissue culture plant12. Preparation of Tissue culture media13. Pollen viability test.

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

PRACTICAL EXAMINATION / Lab- 6

Plant Physiology and Biochemistry

Time: 3 hrs.

Max. Marks: 50

Internal examination Marks : 25

External Examination Marks : 25

Internal Practical Examination

1. Attendance/ Regularity	5
2. Student performance - Seminar/ Group Discussion and other formative assessment related to the subject.	5
3. Activity report- Academic /Institute/Industrial/Field visit or any report activity related to the subject.	5
4. Class record	5
5 - Viva – voce (Internal Examiner)	5
Total :	25

External Practical Examination

Q. 1 – Molecular Biology- major experiment,	07
Q. 2 – Molecular Biology Minor experiment,	03
Q. 3 – Biotechnology Major experiment.	07
Q. 4 – Biotechnology- Minor experiment.	03
Q. 5 - Viva – voce	05
Total :	25