Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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–: પરિપત્ર :–

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ અનુસ્નાતક અભ્યાસક્રમ ચલાવતી કોલેજોનાં આચાર્યશ્રીઓને તથા વિભાગીય વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc. Botany Sem- I, II, III & IV નો અભ્યાસક્રમ વનસ્પતિશાસ્ત્ર વિષયની અભ્યાસ સમિતિ વતી ચેરમેનશ્રીએ મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ સ્વીકારી વિજ્ઞાન વિદ્યાશાખાની તા.૧૪/૦૭/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૦૩ અન્વયે કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૧૭/૦૭/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૩૩ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા.૧૪/૦૭/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ૦૩

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc. Botany Sem- I, II, III & IV નો અભ્યાસક્રમ વનસ્પતિશાસ્ત્ર વિષયની અભ્યાસ સમિતિ વતી ચેરમેનશ્રીએ મંજૂર કરવા કરેલ ભલામણ સ્વીકારી M.Sc.Botany Sem-III નો અભ્યાસક્રમ સુધારા–વધારા સાથે મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૧૭/૦૭/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૩૩

:: આથી ઠરાવવામાં આવે છે કે, વિજ્ઞાન વિદ્યાશાખાની તા.૧૪/૦૭/૨૦૨૩ ની સભાની ઠરાવ ક્રમાંકઃ૦૩ અન્વયે કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

ક્રમાંક : એસ./સાયન્સ/પરિપત્ર/૧૮૮૦૪/૨૦૨૩
તા.૨૧–૦૭–૨૦૨૩

કુલસચિવ

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ અનુસ્નાતક અભ્યાસક્રમ ચલાવતી કોલેજોનાં આચાર્યશ્રીઓ.
..... આપશ્રીની કોલેજ/વિભાગના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારૂ.

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
Veer Narmad South Gujarat University
सत्यम् ज्ञानम् अनन्तम्

CURRICULUM FRAMEWORK

FOR BOTANY

POST GRADUATE (PG) PROGRAM

PREPARED ACCORDING TO

NATIONAL EDUCATION POLICY (NEP)-2020

Effective from Year 2023-24

M.Sc. BOTANY REVISED SYLLABUS (Academic Flexibility) (Credit System) (NEP – 2020)

Syllabus for the Semester System Examination (Academic Flexibility, Credit System, NEP - 2020) w.e.f. June 2023 for M.Sc. Part - I (Semester I & II) and for M.Sc. II (Semester III & IV) from June 2024.

1) The entire course of M. Sc. (Botany) will be of four semesters spread over two years.

2) There shall be four theory (three core and one elective) papers and three practical papers (each based on core theory paper) in every semester. Each semester course shall comprise of four units per theory paper per week.

3) Each unit in theory paper shall comprise of 15 lectures of 1-hour duration and there shall be four lectures per theory paper per week. There shall be three practicals (each with not less than three hour duration) per week. Library (Reference) work/ Excursion/ Field Work/Seminar –Group Discussion/Project Work shall also be conducted in every week.

4) Among the four Theory papers there shall be one elective paper per semester.

5) The candidates should study the typical vegetation in natural condition. There shall be at least one short tour per year for all students. There shall be one long tour (within two years) out of the state to Botanical Regions, floristic rich area, Research Institutes / Centers. All excursion tours, short and long, are obligatory to each student and submission of study report is compulsory.

6) For the elective theory paper, there may be more than one paper offered in a given semester, in which case students can choose any one theory paper based on their interest.

7) Similarly, for the skill based theory paper, there may be more than one paper offered in a given semester, in which case students can choose any one theory paper based on their interest.

   Further, students have to also obtain certificate of online course done at UGC/MoE (Ministry of Education) recognized web portals such as SWAYAM/ NPTEL/MOOCs etc.

8) In the fourth semester there shall be a dissertation work (Botany practical XII) to be done by each student independently under the supervision of allotted faculty and submit a dissertation/thesis in partial fulfillment for the award of M.Sc. degree in Botany.

9) Candidates shall require to produce, the following at the time of practical examination (at the end of each semester). :-

   - Every candidate shall complete laboratory course in accordance with the regulations issued from time to time by Academic Council on the recommendation of the Board of Studies.
   - Every candidate shall record observation directly in the laboratory journal. Every journal shall be signed periodically. At the end of the semester candidate shall produce certified journal during the practical examination.

- A set of micro preparations (semi / permanent) of plant materials illustrating the subject matter of the relevant paper.
- Uncertified Journal will not be considered for evaluation the candidate may not be allowed to appear in the examination at the discretion of subject chairman.
- At least 20-25 Herbarium specimens and preserved specimens (preferably of weeds) collected by the Candidate during the field work or excursion tour.

Frame work for M.Sc. Sem. I to III						
Theory Paper/Practical	Teaching schedule Hrs/week	Exam Schedule			Total Marks	Credit
Theory Papers:		Duration (Hrs)	Internal Marks	External Marks		
Core Paper I	4	3	30	70	100	4
Core Paper II	4	3	30	70	100	4
Core Paper III	4	3	30	70	100	4
Inter/Multi-Disciplinary Elective Paper	4	3	30	70	100	4
Practicals:						
Practical based on Core Paper I to III	12	10-15	50	100	150	6
Skill based elective paper/Swayam/other Mooc Courses	2	2	20	30	50	2
		Total	**190**	**410**	**600**	**24**

- **Pedagogy :** Lectures, Practicals, Field and laboratory visit, Participatory Learning, Seminars, Assignments, Specimen submission etc.

Formative Assessment for theory	
Assessment Occasion/Type	Weightage in Marks
Attendance & Discipline	5
Assignment (per unit one)	10
Seminar	5
Test	10
Formative Assessment for Practical	
Regularity	5
Practical skill (Sectioning, Drawing, Labeling, Record Keeping etc.)	10
Submission (Herbarium, Specimen, Slides, Tour Report etc.)	10
Model Examination/Viva	25

Frame work for M.Sc. Sem. IV						
Theory Paper/Practical	Teaching schedule Hrs/week	Exam Schedule			Total Marks	Credit
Theory Papers:		Duration (Hrs)	Internal Marks	External Marks		
Core Paper I	4	3	30	70	100	4
Special Elective Paper II	4	3	30	70	100	4
Seminar based on research paper presentation	4	7	30	70	100	4
Dissertation work		7	30	70	100	10
Skill based elective paper/Swayam/other MOOC Courses	2	2	20	30	50	2

Programme Outcome and Programme Specific Outcome

Subject Botany

POST-GRADUATION COURSES

In accordance with NEP 2020, the M.Sc. Botany program is designed with the following learning and subject specific outcomes to encourage and popularize the subject of Botany among the biology students in order to make it useful for their career building as well as to incorporate the essence of plant sciences and their importance in the ecology and environment.

Keeping in mind that these students can take up teaching at different levels, research work in research institutes and or industry, doctoral work, environment impact assessment, biodiversity studies entrepreneurship. scientific writing relevant topics have been included in the curriculum.

M. Sc. Botany Program and Course Outcome

On completion of program students will be able to

1. Appreciate the Botany subject as a discipline and its importance in the current scenario of the world.
2. Identify and appropriately classify the plants by using the key characters under a known and established system of classification.
3. Prepare and view specimens for examination using light microscopy.

4. Use pure culture and selective techniques to isolate fungi, plant pathogens, algae and identify them growing on media.
5. Demonstrate the various techniques of plant tissue culture and micro-propagation of economicallyand ecologically important plant species.
6. Qualitative and quantitative estimation of biodiversity components.
7. Use appropriate plant molecular techniques and use of instrumentation related to it.
8. Practice safe laboratory procedures, using appropriate protective, biosafety and emergency procedures.
9. Documentation and report writing on experimental protocols, results and conclusions, study toursand field visits etc.
10. Understand the need for research work and Conduct independent research work in an appropriateand scientific manner and be able to prepare scientific reports/articles.
11. Analyze and interpret results generated through studies in botany, taxonomical treatments, fieldstudies, excursion tours and laboratory techniques used in the subject.
12. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development with respect to assessment, conservation and utilization of floral diversity
13. Understand the importance of medicinal plants and its potential in the market.

Semester -I

Paper No.	Title of paper	Type of Paper	Credit
1001	Fundamental Microbiology	Core-1	4
1002	Mycology and plant Pathology	Core-2	4
1003	Phycology and Lichen	Core-3	4
1004	Organic Farming and Sustainable Agriculture	Elective	4
1005	Manures and Fertilizers	Skill based Elective	2
1006	Practical	Practical	6

Semester -II

Paper No.	Title of paper	Type of Paper	Credit
2001	Bryophytes, Pteridophytes, Gymnosperms & Paleobotany	Core-1	4
2002	Plant Anatomy & Embryology	Core-2	4
2003	Biostatistics, Instrumentation and Techniques	Core-3	4
2004	Pharmacognosy & Phytochemistry	Elective	4
2005	Apiculture	Skill based Elective	2

2006	Practical	Practical	6

Semester –III

Paper No.	Title of paper	Type of Paper	Credit
3001	Plant Physiology	Core-1	4
3002	Plant Ecology and Conservation	Core-2	4
3003	Phytomorphology OR Plant Tissue Culture OR Bioinformatics OR Plant Stress Biology	Special Elective	4
3004	Phytogeography, Plant for Human Welfare and Plant Breeding	Elective	4
3005	Floriculture	Skill based Elective	2
3006	Practical 3006	Practical	6

Semester -IV

Paper No.	Title of paper	Type of Paper	Credit
4001	Cell Biology, Genetics, Molecular Biology & Biochemistry	Core-1	4
4002	Plant Taxonomy and Systematics **OR** Plant Breeding, Cytogenetics and DNA Sequencing	Special Elective	4
4003	Bonsai and Terrace Gardening	Skill based Elective	2
4004	Seminar based on research paper presentation	Presentation	4
4005	Dissertation work	Presentation	10

GUIDLEINES FOR DISSERTATION THESIS & RESEARCH PAPER BASED SEMINAR

PART A. Guidelines for Seminar based on research paper presentation: (4 credits)

1. Candidate has to prepare a seminar presentation based on recently published (in the last 20 years) research papers on any topic of his/her choice under the guidance and supervision of his/her faculty and present the same to the examiner.
2. The PowerPoint presentation should not be more than 10-15 slides.
3. Candidate will be given 5-7 minutes to present his/her work.

PART B. Guidelines for Dissertation Thesis (10 credits)

1. Students (individually or in a group of 2) have to submit either a Dissertation thesis based on experimental research work based on a topic of his/her choice under the guidance and supervision of assigned faculty.
2. The Dissertation thesis must have the following:
    i. Introduction & Review of literature (with reference cited in the text)
    ii. Material and Methods (with reference cited in the text)
    iii. Results and Discussion (with reference cited in the text)
    iv. References/Bibliography
3. The thesis must be formatted in the following manner:
    i. Times New Roman
    ii. 12 Font Size
    iii. Line Spacing 1.5
    iv. Character Spacing: Normal
    v. Pages should be numbered
    vi. Table of content displaying the chapters and page number
4. Figures and tables should be properly labeled with source credits.
5. References should be in a uniform single style such as APA or any other of their choice.
6. Dissertation thesis printing should be eco-friendly and can be spirally bound.
7. For the Dissertation presentation, the candidate has to prepare a PowerPoint presentation of not more than 10-15 slides and present his/her research work.
8. Candidate will be given 8-10 minutes to present his/her work.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - I

FRAMED ACCORDING TO

NATIONAL EDUCATION POLICY (NEP) 2020 (Effective from June 2023)

BOTANY PAPER – 1001

FUNDAMENTAL MICROBIOLOGY

BOT – 1001 :	FUNDAMENTAL MICROBIOLOGY	60 hours	(4 credits)

UNIT 1	HISTORY OF VIROLOGY, CLASSIFICATION OF VIRUS	15 Hours
	➢ What is Virus? ➢ History and Timeline of Virology, classification of Viruses, Morphology and structure of viruses. ➢ Methods of transmission of Viruses, Properties of Virus symptoms of viral infection on plants. ➢ Bacteriophage and TMV. ➢ Economic Importance of Virus.	
UNIT 2	VIRUS AND PATHOLOGY	15 Hours
	➢ Behavior of viruses in plants including infection, replication and movement. ➢ Histopathological changes induced by viruses in plants, inclusion bodies. ➢ Transmission of viruses: virus - vector relationships. Symptoms expression, viroids and prions. ➢ Viral Diseases • Little leaf of Brinjal • Leaf roll of Potato • Mosaic of Sugarcane • Cotton Leaf curl • Tomato bunchy top	
UNIT 3	BIOLOGY, REPRODUCTION & GROWTH MODES OF BACTERIA	15 hours
	➢ Detailed study of bacteria with reference to their Ultra structure, The Size, Shape, and Arrangement of Bacterial Cells ➢ Ultra-Structure of Bacterial cell Structures External to the Cell Wall, Flagella and Motility - Pili (fimbriae), Capsules, Sheaths,	

	Prosthecae and Stalks, The Cell Wall - Structure and Chemical Composition; outer membrane (Gram negative bacteria), cell membrane, nucleoid, ribosomes, and endospore ➢ Binary fission, Budding, Fragmentation, Sexual Reproduction-Bacterial conjugation with sex factor. Growth-Normal Growth Cycle (Growth Curve) of Bacteria ➢ Economic and Industrial importance of Bacteria.	
UNIT 4	BACTERIA AND PATHOLOGY	15 hours
	➢ Diseases caused by plant pathogenic bacteria; entry of bacteria into plants; pathogenicity and virulence factors in bacterial diseases; plant response to bacterial infection; diagnosis of bacterial diseases and symptoms. ➢ Bacterial Diseases : • Bacterial Blight of Paddy • Bacterial Leaf Streak of Rice • Angular leaf spot and wild fire of Tobacco • Yellow Ear Rot of Wheat • Wilt diseases of Potatoes	

REFERENCES:

1) Virus:An Illustrated Guide to 101 Incredible Microbes Marilyn J. Roossinck
2) Plant Viruses : Diversity, Interaction and Management-Dorokhov, Yuri, Gaur, Rajarshi Kumar,Khurana, SMP
3) Plant Pathology–George N Agrios 5th Ed.
4) Virus-insect-plant interactions- Kerry F. Harris, Oney P. Smith and James E. Duffus
5) Plant Immunity against Viruses. Jian-Zhong Liu1, Feng Li and Yule Liu.
6) Micro biology by Michael J. Pelczar, JR., E. C. S. Chan
7) Prescott's Microbiology
8) Bergey's Manual of Systematic Bacteriology
9) Practical Microbiology Vol.1 and 2- Rakesh Patel
10) Practical Botany vol-1 and 2 by B. P. Pandey

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - I

FRAMED ACCORDING TO

NATIONAL EDUCATION POLICY (NEP) 2020 (Effective from June 2023)

BOTANY PAPER – 1002

MYCOLOGY AND PLANT PATHOLOGY

BOT - 1002 :	MYCOLOGY AND PLANT PATHOLOGY	60 hours	(4 credits)

UNIT 1	MYCOLOGY-I	15 Hours
	➢ Fungi-General Characters (Hyphal structure, modification of hyphae, reproduction. ➢ Classification of Fungi (Alexopoulas 1968). ➢ Parasexuality in Fungi(Mechanism of Parasexual cycle and application of Parasexuality). ➢ Edible Fungi. Mushrooms and their cultivation, Economic importance of fungi (Useful activities and Harmful activites)	
UNIT 2	MYCOLOGY-II	15 Hours
	➢ Occurrence, Classification, thallus, cell structure, nutrition and reproduction of. ➢ *Phytophthora* ➢ *Rhizopus* ➢ *Penicillium* ➢ *Claviceps* ➢ *Ustilago* ➢ *Colletotrichum*	
UNIT 3	PLANT PATHOLOGY-I	15 hours
	➢ Plant disease introduction, Pathogenesis (Pre-penetration changes, Penetration process, Post-penetration changes). ➢ General symptoms of plant diseases, Symptoms due to the Nature, Structure and Appearance of visible pathogen. ➢ Anatomical and Morphological symptoms on Host. ➢ Classification of Plant diseases, On the basis of Infection-Pathogen- Occurrence, geographical distribution & perpetuation	

	of spread. ➢ Disease control- Prophylatic measure, Curative measures, Biological measures.	
UNIT 4	Plant Pathology-II	15 hours
	➢ Dispersal of plant pathogens ➢ Plants defend themselves against infection (Morphological defence) ➢ Fungal Diseases of Plants : • Foot rot of Papaya • Blight of Colocasia • Brown stripe downy mildew of Maize • Powdery mildew of Mango • Apple scab	

REFERENCES:

1 Alexopoulus, C. J., Mims, C. W. and Blackwel, M., Introductory Mycology, John Wiley & Sons Inc.

2 Mandahar, C. L. Introduction to Plant Viruses. Chand & Co. Ltd., Delhi.

3 Mehrotra, R. S. and Aneja, R. S. An Introduction to Mycology. New Age Intermediate Press.

4 Rangaswamy, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India. Prentice Hall of IndiaPvt. Ltd., New Delhi.

5 Singh R S. Plant diseases. 6th edition. Oxford and IBH, New Delhi.

6 Singh R.S. Principles of plant pathology. 3rd edition. Oxford and IBH, New Delhi.

7 H C Dube: An introduction to Fungi. (Fourth edition) Scientific publishers (India).

8 Singh, Pande and Jain. A text book of Botany. Rastogi Publications. Meerut.

9 Practical Botany vol-I and 2 by B.P.Pandey.

10 A text book of Practical Botany-1 by Bendre and Kumar.Rastogi Publications. Meerut.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - I

FRAMED ACCORDING TO

NATIONAL EDUCATION POLICY (NEP) 2020 (Effective from June 2023)

BOTANY PAPER – 1003

PHYCOLOGY AND LICHEN

BOT - 1003 :	PHYCOLOGY AND LICHEN	60 hours	(4 credits)

UNIT 1	GENERAL ACCOUNT	15 Hours
	➢ General Characters of Algae ➢ Algal diversity with respect to habit and thallus Similarities and Dissimilarities with Fungi and Bryophytes ➢ Fritsch's system of classification ➢ Habits and Habitats of Algae ➢ The range of thallus structure in Algae and Structure of Algal cell	
UNIT 2	REPRODUCTION IN ALGAE	15 Hours
	➢ Vegetative, Asexual ReproductionSexual Reproduction ➢ Life Cycles in algae ➢ Origin and Evolution of Sex in Algae	
UNIT 3	LIFE HISTORY	20 hours
	➢ Classification (as per Fritsch's System), Morphology, Cell Structure, Reproduction and Life cycle of following types: • Myxophyceae : *Lyngbya, Scytonema* • Chlorophyceae : *Hydrodictyon, Zygnema, Nitella* • Phaeophyceae : *Fucus* • Rhodophyceae : *Gracilaria*	
UNIT 4	LICHENS	10 hours
	➢ Introduction, Occurrence, General Characters of Lichens, Nature ofFungal and Algal Association in Lichens ➢ Ecology and Physiology of Lichen ➢ Classification and thallus structure of Lichens ➢ Economic and Ecological importance of Lichens ➢ *Usnea* : Classification, Morphology, Internal Structure, Reproduction and Economic Importance of *Usnea*	

REFERENCES:

1 Phycology by Annie Ragland; Saras publication

2 An introduction to Algae by V.K. Gupta and Y. P. Varshneya; Kendarnath Ram Nath Publishers

3 An Introduction to Algae by Suresh Kumar; Campus books.

4 An Introduction to Algae by Ian Morris; Hutchinson University Library

5 A text book of Algae by S.K. Sarkar; Central book depot

6 A text book of Botany: The Algae by Brahma Prakash Pandey; Jai Prakash Nath and Co.

7 A class book of Algae by G.L. Chopra; S. Hagin and Co.

8 A text book on Algae by H.D. Kumar and H.S. Singh; East-west press.

9 Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.

10 Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.

11 Fritsch F.E. (1935 The Structure & Reproduction of Algae 1945): Cambridge University PressCambridge, U.K. Vol. I, Vol. II.

12 Smith, G.M (1955) :Cryptogamic Botany(Vol. I Algae, Fungi, & Lichens) McGraw-Hill BookCo., New York

13 Ian Morris (1967): An Introduction to the Algae, Hutchinson, London.

14 A Textbook of Botany vol. I and II S.N. Pandey, P. S. Trivedi and S. P. Misra., Vikas Publication House Pvt. Ltd.

15 Collage Botany Vol. I & II Das, Dutta, Gangulee and Kar., New Central BookAgency

16 Algae, Fungi, Bryophyte, Pteridophyte by Vashishta., S. Chand Pub, New Delhi.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - I

FRAMED ACCORDING TO

NATIONAL EDUCATION POLICY (NEP) 2020 (Effective from June 2023)

BOTANY PAPER – 1004

ORGANIC FARMING & SUSTAINABLE AGRICULTURE

Bot - 1004 :	ORGANIC FARMING & SUSTAINABLE AGRICULTURE	60 hours	(4 credits)

UNIT 1	CONCEPT OF ORGANIC FARMING	15 ours
	➢ Introduction: Farming, organic farming, concept and development oforganic farming. ➢ Principles of organic farming, types of organic farming, biodynamicfarming. ➢ Benefits of organic farming, need for organic farming, conventionalfarming v/s organic farming ➢ Scope of organic farming; National and International status. ➢ Agencies and institutions related to organic agriculture. ➢ Requirements for organic farming, farm components for an organic farm.	
UNIT 2	ORGANIC PLANT NUTRIENT MANAGEMENT	15 Hours
	➢ Organic farming systems, soil tillage, land preparation and mulching. ➢ Choice of varieties of plants for organic farming. ➢ Propagation-seed, planting materials and seed treatments, water management. ➢ Green manuring, composting- principles, stages, types and factors,composting methods and Vermi composting ➢ Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludge. ➢ Bio-fertilizers- types, methods of application, advantages and disadvantages, standards for organic inputs- fertilizers	
UNIT 3	ORGANIC PLANT PROTECTION	15 ours

	➢ Plant protection- cultural, mechanical, boipesticides and biologicalcontrol agents. ➢ Weed management in Organic farm. ➢ Standards for organic inputs- plant protection.	
UNIT 4	ORGANIC PRACTICES AND CERTIFICATION	15 hours
	<u>Organic crop production practices</u> ➢ Organic crop production methods- rice and mango ➢ Organic crop production methods- vegetables- okra, amaranthus andcucurbits ➢ Livestock component in organic farming ➢ Sustainable Agriculture-Apiculture <u>Organic Certification</u> ➢ Farm economy: Basic concept of economics- demand & supply, economic viability of a farm. ➢ Basic production principles, reducing expenses, ways to increase returns, cost of production system. Benefit/ cost ratio, marketing, imports and exports. ➢ Policies and incentives of organic production ➢ Farm inspection and certification ➢ Terrace farming	

REFERENCES:

1 Palaniappan SP & Anandurai K. 1999. Organic Farming–Theory and Practice. ScientificPublishers, Jodhpur

2 Joshi, M. 2014. New Vistas of Organic Farming 2nd Ed. Scientific Publishers, Jodhpur.

3 Farming system : Theory and Practice - S.A.Solaimalai

4 Organic Farming: Theory and Practice- S.P.Palaniappan and K.A. Annadurai

5 A hand book of Organic Farming by A.K.Sharma

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - I

FRAMED ACCORDING TO

NATIONAL EDUCATION POLICY (NEP) 2020 (Effective from June 2023)

BOTANY PAPER – 1005

SKILL BASED ELECTIVE PAPER (MANURES AND FERTILIZERS)

BOT – 1005 :	MANURES AND FERTILIZERS	30 hours	(2 credits)

UNIT 1	SOIL FERTILITY, PRODUCTIVITY AND ITS MAINTENANCE.	10 Hours
	➢ Concept & Practice of Integrated Nutrient Management System (INMS) in the field. ➢ Different types of manures. (NADEP compost, Vermi compost), FYM, Sludge, Poultry manure	
UNIT 2	GREEN MANURE	10 Hours
	➢ Role of Green Manuring in crop production. ➢ Green manuring, its principles, methods and practices. ➢ Different types of Green Manure crops.	
UNIT 3	BIO-FERTILIZERS	10 hours
	➢ Preparation, application, techniques. ➢ Use of bio-fertilizers (as Azolla, Blue-green algae, Rhizobium, Azotobactor, Phosphate and Potash solubilizing bacteria and mycorrhiza; their propagation, source of availability, application and limitations	

REFERENCES:

1. Manures and Fertilizes (1992), Seventh Edition by K. S. Yawalkar, J. P. Agarwal and S. Bokde

2. Soil Fertility, theory and practice (1976) by J. S. Kanwar

3. Soil Fertility and Fertilizers (1985) by S.L. Tisdale, W.L. Nelson and J. D. Beaton.

4. Manure Fertilizers & Agrochemicals by Tanu

BOT – 1006 : 180 Hours (6 credits)

- The candidates should study the typical vegetation in natural condition and should recordtheir observation in journals. Excursion should be arranged during the year to local places.
- Every candidate shall complete laboratory course in accordance with the regulations issuedfrom time to time by Academic Council on the recommendation of the Board of Studies.
- Every candidate shall record observation directly in the laboratory journal. Every journal shall be signed periodically. At the end of the semester candidate shall produce certified journal during the practical examination.

PART A : (FUNDAMENTAL MICROBIOLOGY) : (60 Hours)

- To study different types of Bacteria by slide preparation technique.
- Gram Staining of Bacteria.
- Micrometry for the Bacteria slide.
- Direct examination of root nodule bacteria under microscope.
- Study of Viruses by chart or specimen-TMV, CaMV, Potato Virus, Tomato yellow leaf Curl virus, Ralstonia Phage Virus.
- To study zone & inhibition test (Kirby-Bauer) for antimicrobial activity.
- Isolation of N_2 fixing Bacteria *Rhizobium.*
- Isolation of N_2 fixing Bacteria *Azotobacter.*
- Isolation and identification of bacteria in soil.
- Causal organism, symptoms and control measures of the following plant diseases.
- Viral Diseases
  - Little leaf of Brinjal
  - Leaf roll of Potato
  - Mosaic of Sugarcane
  - Leaf curl of Cotton
  - Bunchy top of Tomato
- Bacterial Diseases :
  - Bacterial Blight of Paddy

- **Bacterial Leaf Streak of Rice**
- **Angular leaf spot and wild fire of Tobacco**
- **Yellow Ear Rot of Wheat**
- **Wilt diseases of Potatoes**

PART B (MYCOLOGY AND PLANT PATHOLOGY) (60 hours)

- To study fungi *Phytophthora* (Permanent Slide : t.s. of infected leaf showing sporangia: Specimen: Irish blight of potato, blight of Colocasia)
- To study fungi *Rhizopus.* (Permanent Slide : Sporangia, zygospore)
- To study fungi *Penicillium* (Permanent Slide : Mycelium bearing conidia, Ascocarp)
- To study fungi *Claviceps.* (Permanent Slide : Mycelium showing conidiophores, V.S. of stroma, V.S. of ascocarp)
- To study fungi *Ustilago.* (Permanent Slide : Chlamydospores (Teleutospores), Specimen (any one: covered smut of barley or oat, Loose smut of wheat, common smut of maize)
- To study fungi *Colletotrichum.* (Permanent Slide : inter and intracellular mycelium, Acervulus and conidia, Specimen: Red rot of sugarcane – lesions on stem and leaf)
- **Isolation and identification of fungi in soil.**
- **Causal organism, symptoms and control measures of the following plant diseases.**
  - **Foot rot of Papaya**
  - **Blight of Colocasia**
  - **Brown stripe downy mildew of Maize**
  - **Powdery mildew of Mango**
  - **Apple scab**

PART C (Phycology and Lichen) (60 hours)

- **To study algae *Lyngbya*. (Permanent Slide : Lyngbya WM)**
- **To study algae *Scytonema*. (Permanent Slide : Scytonema WM)**
- **To study algae *Gleocapsa*. (Permanent Slide : Gleocapsa WM)**
- **To study algae *Anabaena*. (Permanent Slide : Anabaena WM)**
- **To study algae *Pandorina*. (Permanent Slide : Pandorina WM)**
- **To study algae *Hydrodictyon*. (Permanent Slide : Hydrodictyon WM)**

- **To study algae *Pediastrum*. (Permanent Slide : Pediastrum WM)**
- **To study algae *Ulva*. (Permanent Slide : Ulva WM)**
- **To study algae *Pithophora*. (Permanent Slide : Pithophora WM)**
- **To study algae *Zygnema*. (Permanent Slide :Zygnema WM, Zygnema Conjugation)**
- **To study algae *Nitella*. (Permanent Slide : Nitella WM, Nitella Reproductive Structure)**
- **To study algae *Fucus*. (Permanent Slide : Male conceptacle, female conceptacle; Specimen: Thallus structure)**
- **To study algae *Gracilaria*.(Permanent Slide: thallus WM, T.S. of cystocarp)**
- **To study lichen *Usnea*. (Permanent Slide: V.S. of Apothecium; Specimen: Thallus structure)**
- **Student should collect and identify common field Algae and prepare a field report of collection activities in the journal itself.**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - II

BOTANY PAPER – 2001

(BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS & PALEOBOTANY)

(Effective from June 2023)

Number of Theory Credits	Number of Lecture hours/semester	Number of Practical Credits	Number of Practical hours/semester
4	60	2	60

BOT 2001 : (BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS & PALEOBOTANY)		
	Content of Theory Course	**60 Hours**
Unit – I :	**Bryophytes**	**15**
	1. General characters of Bryophytes 2. Classification of Bryophytes by Royhmaler and Proskauer 3. Principal characters of following classes (with a note on comparative account) (a) Hepaticopsida (b) Anthocerotopsida (c) Bryopsida 4. Evolution of sporophytes in Bryophytes 5. Affinities of Bryophytes 6. Economic importance of Bryophytes	
Unit – II :	**Pteridophytes-I**	**15**
	1. General characters of Pteridophytes 2. Classification of Pteridophytes () 3 Affinities of Pteridophytes 4. Heterospory and seed Habit 5. Telome theory 6. Stelar system and evolution of stele in Pteridophytes 7. Apospory and Apogamy	
Unit – III :	**Pteridophytes-II**	**15**
	1. Principal characters of following subdivision (a) Psilophytopsida (b) Psilotopsida (c) Lycopsida (d) Sphenopsida (e) Pteropsida	
Unit – IV :	**Gymnosperms & Palaeobotany**	**15**
	General Characters of Gymnosperms Classification of Gymnosperms Major Classes:	

	a. Cycadales b. Coniferales c. Gnetales Affinities of Gymnosperms Economic Importance of Gymnosperms **Palaeobotany** Geological Time Scale Type of Fossils	

REFERENCES:

1 Smith, G.M. (1955): Cryptogamic Botany Vol. II. (2nd Edition)

(Bryophytes & Pteridophytes) Tata McGraw Hill Publishing Co., New Delhi.

2 Parihar, N.S. ( ): An Introduction to embryophyta – Vol.II. Bryophyta Central Book Depot, Allahabad.

3 Watson, E.V. (1968): British Mosses & Liverworts Cambridge University Press, U.K

4 Parihar, N.S. (19) : An Introduction to Embryophyta Vol.II Pteridophyta Central Book Depot., Allahabad.

5 Smith, G.M. (1955) : Cryptogamic Botany Vol.II (2nd Edn.,) (Bryophytes & Pteridophytes) Tata McGraw Hill Publishing Co., New Delhi.

6 Sporne, K.R. (1970) : The Morphology of Pteridophytes (The Structure of Ferns and Allied Plants) Hutchinson University Library, London

7 Sharma, O.P., 2017, Algae Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut.

8 Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New Delhi.

9 Sundarajan, S. 1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.

10 Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

11 Vanderpoorten, A. and Goffinet, B. 2009, Introduction to Bryophytes, Cambridge Unversity Press, Cambridge.

12 Stewart, W.M. 1983. Paleobotany and the Evolution of Plants, Cambridge University Cambridge.

13 Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - II

BOTANY PAPER – 2002

(PLANT ANATOMY AND EMBRYOLOGY)

(Effective from June 2023)

Number of Theory Credits	Number of Lecture hours/semester	Number of Practical Credits	Number of Practical hours/semester
4	60	2	60

	Content of Theory Course	**60 Hours**
Unit – I :	**TISSUE SYSTEM**	**15Hours**
	➢ Epidermal & Dermal Tissues ➢ Storage tissues ➢ Secretory and Glandular Tissues ➢ Meristematic Tissues (Floral Meristem, RAM & SAM)	
Unit – II :	**Secondary Growth and Wood Anatomy**	**15 Hours**
	➢ Vascular tissues and Vascular Cambium, Cork and Bark ➢ Secondary growth, Anomalous Secondary Growth, An overview of Ring and Diffuse Porous Wood ➢ Physical properties of Wood, Wood Identification and carbon dating ➢ Floral anatomy: General account	
Unit – III :	**Applied Plant Embryology**	**15Hours**
	➢ Pollination: Types and Agents; Pollen, NPC System, Significance of palynology. ➢ Pollen-Pistil Interaction, Sexual Incompatibility System (GSI and SSI) ➢ Apomixis and Polyembryony and its applications	
Unit – IV :	**Seed Biology**	**15Hours**
	➢ Seed: Types (Dicot, Monocot), Seed Structure and Dispersal ➢ Seed Germination, Seed Dormancy, Factors controlling Dormancy, Methods to enhance seed germination ➢ Seed technology: Recalcitrant and Orthodox Seeds, Seed preservation and its significance –Seed Bank	

REFERENCES :

1. Bhojwani and Bhatnagar, Introduction to Embryology of Angiosperms –Oxford & IBH, Delhi

2. BhojwaniSant Saran, 2014.Current Trends in the Embryology of Angiosperms, Woong-Young Soh, Springer Netherlands,

3. Coutler E. G. , 1969. Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.

4. Dickenson, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA

5. Eames A. J. - Morphology of Angiosperms - McGraw Hill, New York.

6. Esau, K. 1990. Plant Anatomy, Wiley Eastern Pvt Ltd New Delhi

7. Evert, R.F. (2006) Esau's Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc

8. Fahn, A.1992. Plant Anatomy, Pergamon Press, USA

9. Johri, B.M. l., 1984.Embryology of Angiosperms, Springer-Verlag, Netherlands.

10. Karp G., 1985. Cell Biology; Mc.Graw Hill Company

11. Maheshwari,P 1950. An introduction to the embryology of angiosperms. New York: McGraw-Hill

12. Mauseth, J.D. (1988). Plant Anatomy, the Benjammin/Cummings Publisher, USA.

13. Nair P .K .K - Pollen Morphology of Angiosperms - Scholar Publishing House, Lucknow

14. Pandey S.N. 1997, Plant Anatomy and Embryology. ChadhaVikas Publication House Pvt L.

15. Pandey, B. P., 1997. Plant Anatomy, S.Chand and Co. New Delhi

16. Raghavan, V., 2000. Developmental Biology of Flowering plants, Springer, Netherlands.

17. Saxena M. R. – Palynology – A treatise - Oxford & I. B .H. New Delhi.

18. Shivanna, K.R., 2003. Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt.Ltd. Delhi.

19. Vashishta .P.C., 1984. Plant Anatomy

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS FOR M.Sc. SEMESTER - II
BOTANY PAPER – 2003
(Biostatistics, Instrumentation and Techniques)
(Effective from June 2023)

Number of Theory Credits	Number of Lecture hours/semester	Number of Practical Credits	Number of Practical hours/semester
4	60	2	60

BOT 2003 :Biostatistics, Instrumentation and Techniques		
	Content of Theory Course	**60 Hours**
Unit – I :	Biostatistics –I	**15**
	➢ Biostatistics: Introduction, Scope and Application ➢ Important Terms: ➢ Data: Types (Grouped and Ungrouped Data) ➢ Variables and its types. ➢ Sample and Population ➢ Sampling Methods (random and Non random) ➢ Graphical representation of Data by Histogram, Bar Charts, Pie Charts and Venn Diagram.	
Unit-II	Biostatistics-II	**15**
	➢ Measures of central tendency (Mean, Median, Mode). ➢ Range and Coefficient of variation (CV), ➢ Measure of Dispersion: Standard Deviation and Variance ➢ Hypothesis testing, Null hypothesis, T-Test, Chi-Square Test, ANOVA, Correlation and Pearson Correlation Coefficient (r)	
Unit – III :	Instrumentation & Techniques –I	**15**
	➢ Beer Lambert Law; Spectrophotometer (UV-VIS) and Colorimeter ➢ ELISA and Microplate Reader ➢ Centrifugation ➢ Mass Spectrophotometry	

Unit - IV :	Instrumentation and Techniques-II	15
	➢ Chromatography: • Thin Layer Chromatography, • Column Chromatography, • Ion Exchange Chromatography, • Molecular Sieve Chromatography, • Affinity Chromatography, • HPLC, • HPTLC, • Gas Chromatography	
	➢ Electrophoresis: • Agarose Gel Electrophoresis (AGE), • Polyacrylamide Gel Electrophoresis (PAGE)	

REFERENCES :

1 Biostatistics in theory and practice by T. K. Saha, Emkat publications, Delhi

2 Biostatistics by P. Ramakrishnan, Saras publication, Kanyakumari

3 Biostatistics by P. N. Arora and P. K. Malhan, Himalaya Publishing House, Mumbai

4 Botanical micro technique by J. E. Sass

5 Plant micro technique by Johansen D. A.

6 Basic Statistics: A Primer for the Biomedical Sciences by Dunn and Clark., 3rd Ed. John Wiley & Sons, Inc, New York

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS FOR M.Sc. SEMESTER - II
BOTANY PAPER – 2004
Pharmacognosy & Phytochemistry
(Effective from June 2023)

Number of Theory Credits	Number of Lecture hours/semester	Number of Practical Credits	Number of Practical hours/semester
4	60	2	60

BOT 2004 : Pharmacognosy & Phytochemistry		
	Content of Theory Course	**60 Hours**
Unit – I :	**Introduction to Pharmacognosy**	
	➢ History, definition and scope of pharmacognosy ➢ Alternative system of medicine: AYUSH (Ayurveda, Unani, Siddha, Homeopathy).	**15Hours**
Unit – II :	**Herbal Drugs**	**15Hours**
	➢ Good agricultural and Harvesting Practices ➢ Good Manufacturing practices ➢ Scenario of trade in Indian medicinal & Aromatic plants- global and Local Scenario ➢ Drug Adulteration: Definition, types, reasons with examples.	
Unit – III :	**Secondary metabolites**	**15Hours**
	➢ Definition, Sources, Classification, Biosynthesis (Shikimate Pathway) of: a. Alkaloids, b. Tannins, c. Glycosides and d. Flavonoids ➢ Volatile Oils and Essential oils- Extraction methods and uses. ➢ Extraction, Isolation & Purification of herbal drugs	
Unit – IV : 4	**Important Medicinal plants**	**15Hours**
	➢ **Latin name, family, distribution, Plant part used, uses, phytochemicals of the following:**	

	• **Underground parts:** *Asparagus racemosus, Chlorophytum borivilianum , Withania somnifera* • **Bark:** *Terminalia arujuna, Saraca asoca,Crataeva nurvala* • **Leaf:** *Leptadenia reticulata, Cassia angustifolia, Tridax procumbens* • **Flowers:** *Madhuca indica, Calotropis procera* • **Fruits:** *Aegle marmelos, Cassia fistula, Catunaregam spinosa* • **Seeds:** *Plantago ovata, Trigonella foenumgraecum, Strychnos nux-vomica* • **Whole Plant:** *Andrographis paniculata, Enicostema axillare, Bacopa monnieri* • **Exudates:** *Papaver somniferum, Commiphora wightii, Sterculia urens* • **Wood:** *Santalum album, Pterocarpus marsupium*	

REFERENCES :

1 Text book of Pharmacognosy & Phytochemistry Biren Shah/ A.K.Seth.

2 Robinson,T.(1981). The organic constituents of Higher Plants,Cordus Press,Mass.

3 Stumf, P.K. and Conn E.E (1980) The Biochemistry of plants Vol 1-14, Academic Press London.

4 Dantel M. (2005). Medicinal Plants. Chemistry and Properties Oxford & IBH Publishers, New Delhi.

5 Evans.W.C 2002. Tease And Evans Pharmacognosy.W.B.Saunders.London.

6 Harborne, J.B (1984) Phytochemicals Methods,AP.London.

7 Anonymous 2002 Quality control methods for medicinal plant materials, World Health Organisation, Geneva A.I.T.B.S Publishers & Distributors,Delhi.

8 Trease and Evans. Pharmacognosy

9 A phytochemical Approach To Economical Botany S.D Sabnis, M. Daniel

10 Quality Control of Herbal Drugs. Pulok Mukherjee Dattani book agency

Quality Control and Evaluation of Herbal Drugs. Pulok Mukherjee Elsevier

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS FOR M.Sc. SEMESTER - II
BOTANY PAPER – 2005

SKILL BASED ELECTIVE PAPER (APICULTURE)

Number of Theory Credits	Number of Lecture hours/semester	Number of Practical Credits	Number of Practical hours/semester
2	30	-	-

UNIT 1	Introduction	15 Hours
	➢ Apis classification and taxonomy & Honey bees anatomy and physiology. ➢ -Identify different types of bees ➢ -Different species of bees ➢ -Life span of different bees ➢ -Different roles played by different types of honey bee ➢ -Different castes of bees and their role in colony ➢ -Life cycle of different types of bees ➢ - Communication method used by bees ➢ -Summer management. ➢ -Autumn and winter management. ➢ -Grafting larvae and rearing new queens. ➢ -Diseases, pests and predators of honey bees.	
UNIT 2	Harvesting and Processing of Honey	15 Hours
	➢ -Time of Harvesting ➢ -Method of harvesting - Identify and use the tools/equipment required for harvesting. ➢ Extraction of honey. ➢ -Harvest Royal Jelly, Propolis, Pollen and Bee venom ➢ - Storage and Packing.	
UNIT 3	Bee keeping system	15 hours
	➢ - Familiarize with the bee-keeping system ➢ - Tools/equipment required for the bee keeping ➢ - Factors to be considered for site selection	

	➢ - Select site for hive installation ➢ -Manage the Colonies of Bee ➢ - Perform the inspection of Colonies ➢ - Register and Insure bee-keeping unit ➢ - Maintain record ➢ - Study the migration of bee colonies	

References:

1 .The Beekeeper's Handbook (4 th Edition) By Diana Sammataro & Alphonse Avitabile

2. The Backyard Beekeeper, 4th Edition: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden.

3.The Practical Beekeeper: Beekeeping Naturally By Michael Bush.

4. Top-Bar Beekeeping: Organic Practices for Honeybee Health By Les crowder & Healther Harrl.

5. Beekeeping & A seasonal guide By Ron Brown.

	PART A : BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS & PALEOBOTANY	**60 Hours**
	Content of Practical Course : List of Experiments to be conducted	
Practical :1	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Plagiochasma.***	
Practical :2	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Pellia***	
Practical :3	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Anthoceros.***	
Practical :4	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Notothylus***	
Practical :5	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Bryum/Funaria (as per availability)***	
Practical :6	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Pogonatum***	
Practical :7	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Psilotum***	
Practical :8	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Lycopodium***	
Practical :9	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Isoetes***	
Practical :10	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Adiantum***	
Practical :11	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Salvinia***	
Practical :12	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Ophioglossum***	
Practical :13	Study of morphology, classification, reproduction and life-cycle of ***Pteris/Dryopteris (as per availability)***	
Practical :14	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Pinus***	
Practical :15	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Taxus***	
Practical :16	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Zamia***	
Practical: 17	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Thuja***	
Practical: 18	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Ginkgo***	
Practical: 19	Study of morphology, classification, reproduction using preserved specimen and permanent slides of ***Gnetum***	
Practical: 20	Palaebotany: Study of following fossils as per availability:	

	1. Rhynia 2. Calamites 3. Sphenophyllum 4. Lyginopteris 5. Stigmaria 6. Pterophyllum	

	PART B : PLANT ANATOMY AND EMBRYOLOGY	**60 Hours**
	Content of Practical Course : List of Experiments to be conducted	
Practical 1	To study different types of stomata from the given plant material	
Practical 2	To study different types of hairs/trichomes from the given plant material.	
Practical 3	To prepare permanent slides from given stems by double staining methods (Secondary growth)	
Practical 4	To prepare permanent slides from given stems by double staining methods (Anomalous Secondary growth)-***Nyctanthes***	
Practical 5	To prepare permanent slides from given stems by double staining methods (Anomalous Secondary growth)-***Salvadora***	
Practical 6	To prepare permanent slides from given stems by double staining methods (Anomalous Secondary growth)- ***Tinospora***	
Practical 7	To prepare permanent slides from given stems by double staining methods (Anomalous Secondary growth)-***Boerhavia***	
Practical 8	Study of various types of Xylem Elements in wood by maceration techniques	
Practical 9	To study heartwood and sapwood using specimen or charts	
Practical 10	To study ring porous and diffuse porous wood from slide or charts	
Practical 11	To study Autumnwood and Spring wood using specimen or charts	
Practical 12	Histochemical study to find out various metabolites like Starch,Lipid, Suberin,Tenin,Lignin	
Practical 13	Study of Raphides, Spheraphides,Cystolith in the plants.	
Practical 14	To study latex gland, latex cells, Oil gland, Lipids, Resin ducts of plants.	
Practical 15	To study Pollen morphology of different families	
Practical 16	To measure the pollen and pollen tube using micrometry	
Practical 17	To study effect of time on pollen germination.	
Practical 18	To study effect of concentration on pollen germination.	
Practical 19	Study of type of seed germination (Epigeal, Hypogeal, Parageal) through Charts.	

Practical 20	To study the methods of enhancing seed germination using Mechanical Scarification.	

	PART C : BIOSTATISTICS, INSTRUMENTATION AND TECHNIQUES	
	Content of Practical Course : List of Experiments to be conducted	**60 Hours**
Practical 1	To prepare Histograms, Bar Charts, Pie Charts and Venn Diagram of the given data.	
Practical 2	To solve statistical problems based on measures of central tendency (mean, median and mode) and interpret your results.	
Practical 3	To solve the statistical problems based on measure of dispersion (Standard Deviation, Variance) and interpret your results.	
Practical 4	To calculate range and coefficient of variation (CV) of the given data and interpret your results.	
Practical 5	To perform test of significance using T-Test and interpret your results.	
Practical 6	To perform test of significance using Chi Square Test and interpret your results.	
Practical 7	To perform test of significance based on Analysis of Variance (ANOVA) and interpret your results.	
Practical 8	To calculate Person correlation coefficient of the given problem and interpret your results.	
Practical 9	To perform TLC of Amino acids and given samples and interpret your results.	
Practical 10	To perform TLC of Sugars and given samples and interpret your results.	
Practical 11	To perform TLC of plant pigments and given samples and interpret your results.	
Practical 12	To prepare standard curve of Protein using UV-VIS Spectrophotometer and estimate the concentration of the given samples using standard curve	
Practical 13	To estimate Chlorophyll content of the given plant samples using Photometry.	
Practical 14	To estimate Sugar content of the given sample using Spectrophotometer .	
Practical 15	To study following techniques using photographs/Charts with reference to its Principle, Working, Parts and Application: a. Column Chromatography, b. Ion Exchange Chromatography, c. Molecular Sieve Chromatography	
Practical 16	To study HPLC using Photographs/Charts (Principle, Working, Parts and Application)	
Practical 17	To study Centrifuge using Photographs/Charts (Principle, Working, Parts and Application)	
Practical 18	To study Mass Spectrophotometer using Photographs/Charts (Principle, Working, Parts and Application)	
Practical 19	To study AGE using Photographs/Charts (Principle, Working, Parts and Application)	
Practical 20	To study PAGE using Photographs/Charts (Principle, Working, Parts and Application)	

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BOTANY PAPER – 3001

PLANT PHYSIOLOGY

BOT - 3001 :	PLANT PHYSIOLOGY	60 hours	(4 credits)

UNIT 1	PLANT WATER RELATIONS	15 Hours
	➢ Water: 1. Sources and Functions 2. Physicochemical properties of water ➢ Absorption of water and minerals 1. Water uptake by root 2. Xylem and phloem transport 3. Passive and active transport 4. The cohesion theory ➢ Transpiration and stomatal movements	
UNIT 2	PHOTOSYNTHESIS	15 Hours
	➢ History ➢ Photosynthetic pigments ➢ Mechanism of photosynthesis • Bacterial Photosynthesis • Plant PhotoSynthesis 1. Light reaction a. PS-I and PS-II b. Photo-oxidation of water c. Production of assimilatory powers 2. Dark reaction 3. C4 Cycle 4. CAM Cycle 5. Photorespiration ➢ Factor affecting the rate of photosynthesis	
UNIT 3	RESPIRATION	15 hours
	➢ History and types ➢ Mechanism 1. Glycolysis 2. Krebs cycle	

	3. ETS ➢ Factors affecting respiration ➢ Anaerobic respiration	
UNIT 4	PHYSIOLOGY OF FLOWERING AND DORMANCY	15 hours
	➢ Photoperiodism – 1. Classification of plants based on Photoperiodic responses 2. Photoperiodic induction 3. Phytochromes and flowering ➢ Vernalization - 1. Mechanism, Physiological maturity of plants and vernalization 2. Technique and Application of vernalization 3. Devernalization ➢ Dormancy - 1. Types 2. Bud Dormancy 3. Seed Dormancy 4. Factors causing seed dormancy 5. Mechanism of dormancy 6. Methods of breaking dormancy	

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5. Hidde Ploegh, Paul Matsudaira (2007). Molecular cell biology (VI Edn). W H Freeman &Company.
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7. Plant physiology by Robert M Devlin; Affiliated East–west Press Pvt Ltd.
8. Text book of Plant Physiology by P. L. Kochhar and A.C. Joshi; Atma Ram and Sons
9. Pant Physiology by R.C. Grewal; Campus books international
10. An Introduction to Plant Physiology by W. O. James; Oxford university press.
11. Plant Physiology by S. N. Pandey and B. K. Sinha; Vikas publishing house Pvt Ltd. 22
12. Fundamentals of Plant Physiology by V. K. Jain; S. Chand and company ltd.
13. Advance in Plant Physiology Vol I, II and III by A. Hemantaranjan; Scientific Publishers

14. Plant Physiology by Salisbury and Ross; Prentice/Hall of India Pvt. Ltd.
15. Physiology of plant growth and development by M. B. Wilkins; Tata McGrew-Hill
16. Bewley, J.D. and Black. M. 1994 Seeds : Physiology of development and germination. Plenum Press, New Yor.
17. Bendre, A. and Kumar, 2004 A. Rastogi pub. Meerut, India.
18. Crocker, W. and Barton V.1953 Physiology of seeds. Waltham, Mass, U.S.A
19. G. Ray Naggle, Grorge J. Fritz- Introductory Plant Physiology
20. Plant physiology by S. Sundara Rajan, 2000

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BOTANY PAPER – 3002

PLANT ECOLOGY AND CONSERVATION

BOT - 3002 :	PLANT ECOLOGY AND CONSERVATION	60 hours	(4 credits)

UNIT 1	CONCEPT OF ECOSYSTEM	15 Hours
	➢ Types–Fresh water, marine and terrestrial ➢ Components of Ecosystem ➢ Food chain and food web ➢ Ecological pyramids ➢ Energy Flow in Ecosystem ➢ Development and evolution of ecosystems ➢ Structure and functions of Ecosystem ➢ Primary production ➢ Litter fall and decomposition ➢ Global biogeochemical cycle C, N, P and S	
UNIT 2	PLANT COMMUNITY	15 Hours
	➢ Composition and Structure of Plant Community ➢ Qualitative and Quantitative Characteristics ➢ Classification of communities ➢ Methods of study of communities-Floristic, physiognomic and phyto-sociological methods ➢ Ecological Succession, Process, Models and Climax Stage of Hydrosere, Xerosere and causes of Succession	
UNIT 3	ECOLOGICAL LEVEL AND BIOLOGICAL DIVERSITY	15 hours
	➢ Population ecology ➢ Ecological Niche ➢ Autecology	

	➢ Biological clock ➢ Mortality ➢ Natality ➢ Role of biodiversity in ecosystem functions and stability ➢ IUCN categories of threat ➢ Biodiversity hot spots ➢ Ecology of plant invasion ➢ IUCN Red data book	
UNIT 4	CONSERVATION	15 hours
	➢ Conservation of Ecosystem ; In-situ and Ex-situ conservation ➢ Environmental Issues Climate Change ➢ Greenhouse gases (CFCs, CH_4, CO_2, N_2O, sources and role) ➢ Ozone depletion and climate change (Global warming, CO_2 fertilization, Sea level rise, UV radiationetc.) ➢ Sustainable development, Bioremediation, Phytoremediation, conservation and management strategies	

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2. Barbour, M.G., Pits, W.D., and Burk, J. H. (1967) Terrestrial Plant Ecology, Addison-WesleyPublisher.
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BOTANY PAPER – 3003 (Special Elective Paper)

PHYTOMORPHOLOGY

BOT - 3003 :	PHYTOMORPHOLOGY	60 hours	(4 credits)

UNIT 1	VEGETATIVE MORPHOLOGY	15 Hours
	➢ Root System, parts of root, its Modification & Function ➢ Stem System, types of stems, its Modification and functions ➢ Leaf: Structure and types, forms (shape & Margin) Types of venation, Types of stipules, Phyllotaxy, Modification & functions	
UNIT 2	MORPHOLOGY OF REPRODUCTIVE PARTS - I	15 Hours
	➢ Bracts ➢ Aestivation ➢ Inflorescence	
UNIT 3	MORPHOLOGY OF REPRODUCTIVE PARTS - II	15 hours
	➢ Flower: a. Parts of a typical flower: Bract, Pedicel, Thalamus-forms, Perianth-Calyx and Corolla, Androecium & Gynoecium b. Symmetry: Actinomorphic and Zygomorphic, Sexuality-Unisexual and Bisexual, Insertion of Floral whorls on thalamus-Hypogyny, Epigyny and Perigyny, Merous Condition-Trimerous, tetramerous and Pentamerous. ➢ Placentation, Types of Placentation	
UNIT 4	PLANT TAXONOMY	15 hours
	➢ History of Taxonomy and Objective ➢ Classification Systems- Artificial, Natural, Numerical and Phylogenetic ➢ APG System of Classification, Numerical taxonomy ➢ Plant Nomenclature, Nomenclature codes ➢ Classification as per Bentham and Hooker, general Characters.	

	Distinguishing Characters and economic and medicinal importance of the following families: ➢ **Nymphiaceae** ➢ **Capparidaceae** ➢ **Ocnaceae** ➢ **Meliaceae** ➢ **Cactaceae** ➢ **Plumbaginaceae** ➢ **Solanaceae** ➢ **Pedaliaceae** ➢ **Amaranthaceae** ➢ **Aristolochiaceae** ➢ **Cannaceae** ➢ **Iridaceae**	

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1. **Plant Classification by Benson, L. B.; D. C. Health Comp.**
2. **Plant Taxonomy by Benson L. B. ; Ronald Press**
3. **Evolution and classification of Flowering plants by Cronquist A.; Nelson New York**
4. **Principles of Angiosperm Taxonomy by Devis P. H. And V. M. Heywood; Oliver and Boyd,Edinburgh**
5. **Families of flowering plants by Gunderson A.; ELBS series**
6. **The families of flowering plants Vol-I- Dicotyledon and Vol-IIMonocotyledon by Hutchinson J.;Oxford University Press**
7. **College Botany Vol-III by Mukerjee S.K. ; New central Book Agency**
8. **An Introduction to plant Taxonomy by Jeffrey C.; Oxford university press**
9. **Plant Classification by Benson, L. B; D. C. Health Comp.**
10. **Plant Taxonomy by Benson L. B. ; Ronald Press**
11. **Plant taxonomy by Core E. L.; Prentice-hall Engle-wood Cliff .**
12. **Evolution and classification of Flowering plants by Cronquist A.; Nelson New York**
13. **Principles of Angiosperm Taxonomy by Devis P. H. And V. M. Heywood; Oliver and Boyd,Edinburgh**
14. **Families of flowering plants by Gunderson A.; ELBS series**
15. **The families of flowering plants Vol-I- Dicotyledon and Vol-II Monocotyledon by Hutchinson J.;Oxford University Press**

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BOTANY PAPER – 3003 (Special Elective Paper)

PLANT TISSUE CULTURE

BOT - 3003 :	PLANT TISSUE CULTURE	60 hours	(4 credits)

UNIT 1		15 Hours
	INTRODUCTION TO PLANT TISSUE CULTURE: Definition, brief history, principle and significance of tissue culture; Cellular totipotency – Totipotency of cells, Cytodifferentiation (differentiation and dedifferentiation, redifferentiation); factors affecting vascular tissue differentiation, cell cycle and TE differentiation. Organogenic Differentiation: induction, factors affecting shoot bud differentiation. LABORATORY ORGANIZATION: Design and layout for wash area, media preparation, sterilization and storage room, transfer area for aseptic manipulations, Culture rooms, and observation/data collection areas. Labwares, Good laboratory practices, good safety practices. INSTRUMENTATION: Working principle, maintenance and management of following instruments: Laminar air flow, autoclave, distillation unit, pH meter, orbital shaker, microscope, deep freezer, Importance of growth chamber	
UNIT 2		15 Hours
	TISSUE CULTURE MEDIA: Introduction, Types of Media and its importance; Preparation of stocks, pH and Buffers and their significance in media. Media Constituents (Vitamins, Unidentified supplements, carbohydrate for energy source, Nitrogen source and organic supplements, complex substances, hormones, Activated charcoal) Methodology - sterilization (physical and chemical methods), culture media, Murashige and Skoog's (MS medium).	

	PLANT HORMONES: Role of Plant hormones (auxins, cytokinins, abscissic acid, ethylene and Gibberellins) in plant development.	
UNIT 3		**15 hours**
	MICROPROPAGATION CULTURE TECHNIQUES: **Callus Culture Techniques- Introduction, principle, protocol, morphology and internal structure, genetic variations, applications. Organogenesis- Introduction, principle, protocol, applications.** **Organ Culture Technique- Introduction, principle, protocol, applications, with respect to roottip culture, leaf culture, ovary and ovule culture.** **Anther & Pollen Culture Technique- Introduction, principle, protocol, factors affecting, Applications** **Endosperm & Embryo culture Techniques -culture requirements, applications, embryo rescue technique.**	
UNIT 4		**15 hours**
	APPLICATIONS OF TISSUE CULTURE TECHNIQUES **Suspension Culture Technique- Introduction, principle, protocol, types, growth measurement, viability test, synchronization, applications. Production of secondary metabolites.** **Plant Protoplast Culture and Fusion: History, Principle, protocol for isolation- Mechanical and Enzymatic, protoplast culture methods, viability test Applications** **Somatic embryogenesis - Process of somatic embryogenesis, structure, stages of embryo development, factors affecting embryogenesis; production of artificial seeds; Cryopreservation** **Somaclonal Variation- Introduction, terminology, origin, selection at plant level, selection at cell level, mechanism, assessment, applications and limitations. somaclonal variations for Biotic & Abiotic stress. Cryopreservation; Germ plasm conservation.**	

REFERENCES:

1. **H.S. Chawla Introduction to Plant Biotechnology, Science Publisher, Inc.**
2. **U Kumar Methods in Plant Tissue Culture, Agro-Botanica.**
3. **S.S. Bhojwani, M.K. Razdan Plant Tissue Culture: Theory and Practice, Elsevier Science.**

4. Kalyan Kumar De. An Introduction to Plant Culture. New Central Book Agency.
5. P.V.G.K Sarma Molecular Biology: A Practical Manual. MJP Publishers.
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BOTANY PAPER – 3003

STRESS PHYSIOLOGY AND PLANT MICROBIOME INTERACTION

BOT – 3003 :	STRESS PHYSIOLOGY AND PLANT MICROBIOME INTERACTION	60 hours	(4 credits)

UNIT 1	STRESS PHYSIOLOGY	15 Hours
	• Water Stress: Effect on Membrane, Stomatal Response, Role of ABA, Effect on Photosynthesis, Osmotic Adjustment, Mechanism of Draught tolerance. • Temperature Stress: Effects on germination and plant productivity, Mechanism of low temperature tolerance, Heat stress, Cellular responses to high temperature: enzyme activities, photosynthesis, ultra structural effects, Molecular responses to high temperature, Heat shock proteins, High temperature tolerance mechanisms.	
UNIT 2	METAL STRESS AND SALT TOLERANCE	15 Hours
	• Metal toxicity and tolerance (Aluminum, Manganese, Iron, Zinc), Phytochelations, Differential plant tolerance to heavy metals, Allelochemicals and its effect. • Effect of high salt concentration (water stress, nutrient ion deficiency, ion toxicity), Regulation of salt content – Salt exclusion, salt elimination, salt succulency, Mechanism of salt resistance and tolerance. • Ultra violet – B: Plant response to UV radiation, Effect of UV-B on chemical composition, Effect of UV-B radiation on photosynthesis, UVB defense and gene expression.	
UNIT 3	PLANT MICROBIOME INTERACTION	15 hours
	• Role of microorganisms in Nitrogen, Carbon, Phosphorus, Sulphur and Iron cycles.	

	• Biological Nitrogen Fixers- Symbiotic and free-living nitrogen fixers- physiology and genetics of nitrogen fixers. • Phosphate solubilizers. • Biofertilizers- PGPR, Mycorrhiza, *Rhizobium, phosphobacteria, Frankia, Azototobacter, Azospirillum.*	
UNIT 4	PHYTOPATHOGENS AND BIOCONTROL	15 hours
	• Phytopahtogens – Bacterial, fungal, Viral diseases (Wilt, Blight, Canker, Mosaic, rot) • Microbial control of pests and diseases- Biopesticides (*B. thuringensis, B. popilliae, B. spherius, Pasteuria penetrans*, BGA), Biocontrol- *Trichoderma, P. fluorescens.*	

REFERENCES:

- Doby, G.: Plant Biochemistry. Inter Science Publishers, New York
- Lehninger, A. L., D. L. Nelson and M. M. Cox 2000: Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.
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- Hopkins, W. G., Introduction to Plant Physiology. 3rd Edition. John Wiley & Sons, New York.
- Salisbury, F. B. and Ross, C. W., Plant Physiology, 4th Edition. Wadsworth Publishing Company, California.
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BOTANY PAPER – 3003

BIOINFORMATICS

BOT - 3003 :	BIOINFORMATICS	60 hours	(4 credits)

UNIT 1	INTRODUCTION TO BIOINFORMTICS	15 Hours
	➢ Definition, Scope and Branches of Bioinformatics ➢ INSDC and its significance ➢ LOGICAL DATABASES	
UNIT 2	BIOLOGICAL DATABASES	15 Hours
	➢ NCBI ➢ DDBJ, ➢ SWISS PROT, ➢ PIR	
UNIT 3		15 hours
	➢ NCBI-DATABASES AND RESOURCES (BLAST, ORF FINDER) ➢ PAIRWISE SEQUENCE ALIGNMENT	
UNIT 4		15 hours
	➢ MULTIPLE SEQUENCE ALIGNMENT ➢ GLOBAL ALIGNMENT ➢ LOCAL ALIGNMENT ➢ PHYLOGENETIC TREE, TYPES AND THEIR COMPARATIVE APPLICATION.	

REFERENCES:

1. Bio-informatics by M. N. Ranga; Agrobios

2. James D. Tisdall, Beginning Perl for Bioinformatics, 2001, O'REILLY

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BOTANY PAPER – 3004

PHYTOGEOGRAPHY, PLANT FOR HUMAN WELFARE AND PLANT BREEDING

BOT - 3004 :	PHYTOGEOGRAPHY, PLANT FOR HUMAN WELFARE AND PLANT BREEDING	60 hours	(4 credits)

UNIT 1	**PHYTOGEOGRAPHY**	**15 Hours**
	➢ Main forest types of India and their floristic composition ➢ Different forest of Gujarat and their vegetation ➢ Social forestry and Agroforestry ➢ Major and minor forest products of India and Gujarat	
UNIT 2	**PLANT FOR HUMAN WELFARE – I**	**15 Hours**
	➢ Medicinal plants: Importance of medicinal plants- role in human health care ➢ Traditional knowledge and utility of some common medicinal plants – *Jatropha curcus, Mentha piperita, Michelia champaca, Mucuna prurens, Oroxylum indicum, Putranjiva roxburghii, Tecomella undulata, Buchanania lanzam, Dillenia indica, Dioscorea bulbifera and Euphorbia hirta* ➢ Common timber yielding plants ➢ Insecticides from plants	
UNIT 3	**PLANT FOR HUMAN WELFARE – II**	**15 hours**
	➢ Nutritive and medicinal value of some fruits and vegetables (Guava, Sapota, Orange, Mango, Banana, Lemon,Pomegranate) ➢ Beverages (Coffee, Tea, Chocolate) ➢ Common ornamental plants ➢ Bonsai General account of dyes, tannins, gums and resins	

UNIT 4	PLANT BREEDING	15 hours
	➢ History and Objective of plant breeding ➢ Application and methods and steps' of plant breeding ➢ Importance of plant breeding ➢ Self-pollinated and cross pollinated crops.	

REFERENCES:

- Chopra, V.L. (2001) Plant Breeding: Field Crops. Oxford IBH Pvt.Ltd. New Delhi
- Chopra, V.L. (2001) Plant Breeding: Theory and Practice. Oxford IBH Pvt.Ltd. New Delhi.
- Ecology and Environment by P. D. Sharma; Rastogi publication
- Plant Ecology and Phytogeography by V. Kumaresan; Saaras publication
- Indian medicinal Plants 3 Vol by Kirtikar , K. R. And Basu B.D.
- Directory of Economic Plants in india by Maheshwari P. And Singh U. ; ICAR New Delhi
- Economic Botany by Bendre and Kumar ; Ratogi Publications
- Ecology of plants by Eug Warming; Biotech Books
- Text book of Plant Ecology by R. S. Ambasht; Student' friends and co
- A text book of Plant Geography of India by Bharuch; Oxford University Press Ltd.
- Plant Geography of flowering plants by Good R; Longmans , Green and Co
- Manual of Indian Forester by Bor N. L. ; Oxford University Press
- Indigenous drugs of India by Chopra R. N. ; Manager of Publications
- Glossary of Indian Medicinal plants by Chopra R. N. ; CSIR
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BOTANY PAPER – 3005

SKILL BASED ELECTIVE PAPER (FLORICULTURE)

BOT - 3005 :	FLORICULTURE	30 hours	(2 credits)

UNIT 1	**FUNDAMENTALS OF FLORICULTURE, VALUE ADDITION, POST HARVEST MANAGEMENT**	10 Hours
	➢ Importance and scope of floriculture (global trade and global scenario of cut and loose flower production) ➢ Breeding techniques: Handling of soils, nursery preparation and management, Propagation methods. ➢ Value addition - Types of value added products, value addition in loose and cut flowers, Techniques in dry flower making, Designing and arrangement of dry flowers ➢ Post harvest management: Packing and storage; Concrete and essential oils; Selection of species and varieties (including non-conventional species), extraction methods, Packing and storage, Selection of species and varieties, Types of pigments, carotenoids, anthocyanin, chlorophyll, betalains; Significance of natural pigments, Extraction methods; Applications.	
UNIT 2	**PRODUCTION TECHNOLOGY FOR CUT & LOOSE FLOWERS.**	10 Hours
	➢ Nursery management, soil requirements, artificial growing media, soil decontamination techniques, planting methods, influence of environmental parameters, water and nutrient management, fustigation, weed management, pruning and other techniques, use of growth regulators, physiological disorders and remedies, ➢ Cut & loose flowers: standards and grades, harvest indices, harvesting techniques, post-harvest handling, Crops: Cut rose, cut chrysanthemum, carnation, gerbera, gladioli, tuberose, orchids, anthodium, aster, lilies, bird of paradise, helicon, alstroemeria, alpinia, ornamental ginger, bromeliads, dahlia, gypsophilla,	

	limonium, statice, stock, cut foliages. ➢ Jasmine, scented rose, chrysanthemum, marigold, tuberose,crossandra, nerium, hibiscus, barleria, celosia, gomphrena, non-traditional flowers (Nyctanthes, Tabernaemontana, ixora, lotus, lilies, tecoma, champaka, pandanus).	
UNIT 3	PROTECTED FLORICULTURE	10 hours
	➢ Types of protected structures – Greenhouses, polyhouses, shade houses, rain shelters etc. ➢ Designing and erection of protected structures; Low cost/Medium cost/High cost structures –economics of cultivation ➢ Location specific designs; Structural components; Suitable flower crops for protected cultivation ➢ Environment control – management and manipulation of temperature, light, humidity, air and CO 2	

REFERENCES:

1. A Handbook on Floriculture and Land Scaping. By K.Vasanthakumar.

2. Floriculture ornamental and plant Biotechnology Volume-V By Jaime A.

3. Floriculture & Landscaping By Naya Udyog,T.K.Bose

4. Textbook of Floriculture & Landscaping By Anil K. Singh

5. Flower crops By A.K.Singh

BOTANY PRACTICAL - 3006

BOT - 3006 : 180 Hours (6 credits)

- The candidates should study the typical vegetation in natural condition and should recordtheir observation in journals. Excursion should be arranged during the year to local places.
- Every candidate shall complete laboratory course in accordance with the regulations issuedfrom time to time by Academic Council on the recommendation of the Board of Studies.
- Every candidate shall record observation directly in the laboratory journal. Every journal shall be signed periodically. At the end of the semester candidate shall produce certified journal during the practical examination.

PART A (PLANT PHYSIOLOGY) : (60 Hours)

- Preparation of different kind of solutions (Normal, Molar, Percentage and ppm).
- Effects of different light on rate of photosynthesis.
- Isolation and estimation of Photosynthetic pigments.
- TLC for plant secondary metabolites.
- Estimation of Curcumin content in a given plant sample.
- Estimation of Total Alkaloid content in Tobacco leaves.
- Determination of saponification value of Oil.
- Estimation of sugar from the given sample.
- Protein estimation from the given sample.
- Isolation and estimation of total amino acid from plant sample.
- Estimation of Ascorbic acid from the given sample.
- Study of following Physiological instruments.

  1. Colorimeter 2. Spectrophotometer 3. pH meter 4. Flame photometer

- Demonstration of following Physiology Experiment.

  1. Comparison of the photosynthesis and respiration processes.
  2. Demonstration of 'Ascent of sap'.
  3. CO_2 release during aerobic respiration.

4. **Demonstration of rate of transpiration.**
5. **Dye reduction by isolated chloroplast.**

PART B (PLANT ECOLOGY AND CONSERVATION) (60 hours)

- **Water analysis**
  1. **Determination of COD from the given water sample.**
  2. **Determination of BOD from the given water sample.**
  3. **Determination of TDS from the given water sample.**
  4. **Determination of TSS from the given water sample.**
- **Soil analysis**
  1. **Determination of pH and conductivity from the given soil sample.**
  2. **Determination of the water holding capacity of the soil.**
  3. **Test for the presence of carbonate, nitrate deficiency of replaceable bases.**
  4. **Test for the presence of inorganic salts in the Soil.**
- **Study of different Ecological instruments.**

  1. Sling-psychrometer 2. Soil thermometer 3. Turbidity meter 4. Anemometer 5. Rainguage 6. Hygro-Thermograph
- **To study important anatomical characters of ecologically (Based on water availability in different habitats) different plant species (Hydrophytes, Mesophytes, Xerophytes, Halophytes. (Stem and Leaves)**

PART C (PHYTOMORPHOLOGY) (60 hours)

1. **To study different:**
   a. **types of roots:**
      - **Tap roots (Vinca), Fibrous Roots (Grass), Adventitious (Sugarcane),**

   b. **Modified roots:**
      - **Prop roots (Banyan tree), Stilt root (Maize), Pneumatophores (Avicennia), Storage roots (Carrot, Sweet Potato).**

2. **To study different types of stem:**
   a. **Aerial Stems- Caudex-Palms, Clums (Bamboo), Scape (Canna and Onions), Excurrent (*Polyalthia longifolia, Casuarina*), Deliquescent (Mango), Weak Stem (*Ipomoea***
   b. **Underground Stems:**
      - **Rhizome-(Ginger, turmeric), Tuber (Potato), Bulb (Onion), Corm (*Amorphophallus*).**

   c. **Specialized Stem:**
      - **Phylloclade (*Opuntia*), Cladode (*Asparagus*).**

3. **To study different types of leaf: (any of the type as per availability)**
   a. **Simple (Mango & Banana),**
   b. **Pinnate Compound Leaf-**
      i. **Unipinnate (Cassia, Rose),**
      ii. **Bipinnate –*Mimosa, Caesalpinia***
      iii. **Tripinnate *(Moringa*)**
      iv. **Decompound (*Coriander*)**

   c. **Palmately Compound Leaf-**
      i. **Unifoliate (*Citrus*),**
      ii. **Bifoliate (Balanites, Bauhinia),**
      iii. **Trifoliate (*Crotalaria, Oxalis*),**
      iv. **Quadrifoliate (*Marsilea*), Mutlifoliate (*Bombax*)**

4. **To study phyllotaxy of the following type:**
   - **Alternate: *Hibiscus***
   - **Opposite Superpose: *Quisqualis indica***
   - **Opposite Decussate: *Calotropis***
   - **Verticillate or Whorled: *Ocimum***

5. **To study Flower: (any of the type as per availability)**
   - **Regular Flower-*Ipomoea***
   - **Irregular Flower-*Clitoria, Caesalpinia***
   - **Unisexual Flower-*Coccinia***
   - **Bisexual Flower-*Hibiscus***

6. **To study type inflorescence of the following: (any one of each)**

   A. Racemose:

   a. Raceme: Caesalpinia pulcherrima, Brassica juncea

   b.* Spike: *Achyranthes aspera, Polianthes tuberosa

   c.* Spadix: *Colocasia

   d.* Catkin: *Acalphya hispida

   e.* Corymb: *Cassia, Ixora

   f.* Umbel: *Coriandrum

   g.* Capitate: *Acacia, Albizzia

   h.* Capitulum: *Helianthus, Tridax

   B. Cymose:

   - **Unbranched**
     a. **Solitary Terminal: *Datura***
     b. **Solitary Axillary: *Hibiscus***
   - **Branched**
     a. **Helicoid: *Hemellia patens***
     b. **Scorpoid: *Heliotropium***
     c. **Dichasial or Biparous: *Clerodendrum, Nyctanthes, Jasminum***
     d. **Polychasial or Multipaorus: *Nerium, Calotropis***

7. **To study the following morphology from the fresh/preserved specimens**
   a) **Types of Aestivations : Valvate, Twisted, Imbricate, Quincuncial, Vexillary.**
   b) **Types of Placentation : Marginal, Axile, Free central, Parital, Basal, Superficial.**

8. **Study of morphological characters, floral dissection, T.S of ovary, floral formula, floral dissection and classification as per Bentham and Hooker of following family (As availability plants from local area.)**
   - **Nymphiaceae**
   - **Capparidaceae**
   - **Ocnaceae**

- **Meliaceae**
- **Cactaceae**
- **Plumbaginaceae**
- **Solanaceae**
- **Pedaliaceae**
- **Amaranthaceae**
- **Aristolochiaceae**
- **Cannaceae**
- **Iridaceae**

OR

PART C (PLANT TISSUE CULTURE) (60 hours)

1. **Aseptic techniques – Study of methods of sterilization**
   A) Moist heat sterilization B) Dry heat sterilization C) Filter sterilization
   Study of surface sterilization of Laminar flow & explant.
2. **Media preparation –**
   Preparation of M.S. stock solutions: (A) Macro-salt (B) Micro-salt (C) Vitamin
3. **Importance of pH in tissue culture (Use different pH levels)**
4. **To study the importance of hormones on growth in Plant tissue culture.**
5. **Micropropagation via different explants (Leaf, Node, Internode, Shoot tip)**
6. **Micropropagation via Anther/Pollen/Embryo culture Technique.**
7. **To prepare artificial seed.**
8. **Isolation and viability study of protoplast by mechanical and enzymatic method**
9. **To study Protoplasmic fusion.**
10. **Isolation of genomic DNA from plant and tissue culture plant with spectroscopic quantification for concentration and purity.**

OR

PART C (PLANT STRESS BIOLOGY) (60 hours)

1. **Stomatal response of plants to water stress.**
2. **Measuring Plant Stress with an Infrared Thermometer.**
3. **Identification of metal stresses in seed germinaiton.**
4. **Detect Stress by Measuring Photosynthesis**
5. **Screening plants for salt tolerance by measuring Na+ and K+ contents by a flame photometer.**
6. **Isolate rhizospheric microorganisms (bacteria and fungus).**
7. **Staining and observation of isolated bacteria and fungus.**
8. **Isolation of Phosphate solubilizing microorganism form soil sample on Pikovski medium.**
9. **Isolation of Nitrogen fixing microorganism form soil sample on Ashby's medium.**
10. **Isolation of *Bacillus thuringensis* from soil sample and endospore staining.**
11. **Isolation of Siderophore producing bacteria on Kings B medium.**
12. **Assessment of heavy metal tolerance in plant.**
13. **Observe algae in coralloid roots of *Cycas*.**

OR

PART C (BIOINFORMATICS) (60 hours)

1. To visit the NCBI database website and enlist its major databases and resource with URL.

2. To visit the EMBL database website and enlist its major databases and resource with URL.

3. To visit the DDBJ database website and enlist its major databases and resource with URL.

4. To visit the SWISS PROT and PIR database website and enlist its major databases and resource with URL.

5. To prepare DNA sequence of the given gene family using nr/nt database.

6. To prepare AMINO ACID sequence of the given PROTEIN using Genpept database

7. To prepare FASTA formatted file for various genes and mRNA sequences.

8. To identify and locate ORFs on a given DNA Sequence/Contig.

9. To identify and characterize given DNA sequences using BLAST programs.

10. To identify and characterize given PROTEIN sequences using BLAST programs

11. To prepare a MSA of the given DNA Sequence dataset and interpret your results using MEGA or CLUSTAL X or CLUSTAL OMEGA

12. To prepare a MSA of the given PROTEIN Sequence dataset and interpret your results using MEGA or CLUSTAL X or CLUSTAL OMEGA.

13. To study synonymous and non-synonymous substitutions on a given Protein MSA data

14. To generate a NJ Tree using the given sequence data and interpret your results.

15. To generate a ML Tree using the given sequence data and interpret your results.

16. To generate a MP Tree using the given sequence data and interpret your results.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - IV

BOTANY PAPER – 4001

(Cell Biology, Genetics, Molecular Biology & Biochemistry)

(Effective from June 2023)

BOT 4001 : (Cell Biology, Genetics, Molecular Biology & Biochemistry)		
	Content of Theory Course	**60 Hours**
Unit – I :	**Cell Biology**	**15**
	a. Cell Division (Comparative Account of Mitosis and Meiosis) b. Cell Cycle and its regulation (molecular control) c. Signal Peptide Hypothesis and Protein Transport	
Unit – II :	**Genetics**	**15**
	Epistatic Gene Interaction: a. 12:3:1-Dominant gene interaction b. 9:3:4-Recessive gene interaction c. 9:6:1-Duplicate Gene with cumulative effects d. 9:7- Complimentary Gene e. 15:1-Duplicate Dominant Gene f. 13:3-Dominant and Recessive Intercation Cytoplasmic Inheritance a. Plastid Inheritance in mirabilis and maize b. Kappa Particles in Paramecium c. Coiling of Shells in snails d. Milk factor in mice Sex linked Inheritance a. Colour-blindness b. Haemophilia Mutation: a. Changes in Structure of chromosome (Deletion, Duplication, Inversion and Translocation) b. Changes in Chromosome Number (Monoploidy, Aneuploidy and Aneuploidy)	
Unit – III :	**Molecular Biology**	**15**
	a. Fine Structure of Gene b. Concept of Split genes, Exons and Introns c. RNA Splicing Mechanism	

	d. Genetic Code and its Properties e. Protein Synthesis: Initiation, Elongation and termination f. RNA Interference	
Unit – IV :	**Biochemistry**	**15**
	a. Amino Acids (Classification, Properties and Structure), b. Protein (Classification, Structures, and Function) c. Enzymes (Introduction, Nomenclature, classification, Physicochemical properties, Mechanism of Enzyme Action, Factors affecting enzyme activity	

References:

1 Smith, G.M. (1955): Cryptogamic Botany Vol. II. (2nd Edition) (Bryophytes & Pteridophytes) Tata McGraw Hill Publishing Co., New Delhi.

2 Parihar, N.S. ( ): An Introduction to embryophyta – Vol.II. Bryophyta Central Book Depot, Allahabad.

3 Watson, E.V. (1968): British Mosses & Liverworts Cambridge University Press, U.K

4 Parihar, N.S. (19) : An Introduction to Embryophyta Vol.II Pteridophyta Central Book Depot., Allahabad.

5 Smith, G.M. (1955) : Cryptogamic Botany Vol.II (2nd Edn.,) (Bryophytes & Pteridophytes) Tata McGraw Hill Publishing Co., New Delhi.

6 Sporne, K.R. (1970) : The Morphology of Pteridophytes (The Structure of Ferns and Allied Plants) Hutchinson University Library, London

7 Sharma, O.P., 2017, Algae Singh-Pande-Jain 2004-05. A Text Book of Botany. Rastogi Publication, Meerut.

8 Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New Delhi.

9 Sundarajan, S. 1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.

10 Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

11 Vanderpoorten, A. and Goffinet, B. 2009, Introduction to Bryophytes, Cambridge Unversity Press, Cambridge.

12 Stewart, W.M. 1983. Paleobotany and the Evolution of Plants, Cambridge University Cambridge.

13 Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - IV

BOTANY PAPER – 4002

SPECIAL ELECTIVE

(PLANT TAXONOMY AND SYSTEMATICS)

(Effective from June 2023)

Number of Theory Credits	Number of Lecture hours/semester	Number of Practical Credits	Number of Practical hours/semester
4	60	-	-

BOT 4002 : (PLANT TAXONOMY AND SYSTEMATICS)		
	Content of Theory Course	**60 Hours**
Unit – I :	**PLANT TAXONOMY**	**15**
	➢ Objectives, principles and Evolutionary Trends of Taxonomy ➢ Origin and evolution of Angiosperms ➢ Modern Trends in Plant Taxonomy • Morphology in Relation to Taxonomy • Anatomy in Relation to Taxonomy • Embryology in Relation to Taxonomy • Palynology in Relation to Taxonomy • Cytology in Relation to Taxonomy	
Unit – II :	**PRACTICE OF PLANT TAXONOMY**	**15**
	➢ Botanical Survey of India ➢ Botanical gardens ➢ Botanical Museum ➢ Herbarium Technique ➢ Plant identification, collection and specimen preparation	
Unit – III :	**PLANT SYSTEMATICS**	**15**
	➢ Application of DNA Hybridization Technique in Taxonomy ➢ Fossil Angiosperms ➢ Scheme to Describe a Flowering Plant ➢ Numerical Taxonomy ➢ Chemotaxonomy ➢ Serotaxonomy	
Unit – IV :	**FAMILIES**	**15**
	Study of the following families with reference to their geographical distribution, systematic position, floral variations, uses and examples. 1. Flacourtiaceae 2. Polygalaceae 3. Burseraceae 4. Ochanaceae 5. Averrhoaceae 6. Phytolaceaceae 7. Piperraceae 8. Louraceae 9. Typhaceae 10. Utricaceae 11. Bombacaceae 12. Iridaceae 13. Moringaceae 14. Dioscoreaceae	

REFERENCE:

- Plant Classification by Benson, L. B.; D. C. Health Comp.
- Plant Taxonomy by Benson L. B. ; Ronald Press
- Evolution and classification of Flowering plants by Cronquist A.; Nelson New York
- Principles of Angiosperm Taxonomy by Devis P. H. And V. M. Heywood; Oliver and Boyd, Edinburgh
- Families of flowering plants by Gunderson A.; ELBS series
- The families of flowering plants Vol-I- Dicotyledon and Vol-IIMonocotyledon by Hutchinson J.; Oxford University Press
- College Botany Vol-III by Mukerjee S.K. ; New central Book Agency
- An Introduction to plant Taxonomy by Jeffrey C.; Oxford university press
- Plant Classification by Benson, L. B; D. C. Health Comp.
- Plant Systematics by Gurcharan Singh, Oxford & IBH Publishing Co. Pvt. Ltd.
- Taxonomy of Angiosperms by V. Singh & D.K. Jain, Rastogi Publication
- Plant Taxonomy by Saxena & Saxena, Pragati Prakashan.
- Plant Taxonomy by Benson L. B. ; Ronald Press
- Plant taxonomy by Core E. L.; Prentice-hall Engle-wood Cliff .
- Evolution and classification of Flowering plants by Cronquist A.; Nelson New York
- Principles of Angiosperm Taxonomy by Devis P. H. And V. M. Heywood; Oliver and Boyd, Edinburgh
- Families of flowering plants by Gunderson A.; ELBS series
- The families of flowering plants Vol-I- Dicotyledon and Vol-II Monocotyledon by Hutchinson J.; Oxford University Press

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS FOR M.Sc. SEMESTER - IV
BOTANY PAPER – 4002
SPECIAL ELECTIVE
(PLANT BREEDING, CYTOGENETICS AND DNA SEQUENCING)
(Effective from June 2023)

BOT - 4002 :	**PLANT BREEDING, CYTOGENETICS AND DNA SEQUENCING**	**60 hours**	**(4 credits)**

UNIT 1	Plant Breeding	15 Hours
	➢ Introduction, Selection and Hybridization, Techniques of Plant Breeding: Bagging and Emasculation. ➢ Selection methods: For self-pollinated, cross pollinated and vegetatively propagated plants. ➢ Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations. ➢ Types: Mass Selection, Pure Line Selection, Pedigree and Bulk Breeding, Heterosis, Back Cross Breeding, Inbreeding Depression, Male Sterility (CMS and GMS).	
UNIT 2	Cytogenetics	15 Hours
	➢ Chromosomal Mutation and Ploidy (Aneuploidy, Euploidy and Polyploidy). ➢ Gene Mutation (Point and Frameshift). ➢ CRISPR-Cas9-a genome editing tool ➢ Chromosome banding, FISH and GISH.	
UNIT 3	DNA Sequencing	15 hours
	➢ Maxam and Gilbert Method of DNA Sequencing ➢ Sangar Method of DNA Sequencing ➢ Automated Sequencing ➢ Genome Sequencing ➢ Next Generation Sequencing	
UNIT 4	Whole Genome Sequencing	15 hours
	➢ Whole Genome Sequencing by clone contig method. ➢ □ Whole Genome Sequencing by Shotgun. ➢ □ Next Generation Sequencing technology.	

REFERENCES:

- Introductory Principles of Plant Breeding 2nd Ed., 2017 by Chaudhary R C, Oxford & IBH Publishing (ISBN: 9788120417755).
- Handbook of Genetics and Plant Breeding, publisher S K Kataria and Sons (ISBN-10: 9383992468; ISBN-13:978-9383992461).
- Key Notes on Genetics and Plant Breeding, Daya Publishing House (ISBN-10:9351246981; ISBN-13:978-9351246985).
- Principles and Procedures of Plant Breeding: Biotechnological and Conventional (2010) by G.S. Chahal (ISBN-10:8173193746; ISBN-13:978-8173193743).
- Plant Breeding Principles and Methods 12th Ed. (2022) by B.D. Singh.
- Concepts in Plant Breeding (2019) by Phundan Singh, Publisher: BRILLION Publishing (2019) (ISBN-10:9387445852; ISBN-13:978-9387445857).
- Essentials of Plant Breeding Paperback (2018) by Phundan Singh, Publisher: Kalyani Publishers (2018), (ISBN-10:9327286677; ISBN-13:978-9327286670).
- Plant Breeding by V. Kumaresan, Saras Publication (ISBN: 9788189941482).
- Plant Breeding Principles and Methods 12th Ed. (2022) by B.D. Singh, MedTech Science Press; ISBN-10:9393168067; ISBN-13:978-9393168061.
- Plant Breeding: Scientific Methodologies and Technologies by Sirohi Prashant Kumar (ISBN-13:9789351115922; ISBN-10: 9351115922).
- Plant Breeding Theory and Practice 2nd Ed. by Chopra, V.L., New India Publishing Agency by Chopra, V.L. (ISBN: 9789386546456).
- Plant Breeding: A Biometrical Approach by Darbeshwar Roy (2012) ISBN: 9788184871876.
- Principles of Genetics and Cytogenetics by Singh Mahak, V V Singh, A K Choudhary & Amit Tomar, Satish Serial Publishing House, 2022 (ISBN: 9789390660902).
- Plant Cytogenetics Breeding and Evolution (2022) by Bentlee Salinas, ED Tech Press (ISBN:97817888224l1).
- Genetics Cytogenetics, 2nd Ed., Medtech Science Press; 2023 (ISBN-10:9393168318; ISBN-13:978-9393168313).
- Cytogenetics by D. Roy, Alpha Science, 2020 (ISBN-13:9788173199257).
- Cytogenetics Hardcover, 2008 by Dr. B.S. Singh & Dr. M.P. Singy (ISBN-13:9788189304409; ISBN-10: 8189304409).
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- Genomes by T.A. Brown, 2006, Publisher: Garland Science; 3rd Ed., 2006 (ISBN-10:0815341385; ISBN-13:978-0815341383).

- Gene Cloning and DNA Analysis an Introduction 7th Ed. John Wiley, 7th Ed., (2016) (ISBN-10: 9781119072560; ISBN-13: 978-1119072560).
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- Next Generation Genome Sequencing: Towards Personalized Medicine, Editor(s): Dr. Michal Janitz, 2008, ISBN:9783527320905; ISBN:9783527625130, Wiley-VCH Verlag GmbH & Co. KGaA.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR M.Sc. SEMESTER - IV

FRAMED ACCORDING TO

NATIONAL EDUCATION POLICY (NEP) 2020 (Effective from June 2023)

SKILL BASED ELECTIVE PAPER 4003

(BONSAI AND TERRACE GARDEN)

BOT – 4003 :	BONSAI AND TERRACE GARDEN	30 hours	(2 credits)

UNIT 1	Bonsai	15 Hours
	➢ -Introduction - history, aim, scope and importance of Bonsai – ➢ -Identification and collection of suitable plants for bonsai making. ➢ -Tools, containers, wiring and preparation of media. ➢ -Training and pruning techniques in bonsai. ➢ -Irrigation, pest and disease management.	
UNIT 2	Bonsai	15 ours
	➢ -Introduction, ➢ -Method of growing bonsai ➢ -Care of bonsai ➢ -Bonsai style - formal upright, informal upright, slanting, wind-swept style, cascade shape, semi cascade style, Broom style, weeping style and Bunjin or Literate style. ➢ -Advantages of Bonsai art.	
UNIT 3	Terrace Gardening	15 hours
	➢ -Introduction ➢ -Plan of Terrace garden ➢ -Tools and equipment's required for the preparation of garden ➢ -Advantages of Terrace gardening	

References: References:

1. Ornamental Hortculture in India. ICAR Jan 1986 Chadha, K. L. and Bhattacharjee. (1986).

2. Ornamental Hortculture in India. ICAR, New Delhi.Floriculture in India. Allied publishers private limited. Jan 2004 Raj, D. (2004).

3. Floriculture at Glance. Kalyani Publisher, Ludhiyana. Randhawa, G. S. and Mukhopadhyay, A. (2010).

4 .Floriculture in India. Allied publishers private limited. New Delhi.The Art of Bonsai. Produced by Communications and Marketing, College of Agriculture and Life Sciences Jan 2015 Relf, D. (2015).

5. The Art of Bonsai. Produced by Communications and Marketing, College Agriculture and Life Sciences, Virginia Polytechnic Institute and State University.

6. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.

Paper No.	Title of paper	Type of Paper	Credit
4004	Seminar based on research paper presentation	Presentation	4
4005	Dissertation work	Presentation	10

GUIDLEINES FOR RESEARCH PAPER BASED SEMINAR & DISSERTATION THESIS

PART A. Guidelines for Seminar based on research paper presentation: (4 credits)

1. Candidate has to prepare a seminar presentation based on recently published (in the last 20 years) research papers on any topic of his/her choice under the guidance and supervision of his/her faculty and present the same to the examiner.
2. The PowerPoint presentation should not be more than 10-15 slides.
3. Candidate will be given 5-7 minutes to present his/her work.

PART B. Guidelines for Dissertation Thesis (10 credits)

1. Students (individually or in a group of 2) have to submit either a Dissertation thesis based on experimental research work based on a topic of his/her choice under the guidance and supervision of assigned faculty.
2. The Dissertation thesis must have the following:
    i. Introduction & Review of literature (with reference cited in the text)
    ii. Material and Methods (with reference cited in the text)
    iii. Results and Discussion (with reference cited in the text)
    iv. References/Bibliography
3. The thesis must be formatted in the following manner:
    i. Times New Roman
    ii. 12 Font Size
    iii. Line Spacing 1.5

iv. Character Spacing: Normal

v. Pages should be numbered

vi. Table of content displaying the chapters and page number

4. Figures and tables should be properly labeled with source credits.
5. References should be in a uniform single style such as APA or any other of their choice.
6. Dissertation thesis printing should be eco-friendly and can be spirally bound.
7. For the Dissertation presentation, the candidate has to prepare a PowerPoint presentation of not more than 10-15 slides and present his/her research work.
8. Candidate will be given 8-10 minutes to present his/her work.