



પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની લાઈફ સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે લાઈફ સાયન્સ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગત બોટની વિષય સેમેસ્ટર-૬નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજૂરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન, ૨૦૨૫ થી અમલવારી કરવાની રહે છે. લાઈફ સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.




ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૭૪૧/૨૦૨૫

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,

સરકારી પોલીટેકનિક કેમ્પસ,

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,

ખડીયા, જૂનાગઢ-૩૬૨૨૬૩

તા.૦૩/૧૧/૨૦૨૫

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન લાઈફ સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમો ચલાવતી તમામ કોલેજોના આચાર્યશ્રીઓ તરફ....

નકલ સાદર રવાના:-

- માન.કુલપતિશ્રી/ કુલસચિવશ્રીનાં અંગત સચિવશ્રી.
- પરીક્ષા નિયામકશ્રી, ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી, જૂનાગઢ

નકલ રવાના જાણ તથા યોગ્ય કાર્યવાહી અર્થે:

- સીસ્ટમ મેનેજરશ્રી, આઈ.ટી.સેલ વિભાગ (વેબસાઇટ ઉપર પ્રસિદ્ધ થવા અર્થે.)



BHAKTA KAVI NARSINH MEHTA UNIVERSITY
JUNAGADH



BOARD OF STUDIES

FACULTY OF LIFE SCIENCE

SYLLABUS FOR BOTANY (HONOURS)

PROGRAMME (SEMESTER- VI)

EFFECTIVE FROM JUNE, 2025

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors) as per NEP-2020
Faculty of Life Sciences
Effective from June 2025
Subject: Botany
SEMESTER-VI

Framed according to National Education Policy (NEP) - 2020
Under Choice Based Credit System-Semester-Grading System pattern
UG (B. Sc.) Programme in Botany
Semester-V and VI

PREAMBLE

Over the past few decades, India's higher education system has witnessed significant structural and functional transformations, resulting in both quantitative expansion and qualitative advancement. In alignment with the National Education Policy (NEP) 2020, the upgradation of undergraduate programmes plays a vital role in fostering individual and societal well-being, and in realizing the Constitutional vision of a democratic, just, culturally enriched, and humane nation committed to liberty, equality, fraternity, and justice for all.

NEP 2020 envisions a holistic and multidisciplinary education that cultivates intellectual, aesthetic, social, physical, emotional, and moral capacities in an integrated manner. Such a comprehensive approach aims to nurture well-rounded individuals equipped with critical skills and ethical sensibilities. The adoption of a learning outcome-based curriculum is central to this vision, ensuring that teaching and assessment are purposefully aligned with clear, measurable goals. Specifically, in the discipline of Botany, this framework enables educators to define and achieve targeted learning outcomes, enhancing the educational experience and effectiveness of instruction.

The curriculum template has been meticulously designed to promote integrated personality development. It provides students with exposure to core subjects, discipline-specific electives, generic electives, ability enhancement, and skill enhancement courses. Emphasis is placed on practical learning and innovative pedagogical methods, fostering essential competencies such as technical proficiency, subject-specific expertise, and communication skills. The framework outlines well-defined programme outcomes, including core knowledge, communication, critical thinking, problem-solving, analytical reasoning, research aptitude, digital literacy, teamwork, ethical awareness, and leadership readiness. Each course is introduced with specific learning outcomes to guide both instruction and evaluation.

This Learning Outcomes-Based Curriculum Framework (LOCF) for the B.Sc. (Botany/Botany Honours) programme is firmly aligned with NEP 2020. It is designed to be flexible, interdisciplinary, and holistic—representing a significant milestone in the evolution of outcome-based education.

Modern plant science represents a dynamic fusion of traditional botany with contemporary advances in biochemistry, molecular biology, and biotechnology. Research across these domains has significantly enriched our understanding and application of plant science. The growing global emphasis on biodiversity conservation has elevated the role of field botanists and taxonomists in documenting and classifying plant diversity. Innovative research tools and techniques have expanded our insight into plant development, physiology, anatomy, and ecology. Environmental challenges such as pollution and climate change underscore the urgency of equipping students with the knowledge and skills to address these issues.

In this context, a timely revision of the undergraduate Botany curriculum has been undertaken. From the outset of their academic journey, students will engage with a thoughtfully structured programme encompassing key areas such as plant diversity, physiology, molecular biology, reproduction, taxonomy,

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anatomy, ecology, economic botany, and environmental science. These components are thoughtfully distributed across six semesters to provide balanced and comprehensive coverage.

Additionally, students will gain exposure to essential laboratory and field tools that allow exploration down to the sub-cellular level. A dedicated course on tools and techniques will prepare them for advanced learning in modern plant sciences. With an emphasis on employability and entrepreneurship, applied courses offer practical experience and professional insights, enhancing students' readiness for diverse career paths.

Altogether, the curriculum is rich in academic content, well-supported by resource materials, and geared toward producing graduates who are not only knowledgeable but also skilled, adaptable, and socially responsible. A student completing this revised programme in Botany will emerge as a competent and confident botanist, well-prepared for higher education, research, or professional ventures.

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Sem No.	Sr. No.	Category of Course	Course Title	Course Level	Credit	Teaching Hrs.	SEE Marks	CCE Marks	Total Marks	Exam Duration
Sem-6	1	Major-14	Plant Biotechnology and Reproductive Biology	5.0	4T	60	50	50	100	02:00 Hours
	2	Major-15	Plant Physiology	5.0	4T	60	50	50	100	02:00 Hours
	3	Major-16	Plant Biotechnology and Reproductive Biology and Physiology	5.0	4P	120	50	50	100	05:00 Hours
	4	Minor-6	Applied Green Science	5.0	4T	60	50	50	100	02:00 Hours
				Total	16					

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Course Level	5.5	Internal Marks	50
Programme	B.Sc. (Honors)	External Marks	50
Semester	6	Practical Internal	-
Course Type	Major 14 (Theory)	Practical External	-
Course Credit	4T	Prac. Ext. Exam Time	
Teaching Hours	60 hrs.	Total	100
Course Code		Exam Duration	02:00 Hours
Course Title	PLANT BIOTECHNOLOGY AND REPRODUCTIVE BIOLOGY		

Course Objectives:

- Understand the fundamentals of plant biotechnology, genetic engineering, and reproductive biology of angiosperms.
- Develop competency in plant tissue culture techniques and gene transfer methods.
- Analyze the roles of enzymes, vectors, and processes involved in genetic manipulation.
- Evaluate the structure and function of anther walls, pollen walls, ovules, and processes like pollination and fertilization.
- Comprehend and classify polyembryony, apomixis, and address major concerns in transgenic technology.

Course Learning Outcomes: After completion of the course, the students will be able to:

- Work in agri-biotech and seed companies on crop improvement.
- Pursue higher studies or research in plant biotechnology.
- Join teaching or academic roles after qualifying exams.
- Contribute to conservation and sustainable agriculture.
- Gain skills in tissue culture, genetic engineering, and molecular biology.

Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
6	1	PLANT TISSUE CULTURE 1.1 Historical perspective; Gottlieb Haberlandt work, types of tissue culture; Composition of media (MS media). 1.2 Totipotency; Organogenesis; Embryogenesis (somatic and zygotic). 1.3 Protoplast isolation, Anther culture and Meristem culture, Artificial seeds. 1.4 Tissue culture applications: Micropropagation, Cryopreservation; Germplasm Conservation.	15

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	2	BIOTECHNOLOGY 2.1 Biotechnology: History, Karoly Ercky work (world, Kiran Majumdar Shaw (India)), Restriction Endonucleases (Types I-IV, biological role and application). 2.2 Cloning Vectors: Prokaryotic (pBR322); Eukaryotic Vectors (YAC), Techniques: Recombinant DNA, 2.3 Gene transfer: Indirect gene transfer (Agrobacterium- Ti and Ri plasmid), Direct gene transfer (Particle bombardment), selectable marker (Ampicillin & Tetracycline resistant in pBR322) and reporter genes (Luciferase, GFP). 2.4 Application of Biotechnology: Pest resistant (Bt-cotton), Transgenic crops with improved quality traits (Flavr Savr tomato, Golden Rice); Genetically Engineered Product: Humulin.	15
	3	REPRODUCTIVE BIOLOGY-I 3.1 History (Indian contributors- P. Maheshwari and B.M. Johri) and scopes of reproductive Biology. 3.2 Anther wall: Structure and its functions, Male gametophyte – microsporogenesis (PMC to microspore formation), Microgametogenesis (Pollen, wall structure, MGU (male germ unit)). 3.3 Morphological framework: NPC system, Pollen viability. 3.4 Abnormal features: Pseudomonads, polyads, massulae, pollinia.	15
	4	REPRODUCTIVE BIOLOGY-II 4.1 Structure and Types of ovule; Special structures– endothelium, obturator, aril, caruncle and hypostase. 4.2 Female gametophyte– megasporogenesis (mega spore mother cell – MMC to mega spore formation), Mega gametogenesis (Embryo sac: monosporic - Polygonum, bisporic - Allium and tetrasporic - Peperomia. 4.3 , Double fertilization, types of endosperm and its functions 4.4 Introduction; Classification; Causes and applications of Polyembryony and Apomixis.	15

Suggested Reading:

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

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Course Level	5.5	Internal Marks	50
Programme	B.Sc. (Honors)	External Marks	50
Semester	6	Practical Internal	-
Course Type	Major 15 (Theory)	Practical External	-
Course Credit	4T	Prac. Ext. Exam Time	
Teaching Hours	60 hrs.	Total	100
Course Code		Exam Duration	02:00 Hours
Course Title	PLANT PHYSIOLOGY		

Course Objectives:

- Understand water relations and mineral nutrition in plants.
- Explain ion transport, sugar translocation, and plant growth regulators.
- Describe photosynthesis pathways and influencing factors.
- Understand respiration processes and energy metabolism in plants.
- Analyze metabolic regulation, biosynthesis, and nitrogen fixation.

Course Learning Outcomes: After completion of the course, the students will be able to:

- Understand the functional mechanisms of plant systems, including water transport, photosynthesis, and respiration.
- Gain insights into nutrient uptake, hormone regulation, and stress responses in plants.
- Develop skills to analyze metabolic pathways and energy flow within plant cells.
- Apply knowledge to improve crop productivity, sustainability, and biotechnology practices.
- Build a strong foundation for careers or research in plant sciences, agriculture, and environmental biology.

Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
6	1	PLANT PHYSIOLOGY-I 1.1 Absorption of water: Site, Path, Mechanism 1.2 Transpiration: Types, Mechanism of stomatal transpiration, Significance, Guttation 1.3 Mineral Nutrition: Essential elements, physiological role and deficiency symptoms of Major (C, N, K, P) and Minor (Fe, Zn, Mo, Mn) elements. 1.4 Ascent of sap: Path, Mechanism, Significance	15

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	2	PLANT PHYSIOLOGY-II 2.1 Translocation of organic solutes: Phloem sap, Direction, Mechanism, Source-sink relationship, Significance 2.2 Photoperiodism: Classification of plants, Photoperiodic Induction, Perception of light stimulus, Mechanism of flowering inductor, Significance 2.3 Vernalization: Perception of cold stimulus, Mechanism, Practical application, Devernalization 2.4 Seed Dormancy: Types, Causes and breaking, Significance	15
	3	PHOTOSYNTHESIS 3.1 Historical background of Photosynthesis, photosynthetic pigments. 3.2 Photochemical reactions, photosynthetic electron transport (photolysis of water) and photophosphorylation (PS-I & PS-II), chemiosmotic mechanism, ATP synthase (photophosphorylation). 3.3 Calvin cycle, Photorespiration, factors affecting photosynthesis. 3.4 C4 pathways, Crassulacean acid metabolism.	15
	4	RESPIRATION 4.1 Glycolysis, fermentation (anaerobic respiration- alcoholic and lactic acid), oxidative pentose phosphate pathway. 4.2 Aerobic respiration-TCA cycle and Oxidative phosphorylation (ETS), chemiosmotic mechanism, ATP synthases (oxidative phosphorylation). 4.3 Factors affecting respiration, Respiratory quotient (carbohydrates, lipid and protein) 4.4 Amphibolic pathway, anabolic and catabolic pathways, regulation of metabolism, Bio-synthesis and Beta-oxidation (breakdown) of Palmitic acid	15

Suggested Reading:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
5. Verma, V. (1995). A Textbook of Plant Physiology. 7th Edition. Emkay Publications, Delhi.
6. Ragland, A., Rajakumar, K., Jayakumar, M., Rajarathinam, K., & Arumugam, N. (2014). Plant Functions. Saras Publication, Nagarcoil, India.

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Course Level	5.5	Internal Marks	-
Programme	B.Sc. (Honors)	External Marks	-
Semester	6	Practical Internal	50
Course Type	MAJOR 16 (Practical)	Practical External	50
Course Credit	4P	Prac. Ext. Exam Time	05:00 Hours
Teaching Hours	120 hrs.	Total	100
Course Code		Exam Duration	-
Course Title	PLANT BIOTECHNOLOGY, REPRODUCTIVE BIOLOGY AND PLANT PHYSIOLOGY		

Course Objectives:

- To develop skills in plant tissue culture techniques
- To understand fundamental concepts of plant biotechnology
- To study reproductive structures and processes in plants
- To examine key physiological processes in plants
- To demonstrate the effect of environmental factors and hormones on plant growth and development

Course Learning Outcomes: After completion of the course, the students will be able to:

- Gained hands-on experience in plant tissue culture, genetic transformation, and micropropagation techniques.
- Understood mechanisms of plant reproduction including embryogenesis and pollination biology.
- Acquired practical skills in analyzing photosynthesis, respiration, and nutrient transport in plants.
- Learned techniques to study plant hormones, secondary metabolites, and stress responses.
- Developed the ability to design and conduct experiments in plant physiology and biotechnology for research applications.

Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations.

Course Contents

Sr. No.	Practical Content Group A	Teaching Hours
1	Preparation of MS medium.	60
2	Study of anther and meristem culture, micro propagation by culture method.	

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3	Study of somatic embryogenesis & artificial seeds through photographs.	
4	Study of methods of gene transfer through photographs/charts: indirect (Agrobacterium-mediated), direct (particle bombardment).	
5	Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.	
6	Anther: Wall and its ontogeny; Tapetum; spore tetrads, and male germ unit (MGU) through photographs and schematic representation.	
7	Pollen grains: pseudomonads, polyads, pollinia (slides/photographs/ fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test (TTZ).	
8	Structure and types of Ovule: anatropous, hemianatropous, orthotropous, amphitropous, campylotropous, circinotropous (permanent slides/specimens/photographs).	
9	Embryogenesis: Study of development of dicot embryo through permanent slides/ photographs; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.	

Sr. No.	Practical Content Group B	Teaching Hours
1	Determination of osmotic potential of plant cell sap by plasmolytic method.	60
2	Determination of water potential of given tissue (potato tuber) by weight method.	
3	To study the induction of amylase activity.	
4	Determination of ascent of sap by ringing method.	
5	Separation of photosynthetic pigments by paper chromatography.	
6	To study the effect of light intensity on the rate of photosynthesis.	
7	Effect of carbon dioxide on the rate of photosynthesis.	
Demonstration experiments		
8	To demonstrate suction due to transpiration.	
9	Fruit ripening/Rooting from cuttings (Demonstration).	
10	Bolting experiment/Avena coleoptile bioassay (demonstration).	
11	To study the respiration by Ganong's respirometer (Demonstration).	

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Suggested Reading:

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
6. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
7. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
8. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
9. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.
10. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
11. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
12. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
13. Pandey, B. P. (2010). Modern Practical Botany, Vol. I, II, III. S. Chand & Company Ltd. New Delhi.
14. Bendre, A. M. & Kumar, A. (2018). A textbook of Practical Botany. Vol. I, II, III. Rastogi Publications, Meerut, India.

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BHAKTA KAVI NARSINH MEHTA UNIVERSITY, JUNAGADH
B.SC. BOTANY- SEM-5 (NEP-2020) (EFFECTIVE JUNE- 2025)
BOTANY PRACTICAL (MAJOR)
PLANT BIOTECHNOLOGY AND REPRODUCTIVE BIOLOGY AND PHYSIOLOGY
(GROUP A & GROUP B)

Time: 5 hrs

Total Marks: 50

Instructions: Strictly follow the instructions given by examiner(s).

Que. No.	Particulars	Marks
Que-1	Write the procedure for Preparation of MS medium / In vitro sterilization / Inoculation method using explants.	(07)
	OR	
	To study of the tissue culture technique for anther/meristem culture, micropropagation.	
Que-2	Study and write from given material: a. Tapetum / Tetrad / Anther wall development (photograph-based)	(07)
	OR	
	b. Dicot embryo development / Suspensor structure (slide/photo/dissection of seed)	
Que-3	Determination of osmotic potential (plasmolytic method)	(07)
	OR	
	Determination of water potential (potato tuber-weight method)	
Que-4	Study of photosynthetic pigment separation by paper chromatography	(07)
	OR	
	Study the effect of light intensity / CO ₂ concentration on the rate of photosynthesis	
Que-5	a. Genetic engineering steps: Bt cotton / Golden rice / Flavr Savr tomato (photographs/charts)	(12)
	OR	
	b. Gene transfer methods – Agrobacterium-mediated / Particle bombardment (photo/chart)	
	OR	
	c. Pollen viability – TTZ test / Types of ovules (anatropous to circinotropous) (slides/photos)	
Que-6	a. Certified Journal	(05)
	b. Submission and Viva-Voce	(05)

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Course Level	5.5		Internal Marks	50
Programme	B.Sc. (Honors)		External Marks	50
Semester	6		Practical Internal	-
Course Type	Minor 6 (Theory)		Practical External	-
Course Credit	4T		Prac. Ext. Exam Time	
Teaching Hours	60 hrs.		Total	100
Course Code			Exam Duration	02:00 Hours
Course Title	APPLIED GREEN SCIENCE			

Course Objectives:

- To develop an understanding of sustainable agriculture through organic and eco-friendly practices such as biofertilizers, bioinsecticides, and composting.
- To familiarize students with environmental biotechnology tools like phytoremediation, sewage treatment, and the use of plant biomass for renewable energy.
- To introduce biotechnological innovations in healthcare and industries, including edible vaccines, single-cell proteins, and secondary metabolite production.
- To impart knowledge of plant biotechnology applications such as micropropagation and biodiesel production, along with the awareness of herb adulteration.
- To sensitize students to the importance of green initiatives like green belt development and urban forestry for sustainable urban living.

Course Learning Outcomes: After completion of the course, the students will be able to:

- Explain and evaluate sustainable agricultural practices and their environmental impact, including organic farming, hydroponics, and bio-inputs.
- Understand and apply environmental biotechnology techniques for waste management and renewable energy generation using plant-based systems.
- Demonstrate knowledge of the role of biotechnology in health and industry through the study of edible vaccines, SCP, and fermentation technologies.
- Analyze and apply micropropagation techniques and understand the production and importance of plant-based biofuels and herbal product integrity.
- Assess and design models of green urban development through knowledge of urban forestry and green belt planning.

Pedagogy: Lectures / Use of Multimedia / Assignments / Hands-on experiments / Demonstrations / Field visit.

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Faculty of Life Sciences
Effective from June 2025
Subject: Botany
SEMESTER-VI

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
6	1	SUSTAINABLE AGRICULTURE AND ORGANIC PRACTICES 1.1 Biofertilizers: Types, scope and importance; Azolla: Mass cultivation field application and uses 1.2 Bioinsecticides: Scope, differences between chemical and bioinsecticides, Advantages and limitations of bioinsecticides, Neem as Biopesticides 1.3 Organic farming: Compost preparation, Compost procedure (Indore, Bangalore, Mushroom, Vermicomposting), Rooftop and Balcony organic farming, Kitchen gardens 1.4 Hydroponics: Definition and concept, Types , Nutrient solutions, Growing media, Challenges and future prospects	
	2	ENVIRONMENTAL BIOTECHNOLOGY AND WASTE MANAGEMENT 2.1 Phytoremediation: Definition and scope, type of phytoremediation, Plant characteristics for Phytoremediation, Advantages and limitations 2.2 Petroleum plants: List of common Petro plants, Hydrocarbon cracking, Energy plantation crops (Hevea, Euphorbia, Lathyris, E. tirucalli, Calotropis, Jatropha curcas) Plant biomass, Application of Plant biomass 2.3 Sewage treatment: Concept, Steps involved in waste water treatment, Oxidation ponds, Advantages 2.4 Biogas: Concept, Biogas plant, Components, Operation of Biogas plant, Uses of Biogas	
	3	BIOTECHNOLOGICAL INNOVATIONS IN HEALTH AND INDUSTRY 3.1 Immunotherapeutic Drugs: Concept, Edible vaccines, Advantages of edible vaccines, edible antibody, edible interferons. 3.2 Single Cell Protein (SCP): Definition, sources of SCP, Nutrition of composition, Advantages, limitations and concern, Applications 3.3 Production of Beverages: Introduction, Classification of Beverages, Production of Ethanol, Biosynthesis of Ethanol, Uses of Beverages 3.4 Production of Secondary Metabolites: Introduction, Culture of plant cells for the extraction of secondary metabolites, Industrial significance	
	4	PLANT BIOTECHNOLOGY AND URBAN GREEN INITIATIVES 1.1 Micropropagation: Concept, List of plants through micropropagation, Factors affecting, application, Advantages, and disadvantages 1.2 Biodiesel: Concept, Properties, Manufacture, Uses, Advantages	

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		1.3 Adulterants in Herbs and Herbal Products: Concept, reasons for adulteration, types of Adulterations, Disadvantages, Adulterants, Types of Adulterants, List of Adulterants used in Ayurveda, Siddha and Unani common adulterants 1.4 Green Belt Development and Urban Forestry – Definition and objectives, Types of green belts, Plant species suitable for urban forestry, Ecological and environmental benefits, Challenges in green belt developments	
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Suggested Reading:

1. Arumugam, N. & Kumaresan, V. (2016). Applied Plant Biotechnology. Saras Publication.
2. Ragland, A., & Kumaresan, V. (2010). Plant Ecology and Applied Botany. Saras Publication.

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INTERNAL EVALUATION SCHEME		
NO	Particulars	Marks
1	Mid Semester Exam (Mandatory)	25
2	Class Test	05
3	Open book exam/test	05
4	Open note exam/test	05
5	Self-test/ Online test	05
6	Essay/Article writing	05
7	Quizzes/Objective test	05
8	Class assignment	05
9	Home assignment	05
10	Reports Writing	05
11	Research/Dissertation	05
12	Case Studies	05
13	Viva/Oral exam	05
14	Group Discussion	05
15	Role Play	05
16	Paper presentation/Seminar	05
17	Language Lab work	05
18	Interview	05
19	Craft work	05
20	Co-curricular work	05
21	Field Assignment	05
22	Poster Presentation	05
23	Attendance	05
24	Project Work	05
	Total	50

Note: Sr.No.1 is mandatory. Select any five from Sr.No.2 to 24. Each Contains five marks. Student should secure 18 Marks for passing in internal Exam.

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BHAKTA KAVI NARSINH MEHTA UNIVERSITY, JUNAGADH
B.Sc. Programme (CBCS - Semester - Grading Pattern)
(Effective from June 2025-26, UNDER NEP-2020)
B. Sc. BOTANY: SEMESTER END EXAMINATION
FORMAT FOR QUESTIONS PAPER FOR 4 CREDITS COURSE IN BOTANY
(B.Sc. Sem- VI)

The university examination paper consists of four questions.

- First question is of 12 marks and will be from Unit – I.
- Second question is of 13 marks and will be from Unit – II.
- Third question is of 12 marks and will be from Unit – III.
- Fourth question is of 13 marks and will be from Unit – IV.

Name of subject: BOTANY		Paper code:
Name of paper:		
Total Hours: 02 hrs.		Total Marks: 50
Instructions: (1) This question paper contains four questions. (2) All questions are compulsory. (3) Figures at right side indicate the marks of question. (4) Illustrate your answer with labelled diagram.		
Q.1 (A)	Describe in detail:(any one) (1) (2)	08
(B)	Write a short note on:(any one) (1) (2)	04
Q.2 (A)	Describe in detail:(any one) (1) (2)	09
(B)	Write a short note on:(any one) (1) (2)	04
Q.3 (A)	Describe in detail:(any one) (1) (2)	08
(B)	Write a short note on:(any one) (1) (2)	04
Q.4 (A)	Describe in detail:(any one) (1) (2)	09
(B)	Write a short note on:(any one) (1) (2)	04

**Important Notifications and Guidelines released from UGC & Ministry of Education,
Government of India for reference.**

1. **NEP-2020-English:** From page No. 33-Major problems faced by the higher education system and key changes required in current education system (https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf)
2. **Gujarati version of NEP-2020** (https://www.education.gov.in/sites/upload_files/mhrd/files/nep/2020/GUJARATI.pdf)
3. **IKS in Higher Education Curricula:** Details of course and curriculum of IKS which will be integral part of current education system (https://www.ugc.gov.in/pdfnews/6436045_Guidelines- IKS-in-HE-Curricula.pdf)
4. **Training of faculty on IKS:** Need and process of training of faculties on IKS ([https://www.ugc.gov.in/pdfnews/3746302_Guidelines-for-TrainingOrientation-of-Faculty- on-Indian-Knowledge-System-\(IKS\).pdf](https://www.ugc.gov.in/pdfnews/3746302_Guidelines-for-TrainingOrientation-of-Faculty- on-Indian-Knowledge-System-(IKS).pdf))
5. **Multiple Entry and Exit Options:** The mechanism to adopt flexibility of multiple entry and exit in all HEIs to facilitate the students during academic cycle (<https://www.ugc.gov.in/e-book/GL%20Multiple%20Entry%20Exit.pdf>)
6. **Apprenticeship/ship:** Objective, process and roles of HEIs and Industries to implement ship/apprenticeship (https://www.ugc.gov.in/pdfnews/9105852_ugc-guidelines Apprenticeshipship.pdf)
7. **Open and Distance Learning (ODL):** Guideline, process, and eligible institutes to provide the ODL mode of learning. https://www.ugc.gov.in/pdfnews/7421799_Current-Regulations.pdf
8. **Curriculum and Credit Framework:** Suggestive points by UGC to design the course curriculum and define the credit structure (https://www.ugc.gov.in/pdfnews/7193743_FYUGP.pdf)
9. **Academic Bank of Credits:** Objective, function and implementation methodology of Academic Bank of Credits into HEIs https://www.ugc.gov.in/pdfnews/9327451_Academic-Bank-of- Credits-in-Higher-Education.pdf
10. **Transforming Higher Education:** Objective, approach and readiness of the institution to transform into multidiscipline institutions (https://www.ugc.gov.in/pdfnews/5599305_Guidelines-for-Transforming-Higher-Education- Institutions-into-Multidisciplinary-Institutions.pdf)
11. **National Credit Framework:** Assignment of credits, Implementation, and operationalization of credit framework through ABC https://www.ugc.gov.in/pdfnews/9028476_Report-of- National-Credit-Framework.pdf
12. **National Higher Education Qualification Framework:** NHEQF level qualification specification and Course Learning Outcome (https://www.ugc.gov.in/pdfnews/9028476_Report-of- National-Credit-Framework.pdf)
13. **Blended mode of Learning:** Infrastructure readiness at HEIs, implementation process, assessment and evaluation and suggested framework for blended mode of learning. (https://www.ugc.gov.in/pdfnews/6100340_Concept-Note-Blended-Mode-of-Teaching-and- Learning.pdf)
14. **Practical exam** (<https://ngu.ac.in/Admin/CircularPDF/PARIXA-KHANGI-EMAIL-2024.pdf>)
15. **Common credit structure** (<https://ngu.ac.in/Admin/CircularPDF/Credit%20Framework%20GR%20Gujarati%2011072023.pdf>)