

Semester: 3

B.Sc. 2 Year (Semester 3) Botany Core Paper 1 Flowering Plants Identification & Aesthetic Characteristics (Theory)

Programme/Class:

Programme/Cla Diploma	iss:	Year: 2		Semester: 3		
Subject: Botar	Subject: Botany					
Course Code: B0	3040301T Course Title: Flowering Plants Identification & Aesthetic Characteristics					
Course outcom After the complet 1. To gain an un taxonomy and classification. 2. To learn the m classify plants. 3. To compare th 4. To become fa knowledge of th current taxonom 5. To discover a publications. 6. For the entrep up a farm Or Ru	es: etion of the co derstanding o najor patterns he different ap miliar with m e ny of a major p nd use diverse preneur career n a plantation	ourse the students wi f the history and cor of diversity among proaches to classific ajor taxa and their ic plant family. e taxonomic resource in plants, one can es consultancy firm	ill be able to neepts under plants, and cation with dentifying c es, reference stablish a nu	o: rlying various appro the characters and t regard to the analys haracteristics, and t e materials, herbari ursery, Start a lands	oaches to plant types of data used to sis of data. to develop in depth um collections, scaping business, Set	
Credits: 4 Core Compulsory						
Max. Marks: 25+75 Min. Passing Marks: 33 %						
Total No. of Lo	ectures-60					
Units		Тор	vic		No of Lectures 60	
I Taxonomic Resources & Nomenclature Components of taxonomy (identification, nomenclature, classification) ; Taxonomic resources: Herbarium- functions& important herbaria, Botanical gardens, Flora, Keys- single access and multi-access. Botanical Nomenclature- Principles and rules of ICN (ranks and names; principle of priority, binomial system; type method, author citation, valid- publication).			07			
Π	IITypes of classification & EvidencesIIArtificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series) angiosperm phylogeny group (APG III) classification. Taxonomic evidences from palynology, cytology, phytochemistry &Molecular biology data (Protein and Nucleic acid homology).				08	

Ш	Identification of Angiospermic families -I: (Families can be chosen University wise as per local available flora) A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system) Ranunculaceae, Malvaceae, Rutaceae, Fabaceae, Myrtaceae, Cucurbitaceae, Rubiaceae Asteraceae, Apocynaceae, Acanthaceae, Asclepiadiaceae, Solanaceae	08
IV	Identification of Angiospermic families -II: (Families can be chosen University wise as per local available flora) A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system) Amaranthaceae, Euphorbiaceae, Papaveraceae, Scrophulariaceae, Orchidaceae, Liliaceae Arecaceae, Poaceae	07
V	Modern trends in Plant taxonomy: Phenetics and Cladistics: Brief idea on Phenetics, Numerical taxonomy- methods, Operational Taxonomic Units, Cladistics- construction of dendrogram and primary analysis; Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy.	08
VI	TOOLS & SOFTWARES IN PLANT IDENTIFICATIONGIS (Mapping of (i) Patterns(ii) Features (iii) Quantities 0P02.010H11YLIP - Free Phylogenetic Software, Digital Taxonomy, DEscription Language for TAxonomy – DELTA Internet directory for botany.	07
VII	Computer Applications Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems, compilers and interpreters, personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media.	07
VIII	Aesthetic Characteristics of Plants: Aesthetic characteristics of plants, English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Trees, shrubs and shrubberies, climbers and creepers, rockery, Flower beds, Shrubbery, Borders, Water garden). Some Famous gardens of India. Conservatory, green houses, Indoor garden, Roof garden, Topiary, Bonsai.	08

Course Books published in Hindi may be prescribed by the Universities.

1. आवृिबीजी वनस्पति तवज्ञान (टैक्स।नॉर्र), एनाटॉर्ी ,एंतब्रयोलॉजी िथा इकोनातर्क बॉटनी) लेखक -ससंह, पांडे िथा जैन प्रकाशन :िस्िोगी प्रकाशन, र्ेिठ

2. भािि की संपदा,तवज्ञान संचाि भवन डू. क.स. कृष्र्न र्ागण पूसा कॅं पस

3. Propagation And Nursery Management (hindi) (hb) ISBN : 9788177546200Edition : 01Year : 2016Author : Pandey

S.K., Soni N.Publisher : Agrobios (India)

4. Dr. Amar Singh. पादपवर्गिकी- Plant Taxonomy (An Old and Rare Book) from the category Ayurveda in our Books collection. Uttar Pradesh Hindi Sansthan, Lucknow

1. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.

2. Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; Dehra Dun.

3. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intkey.com

4. https://www.naace.co.uk/school-improvement/ict-mark/

5. https://www.socitm.gov.uk, (2002) Learning in the 21st century Executive briefing A Socitm Insight publication, July 2002 Socitm.

6. K. B. Anjaria, (2015)"Electronic Herbarium and Digital Database Preparation of Common Trees of Anand District, Gujarat" MRP submitted to UGC, WRO, Pune 2015 (unpublished)

7. Lizeron Eremias and R. Subash.(2013) "E-Content Development: A Milestone In The Dynamic Progress Of ELearning" International Journal of Teacher Educational Research (IJTER) Vol.2 No.1 January, 2013 ISSN: 2319-4642

8. Pandey, B.P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd, New Delhi.

9. Stace, C. A. 1989. Plant Taxonomy and Biostatistics (2nd Ed.). Edward Arnold, London.

10. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.

11. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.

12. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.

13. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.

14. Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.

15. Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ:

Pearson Prentice Hall.

16. Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London: Octopus Publishing Group.

17. Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons.

18. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Further Suggestions:

It widens the scope for students to join Government and Non-Government organization up skillingthe people at different levels as per their socio-economic structure.

At the End of the whole syllabus any remarks/ suggestions:

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ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)

Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India) U.P. STATE GOVERNMENT UNIVERSITY, (Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

B.Sc. 2 Year (Semester 3) Botany Paper 1

Plant Identification Technology (Practical)

Programme/Cla Diploma	ISS:	Year: 2		Semester: 3	
Subject: Botany					
Course Code: B040302P Cour		Course Title: Plant	Course Title: Plant Identification Technology		
Course outcomes:After the completion of the course the students will be able:1. To learn how plant specimens are collected, documented, and curated for a permanent record.2. To observe, record, and employ plant morphological variation and the accompanying descriptive terminology.3. To gain experience with the various tools and means available to identify plants.4. To develop observational skills and field experience.5. To identify a taxonomically diverse array of native plants.6. To recognize common and major plant families.7. To Understand aesthetic characters of flowering plants by making-landscapes, gardens, bonsai, miniatures8. Comprehend the concepts of plant taxonomy and classification of Angiosperms.Credits: 2Max. Marks: 25+75Min. Passing Marks: 40 %					permanent record. npanying descriptive ants.
Total No. of La	ab Periods/Pr	actical= 30 (60 hou	rs)		
Units	Торіс			No of Lab Periods	
Ι	Herbarium: Plant collecting, Preservation and Documentation: Stepwise Practicing Herbarium techniques: a. FIELD EQUIPMENTS, Global Positioning System (GPS) instrument & Collection of any wild 25 plant specimens b.Learn to handle Herbarium making tools c. Pressing and Drying of collected plant specimens d. Special treatments for all varied groups of plants e. Mount on standard herbarium sheets f. Label them using Standard method g. Organize them and give Index Register Number			07	
Ш	Taxonomic I a. Classify 25 (Plant Morph adaptation and of classification Fabaceae (Paj Acanthaceae, Identification a.Conducting common wild syllabus (list BOOK and fi	ic Identification using plant structure 25 plants on the basis of Taxonomic description rphology, Anatomy, Reproductive parts, Habit, anomalies) according to Benthum Hooker system cation in the following families: Malvaceae, (Papilionaceae), Solanaceae, Scrophulariaceae, eae, Labiatae (Lamiaceae), Rubiaceae. tion during excursions ing Spot identification (Binomial, Family) of vild plants from families included in the theoretical ist to be provided) and making FIELD NOTE d filling Sample of a page of field-book, used in			08
L	Botanical Sur	vey of India.	65 of 11010		

	b. Describe/compare flowers in semi-technical language	
	giving V.S. of flowers, T.S. of ovaries, floral diagrams and	
	Floral Formulae. Identify and assign them to their respective	
	families giving reasons.	
	COLLECTION, PRESERVATION AND STORAGE OF	
IV/	ALGAE, FUNGI BRYOPHYTES, PTERIDOPHYTES (Two	07
1 V	each)	07
V	Botanical Nomenclature & reporting Method:	07
	a. Give nomenclature to collected plants as per ICN rules and	
	prepare labels as per BSI	
	b. Author Citation. Effective Publication and Principle of	
	Priority: To show a specimen paper on Basic structure of a	
	taxonomic Research published on a new species in	
	taxonomic journal	
VI	COMPUTERS	07
V I	1. Learning to use EXCEL Microsoft PowerPoint and Word.	07
	WORKING WITH FOLDER AND WINDOWS UTILITY.,	
	CREATE AND MANAGE FILES AND FOLDER TREE,	
	2. Practice browsing of different sites using search engine. practice	
	and understand different E-Mail services – Outlook, Yahoo mail,	
	rediffmail etc. Practice Creating E-Mail accounts, Sending,	
	Receiving & Storing of mails.	
	3. Create and Participate in virtual conferencing in an interactive	
	Zoom Meeting	
VII	Computer Application in taxonomy	08
	1. Use Taxonomic Softwares (Dichotomous Key)	
	2. Practicals on Phylogenetic analysis	
	3. Make line drawing of Plants for description	
	4. Using of plant identification apps on android phones	
VIII	1. Create a Bonsai of any plant	09
	2. Develop a miniature garden	
	3. Draw Layouts of various types of gardens	
	4. Plant Propagation methods practice	



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U.P. STATE GOVERNMENT UNIVERSITY, LUCKNOW, U.P. (INC

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Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

प्रयोगात्र्क वनस्पति तवज्ञान भाग 2 लेखक :अशोक बेंद्रे िथा अशोक कुर्ाे प्रकाशन :िस्िोगी प्रकाशन, र्ेिठ प्रयोगात्र्क वनस्पति तवज्ञान भाग 3 लेखक :अशोक बेंद्रे िथा अशोक कुर्ाे प्रकाशन :िस्िोगी प्रकाशन ,र्ेिठ प्रायोतगक वनस्पति तवज्ञान बी.एस-सी-1,11,111एस बी अग्रवालएस बी अग्रवाल प्रकाशक : तशवलाल अग्रवाल एण्ड कम्पनी

प्रायोतगक वनस्पति तवज्ञान II Author Name: - Dhankar - Sharma - Trivedi RBD Publication House

1. Day, S.C. (2003)A Art of Miniature Plant Culture. - Agrobias. Jodhpur, India.

2. Practical Taxonomy of Angiosperms By : R K Sinha ISBN : 9789386768520 I.K International Publishing House Pvt.Ltd.

1. Day, S.C. (2003)Complete Home Gardening. (2003) Agrobias, Jodhpur, India.

- 2. Dhopte, A.M. (2003) Principles and Techniques for Plant Scientists. Agrobios, Jodhpur, India.
- 3. Khan, M.R. (1995) Horticulture and Gardening.- NiraliPrakashan, Pune. India.
- 4. PramilaMehra Gardening for every one-. Hind pocket book private limited, NewDehli.
- 5. Kumarsen V. Horticulture ,Saras Publication

6. Ramesh Bangia Learning Computer Fundamentals.,., Khanna Book Publishers

7. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH PublishingCo., New Delhi.

8. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.

9. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

10. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.

11. Womersley, J. S. 1981. Plant collecting and herbarium development: A manual.

12. Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; Dehra Dun.

13. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intkey.com https://www.naace.co.uk/school-improvement/ict-mark/

14. Manilal, K. S. and M. S. Muktesh Kumar (ed.) (1998) A Hand book of Taxonomy Training, DST, N. Delhi

15. Naik, V. N. (1984) Taxonomy of Angiosperms Tata McGrow-Hill Publication Com. Ltd., New Delhi

16. Primak, R. B. (2004) A Primer of Conservation Biology. Sinauer Associales, Inc. Publishers

17. Quicke, Donald, L. J. (1993) Principles and Techniques of Commemoratory Taxonomy. Blakie, Academic and Professional, London

18. Singh, G (2004) Plant Systematics: Theory and practice Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi.

19. Bridson, D. & L. Forman. eds. 1998. The Herbarium Handbook. 3rd ed. Royal Botanic Gardens, Kew (Reprinted 1999).

20. De Vogel, E.F. 1987. Manual of Herbarium Taxonomy: Theory and Practice. UNESCO, Jakarta.

21. Fosberg, F.R. & M.-H. Sachet. 1965. Manual for tropical herbaria. Int. Bur. Pl. Tax. & Nom., Regnum Vegetabile Vol. 39. Utrecht.

22. Jain, S.K. & R.R. Rao. 1977. A handbook of field and herbarium methods. Today & Tomorrow's Printers and Publishers, New Delhi.

23. Victor, J.E., M. Koekemoer, L. Fish, S.J. Smithies, M. Mossmer. 2004. Herbarium essentials: the Southern African Herbarium user manual. Southern African Botanical Diversity Network Report No. 25. SABONET, Pretoria.

Suggested Continuous Evaluation Methods:

- Assessment of observation report.
- Preparation of
- questionnaire.
- Visits Records.Attendance.

This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 from Science



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Further Suggestions:

It widens the scope for students to join Government and Non-Government organization up skillingthe people at different levels as per their socio-economic structure. At the End of the whole syllabus any remarks/ suggestions



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B.Sc. – BOTANY (2nd Year, Semester-III or IV)

(GE 3 or 4 /Minor Elective)

Plant Metabolism and Biodiversity

(Session -2022-23)

Programme/Class: Certificate	Year: Second	Semester: Third or Fourth		
Subject: BOTANY				
Course Code: B040203T	Course Title: Plant Me	etabolism and Photosynthesis		
Course Outcomes:				
The student at the completion of the	he course will be able to:			
Get acquainted with natu	ıral habitats physiology o	f plants.		
Understand how Role of	various plant hormones	n Plant growth and defence		
• Become aware of the important role water, light and various metabolite of plant.				
• Gain in depth knowledge of different types of physiological aspect of plant				

ige Get familiar with problems of various abiotic factors that influences plant growth and development •

Credits: 4	GE 2/Minor Elective		
Max. Marks	: 25+75 Min. Passing marks: as per rules		
Total No. of	Lectures-60		
Unit	Topics	Total No. of Lectures/ Hours (60)	
Ι	 Plant metabolism and photosynthesis Respiration: Glycolysis, anaerobic respiration, TCA cycle, Electron transport system and their inhibitors. Mechanism of oxidative phosphorylation Photosynthesis: Photosynthetic pigments, photosynthetic light reactions, photo- phosphorylation, carbon assimilation pathways: C3, C4, and CAM (brief account) Photorespiration and its significance. 	20	
Π	 Plant - Water relations Diffusion, imbibition and osmosis; concept & components of Water potential. Absorption and transport of water and ascent of sap. Transpiration -Definition, types of transpiration, structure and types of stomata, opening and closing mechanism of stomata. Translocation of organic solutes: mechanism of phloem transport, source-sink relationships. 	15	
ш	 Plant hormones and development Physiological effects of phytohormones - Auxins, Gibberellins, Cytokinins, ABA, Ethylene and Brassinosteroids. Plant Secondary metabolite, alkaloid, terpenoid, phenol 	15	



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• Physiology of flowering -photoperiodism,	
• Role of phytochrome in flowering, Vernalization.	
IV Plant conservation	10
Plant Diversity	10
 In situ and Ex situ concervation 	
In-situ and Ex-situ consel varion Deterrined condense. Some langertent condense. National needes	
Botanical gardens, Some Important garden, National parks	
• Wild life sanctuaries, Biosphere reserve, Germplasm bank	
Suggested Readings:	1
1-Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.	
2-A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders Of Crops (pb)ISB	N :
9788177543377Edition: 01Year: 2011Author: Pathmanabhan G, Vanangamudi M, Chandrasekaran CN,	
Sathyamoorthi K, Babu CR, Babu RC, Boopathi PNPublisher : Agrobios (India)	
3. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.	
4. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing Company.	
5.Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.	
6. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.	_
7. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Bo	ok.
Agencies. 9 Mart D. and Mart I.C. Die Chamistum (2nd ad.) 2005. Jahn Willow & Sana	
6. Voel, D. and Voel, J.C., Bio-Chemistry (Sided.), 2003, John Wiley & Sons.	
10 Lehninger Principles of Biochemistry Sixth Edition 2013 David L. Nelson Michael M Cox Freeman M	Iacmillan
11. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.	
12Verma, SK. Plant Physiology and Biochemistry, S. Chand & Sons, New Delhi.	
13. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biologyot	f plants, 2000,
I.K. International.	1 / /
14. Ramesh Gupta. Efficacy, Safety and Toxicity brings together all current knowledge regarding nutraceutica	ls and their
potential toxic effects. 2016. Elsevier.	
15. Harborne, J.B. 1973 . Phytochemical Methods. John Wiley & Sons, New York.	
16. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the	e Gene 6th edition.
Cold Spring Harbour Lab. Press, Pearson Pub.	

This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods: • Seminar/ Presentation on any topic of the above syllabus • Test with multiple choice questions/ short and long answer questions Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th. The eligibility for this paper is 10+2 with any subject

Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure



B.Sc. – BOTANY (2nd Year, Semester-III)

(SEC-3)/Vocational Course-3

Bio-fertilizer and Bio-pesticide

(Effective from Session 2023-2024)



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)

Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India) U.P. STATE GOVERNMENT UNIVERSITY, (Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

Drogrommo/Clogg	Voon Coond		Samastan Third		
Certificate	rear: Second		Semester: Third		
Subject: Botany					
Course Code:		Course Title	e: Bio-fertilizer and Biope	sticide	
B040304T			Ĩ		
Course Outcomes:					
The student at the con	npletion of the course w	will be able to:	1 (D) ()) 1 D		
Upon completi Assimilate kno	on the students will lea	irn about the ro	ble of Biofertilizer and Bioj	pesticide.	
Assimilate Kilo Learn about us	e and application of Bio	ofertilizer and	Bionesticide		
 Will get suffici 	ent knowledge regardin	ng different ty	pes of Biofertilizer and Bio	pesticide	
U	0 0	2	L		
Cradita: 3		SEC 3/Vo	entional Course 3		
Max Marks: 40+60		Min Pass	ing marks: as per rules		
101aA. 101a1 KS. 40100		1 1111. 1 (155)	ing marks. as per rules		
	Тор	oics		Total No. of	
	ł			Lectures/ Unit &	
				Hours (45)	
I Biofertilizer	Definition of Diefentili			15	
Types of Biofertil	Introduction and Definition of Biofertilizer				
Bacterial Biofertil	lizer e g Rhizobium an	d Azospiriliu	m		
Algal Biofertilizer	r e.g. Blue green algae	(BGA), and A	zolla		
Fungal Biofertiliz	er e.g.Mycorrhiza				
Phosphate solubil	izer and phosphate mot	bilizer		10	
Organic matter de	composer e.g-celluloly	tic and Lignol	lytic		
Mode of applicati	on; Advantages and Dis	sadvantages of	f biofertilizer		
Pesticide				10	
Introduction and c	lefinition of Biopesticio	de			
Types of Biopesti	cides e.g Biochemical,	microbial and	Plant-incorporated		
Integrated pest ma	anagement (IPM)				
Mode of action of	f biopesticide			10	
Factor influencing	Factor influencing use of biopesticide				
Applications, adv	Applications advantages & disadvantages of pesticide				
II		I			
Suggested Readings:	T (1 (, '1			וו ת	
1. Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi.					
2. Alexopoulas U.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi.					
3. Aneja K.R., I	3. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom				
cultivation, Ne	cultivation, New Age International, New Delhi				
4. Hurst, C.J., E	4. Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C.				
5. Mehrotra A.S	., Plant Pathology, Tata	a Mcgraw Hill	Publications limited, New	Delhi.	
6. Pelczar M.J.,	Chan E.C.S and Kreig	6. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.			

7. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, NewYork.



रूवाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,

(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

- 8. Salle A.J., Fundamental Principles of Bacteriology, Tata Mcgraw-Hill Publishing Company Limited, New Delhi.
- 9. Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London.
- 10. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
- 11. Subbarao N.S., Soil Microroganisms and Plant Growth, Oxford and IBH Publishing Company, NewDelhi.
- 12. Steward W.D.P., Nitrogen Fixation in Plants, The Athlone Press, London.
- 13. Suggestive digital platforms web links-
 - <u>https://www.classcentral.com/tag/microbiology</u>
 - <u>https://www.mooc-list.com/tags/biotechnology</u>
- <u>https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques</u> https://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health

This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods: • Seminar/ Presentation on any topic of the above syllabus • Test with multiple choice questions/ short and long answer questions Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th. The eligibility for this paper is 10+2 with any subject

Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.



रूवाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India) U.P. STATE GOVERNMENT UNIVERSITY, (Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

B.Sc. 2 Year (Semester 4) Botany Paper 1

Economic Botany, Ethnomedicine and Phytochemistry (Theory)

ass:	Year: 2 Semester: 4			
ny				
Course Code: B040401T Course Title: Economic Botany, Ethnomedicine			e and Phytochemistry	
nes:			Bloom's Taxo	onomy
tion of the cou	rse the students will	l be able to:		
l about the use	s of plants –will kno	ow one		K1. K3
yment	1 1 1 1 4 1 4			
i phytochemic	al analysis related to) ts produced		K2, K4
situit plants a	la économie produc	is produced		
it the importar	nce of Medicinal pla	nts and its		
nomically imp	ortant plants in our o	daily life		K3, K4
e traditional m	nedicines and herbs,	and its		
lern times.		[
		Core Con	npulsory	
Max. Marks: 25+75 Min. Passing Marks:33				
ectures-60				
	Торіс			No of Lectures
Origin and domestication of cultivated plants Centers of diversity of plants, origin of crop plants. Domestication and introduction of crop plants. Concepts of sustainable development; cultivation, production and uses of Cereals legumes. Spices & beverages			07	
Botany of oils, Fibers, timber yielding plants & dyesIIStudy of the plants with Botanical names, Family, part used, and economic uses yielding Edible & essential oils; Sugar , Starch; Fibers; Paper, Fumitories & Masticatories, Rubber Dyes, Timber, biofuel crops				07
Commercial	production of Flov	vers, Vegeta	ables, and	07
fruits (To be	Chosen area wise)			07
Commercial g	greenhouse cultivation	on of rose, (Gerbera,	
Gladiolus, Ar	thurium/lilium/lily,	tomato, bel	l pepper,	
Hydroponics				
IPR & Tradi	tional Knowledge			
Hydroponics.IPR & Traditional KnowledgeIVIPR and WTO (TRIPS, WIPO), Patent Act 1970 and its amendments, TIFAC, NRDC, Rights, Procedure of obtaining patents, Working of patents, Infringement, Copyrights, Trademarks, Geographical Indications, Traditional Knowledge Digital Library, Protection of Traditional , Knowledge & Protection of Plant Varieties and Biotech inventions.			08	
	ass: ny 40401T hes: tion of the could about the use yment about the use yment a	Ass: Year: 2 Ny 40401T Course Title: Economic Nes: tion of the course the students will about the uses of plants –will know yment about and state analysis related to ortant plants and economic produc about the importance of Medicinal plants the importance of Medicinal plants about about plants in our of the traditional medicines and herbs, lern times. 5+75 ectures-60 5+75 ectures-60 Topic Origin and domestication of cul Centers of diversity of plants, ori Domestication and introduction of sustainable development; cultivati of Cereals, legumes, Spices & be Botany of oils, Fibers, timber y Study of the plants with Botanica and economic uses yielding Edib Starch; Fibers; Paper, Fumitories ,Dyes, Timber, biofuel crops Commercial production of Flow fruits (To be Chosen area wise) Commercial greenhouse cultivati Gladiolus, Anthurium/lilium/lily, cucumber, strawberry & Exotic le Hydroponics. IPR & Traditional Knowledge IPR and WTO (TRIPS, WIPO), F amendments, TIFAC,NRDC, Righ patents, Working of patents, Infri Trademarks, Geographical Indica Knowledge Digital Library, Protec Knowledge & Protection of Plant inventions.	ass: Year: 2 year: 4 yean: 4	ass: Year: 2 Semester: 4 ny 404001T Course Title: Economic Botany, Ethnomedicin hes: Bloom's Taxe ition of the course the students will be able to: Bloom's Taxe about the uses of plants – will know one yment phytochemical analysis related to print phytochemical analysis related to ornant plants and economic products produced it nt the importance of Medicinal plants and its onomically important plants in our daily life e traditional medicines and herbs, and its core Compulsory 5+75 Min. Passing Marks:33 ectures-60 Topic Origin and domestication of cultivated plants Concepts of glants. Oncepts of sustainable development; cultivation, production and uses of Cereals, legumes, Spices & beverages. Botany of oils, Fibers, timber yielding plants & dyes Starch; Fibers; Paper, Fumitories & Masticatories, Rubber Dyes, Timber, biofuel crops Commercial production of Flowers, Vegetables, and fruits (To be Chosen area wise) Commercial greenhouse cultivation of rose, Gerbera, Gladiolus, Anthurium/lilium/lily, tomato, bell pepper, cucumber, strawberry & Exotic leafy vegetables using Hydroponics. IPR & Traditional Knowledge IPR & Traditional Knowledge IPR & Traditional Knowledge Protection of Traditional, Knowledge Digital Library, P

		00
V	Etimobotany Mathadalagian of athe abotanical managers Eiglder	08
	vietnodologies of ethnobotanical research: Field Work,	
	Literature, Herbaria and Musea and other aspects of	
	ethnobotany. Importance of ethnobotany in Indian systems	
	of medicine (Siddha, Ayurveda and Unani), Role of	
	AYUSH, NMPB, CIMAP and CARI. Tribal knowledge	
	towards disease diagnosis, treatment, medicinal plants,	
	plant conservation and cultivation.	
VI	Medicinal aspects	08
	Study of common plants used by tribes (Aegle marmelos,	
	Ficus religiosa, Cynadon dactylon, Eclipta alba, Oxalis,	
	Ocimum sanctum and Trichopus zeylanicus) Ethnobotanical	
	aspect of conservation and management of plant resources,	
	Preservation of primeval forests in the form of sacred	
	groves of individual species and Botanical uses depicted in	
	our epics. Plants in primary health care: common medicinal	
	plants: Tinospora, Acorus, Ocimum, Turmeric and Aloe.	
	Indian Pharmacopeia, Quality Evaluation of crude drugs &	
	adulteration	
VII	Pharmacognosy	08
	Preparation of drugs for commercial market - Organoleptic	
	evaluation of drugs – Microscopic evaluation of drugs -	
	Physical evaluation of drugs - Active and inert constituents	
	of drugs - Classification of drug plants - individual drugs -	
	drug adulteration. Sources of crude drugs – roots, rhizome.	
	bulb, corm, leaves, stems, flowers, fruits and seeds :	
	organoleptic study of Adhatoda vasica. Andrographis	
	paniculata Azadirachta indica Coriandrum sativum	
	Datura metal Eclipta alba Emblica officinalis Ocimum	
	sanctum Phyllanthus amarus Ricinus communis Vinca	
	rosea and Zingiber officinale	
VIII	Herbal Prenarations & Phytochemistry ·	07
V 111	Collection of wild berbs - Cansules - compresses - Elivirs -	07
	Glycerites - Hydrotherapy or Herbal bath - Herbal oils -	
	Liquid extracts or Tincture - Poultices - Salves - Slipperv	
	alm slurry and grual Suppositorias Tags Plant natural	
	products general detection extraction and characterization	
	products, general detection, extraction and characterization	
	applications. Anthogyaning and Courses and therepeutic	
	applications. Anthocyanins and Countarins and therapeutic	
	applications, Lignans, Terpenes, Volatile oils and Saponins,	
	Carolenoids and Alkaloids Carolenoids and	
	pharmacological activities.	

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
 Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. New Delhi.

3. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency, India.

Reddy P. Parvatha. 2016. Sustainable crop protection under protected cultivation. Springer, Singapore.
 Amit Deogirikar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture. Rajlaxmi Prakashan,

Aurangabad, India.

6. Singh, B., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation. New India Publishing Agency, India.

7. Sharma, OP. 1996. Hill's Economic Botany (Late Dr. AF Hill, adopted by OP Sharma). Tata McGraw Hill Co. Ltd., New Delhi.

8. Joe J. Hanan. 1997. Greenhouses: Advanced Technology for protected horticulture. CRC Press.

9. Krishnamurthy, K.V. (2004). An Advanced Text rbook of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

10. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).

11. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).

12. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).

13. Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).

- 14. Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.
- 15. Jain, S. K. and V. Mudgal. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun.
- 16. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.London.
- 17. Joshi, S. G. 2000. Medicinal Plants. Oxford and IBH, New Delhi.
- 18. Kokate, C. and Gokeale- Pharmocognacy- Nirali Prakashan, NewDelhi.
- 19. Lad, V. 1984. Ayurveda The Science of Self-healing. Motilal Banarasidass, New Delhi.
- 20. Lewis, W. H. and M. P. F. Elwin Lewis. 1976. Medical Botany. Plants Affecting Man's Health. A
- a. Wiley Inter science Publication. John Wiley and Sons, New York.
- 21. Farooqui, A. A. and Sreeraman, B. S. 2001. Cultvation of medicinal and aromatic crops. Universities Press.

22. Harborne, J. B. 1998. Phytochemical methods – a guide to modern techniques of plant analysis 3 rd edition, Chapman and Hall.

23. Yesodha, D., Geetha, S and Radhakrishnan, V. 1997. Allied Biochemistry. Morgan publications, Chennai.1. Gurdeep Chatwal, 1980. Organic chemistry of natural productis. Vol. I. Himalaya Publishing house.

24. Kalsi, P. S. and Jagtap, S., 2012. Pharmaceutical medicinal and natural product chemistry. N.K. Mehra for Narosa Publishing House Pvt. Ltd. New Delhi.

- 25. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.
- 26. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.

27. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.

28. Sharol Tilgner, N. D. 1999. Herbal medicine - From the heart of the earth.Edn. 1, Printed in the USA by Malloy Lithographing Inc.

29. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.

30. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizoms drugs. Bulletin No.1 Ministry of Health, Govt. of India.

31. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.

32. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.

33. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today&

- 34. Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co. Ltd.
- 35. K. Wilson and J. Walker Eds. 2005. Biochemistry and Molecular Biology. Cambridge University Press.

36. k. Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn Edward Arnold, London.

This course can be opted as an elective by the students of following subjects: 1

The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions

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- Preparation of Audio-visual aids.
- Attendance



रूवाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India) U.P. STATE GOVERNMENT UNIVERSITY, (Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

B.Sc. 2 Year (Semester 4) Botany Paper 2 **Commercial Botany & Phytochemical Analysis (Practical)**

Programme/Cla Diploma	ass:	Year: 2		Semester: 4	
Subject: Botar	ny				
Course Code: B040402P Course Title: Commercial Botany & Phytochemi					nical Analysis
Course outcomes: After the completion of the course the students will be able to:					omy
CO1- Know abou plants.	t the commer	cial products produc	ed from		K1, K3
CO2- Gain the kn some economic c	owledge abou props.	at cultivation practic	es of		K2, K4
CO3- Understand	d about the eth	nnobotanical details	of plants.		K3, K4
CO4- Learn abour preparations	t the chemistr	y of plants &herbal			K2, K5
CO5-Can becomproducer, Pharma company.	e a protected of a cologist or qu	cultivator, aromatic ality analyst in drug	oil g	K3,K4	
Credits: 2 Core Compulsory					
Max. Marks: 25+75 Min. Passing Marks:40					
Total No. of La	ab Periods/ P	ractical-30 (60 hour	rs)		
Units		Торіс			No of Lab Periods
Ι	Economic Be Cereals: Whe grains, micro paddy and gra Legume: Pea micro-chemic Source of sug cane juice- m tuber morpho starch grains, Tea- tea leave seeds, tests fo Timbers: sect Jute- specime on T.S. of ste fiber followir Study of spec mentioned in	 nomic Botany & Microtechniques: eals: Wheat (habit sketch, L.S./T.S. of grain, starch ns, micro-chemical tests); rice (habit sketch, study of dy and grain, starch grains, micro-chemical tests) ume: Pea or ground nut (habit, fruit, seed structure, ro-chemical tests) rce of sugars and starches: Sugarcane (habit sketch; e juice- micro-chemical tests); potato (habit sketch, er morphology, T.S. of tuber to show localization of ch grains, W.M. of starch) grains, micro-chemical tests. tea leaves, tests for tannin Mustard- plant specimen, ds, tests for fat in crushed seeds bers: section of young stem. specimen, transverse section of stem, tests for lignin T.S. of stem and study of er following maceration technique. dy of specimens of economic importance 			08
п	Commercial Field visit to vegetables pr	Cultivation Green houses for un oduction Developme	mentioned in Unit I-& II Commercial Cultivation Field visit to Green houses for understanding Floriculture & vegetables production Development of hydroponics nutrient		

	solutions & running models for cultivation of vegetables	
	Development of hydroponics nutrient solutions & running	
	models for cultivation of fodder	
III	Cultivating Medicinal and aromatic plants & Essential oil	
	extraction	07
	a. Lemon grass/ Neem/ Zinger /Rose/Mint	
	Documentation from Traditional Knowledge Digital Library,	
IV	Mark the Geographic Indications on Map,	07
	Understand – Nakshtra Vatika, Navgrah vatika and develop in	
	your college	
	To extract the names of the plants and Botanical uses depicted in	
	our epics.	
	Visit NISCAIR,New Delhi	
V	Ethnobotany	07
	Study of common plants used by tribes. <i>Aegle marmelos</i> ,	
	Ficus religiosa, Cynadon dactylon.,	
	Visit a tribal area and collect information on their	
	traditional method of treatment using crude drugs.	
	Familiarize with at least 5 folk medicines and study the	
	cultivation, extraction and its medicinal application.	
	Observe the plants of ethno botanical importance in your	
	area.	
	Visit to an Ayurveda college or Ayurvedic Research	
	Institute / Hospital	
VI	Instrumentation and herbal Preparations	08
	Develop Capsules of herbs/, Develop Herbal oils/, Develop	
	Poultice/cream Analyse some active ingredients using	
	chromatography /Spectrophotometry	
VII	Pharmacognosy	08
	Organoleptic studies of plants mentioned in the theory :	
	1. Morphological studies of vegetative and floral parts.	
	2. Microscopic preparations of root, stem and leaf.	
	3. Stomatal number and stomatal index.	
	4. Vein islet number.	
	5. Palisade ratio.	
	6. Fibres and vessels (maceration).	
	7. Starch test	
	8. Proteins and lipid test	
VIII	Phytochemistry:	07
	Determination of the percentage of foreign leaf in a drug	••
	composed of a mixture of leaves.	
	Dimensions of Calcium oxalate crystals in powdered crude	
	drug	
	Preliminary phytochemical tests for alkaloids terpenoids	
	Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tanning & resins	
	glycosides, volatile oils, tannins & resins.	

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.

2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.

3. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.

4. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.

5. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health, Govt. of India.

6. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.

7. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
8. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi.

9. Khasim S.M Botanical Microtechniques: Principles and Practice-

10. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. New Delhi.

11. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India

Publishing Agency

This course can be opted as an elective by the students of following subjects: Open for all

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th. The eligibility for this paper is 10+2 with any subject

Further Suggestions:

At the End of the whole syllabus any remarks/ suggestions:

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B.Sc. - BOTANY (2nd Year, Semester-IV)

(SEC-4)/Vocational Course-4

Plant development and Conservation

(Effective from Session 2023-2024

Programme/Class: Certificate		Year: Second		Semester: Fourth	
Subject: Botany					
Course Code: B040404T Course Title: Plant development and Conservation					
Course Outco	omes:			Bloom's Taxonomy	
The student at the completion of the course will be able to:					
CO1- To understand the importance of Biodiversity.				K	1, K3
CO2- To understand, learn about the role of plant hormones in development of plant K					2, K4
CO3-To er various proc	nable the students to cess of plant conserva) get sufficient knowle ation	dge about the	K	3, K4
Credits: 3 SEC-4/Vocational Course-4					
Max. Marks: 40+60 Min. Passing marks: as per rule					
Total No. of Lecture	es-Tutorials-Practical	(in hours per week): L-	T-P: 3-0-0		
Unit		Topics			Total No. of Lecture s/ Unit & Total Hours (45)
Ι	Plant development Definition and Role of Phytohormones in regulation of plant growth and development Structure, biosynthesis and Physiological functions of Auxins Structure, biosynthesis and Physiological functions of Gibberellins Structure, biosynthesis and Physiological functions of Cytokinins,				10
II	Structure, biosynthes Structure, biosynthes Structure, biosynthes Introduction of Plant	tructure, biosynthesis and Physiological functions of Optimities, tructure, biosynthesis and Physiological functions of Ethylene tructure, biosynthesis and Physiological functions of Brassinosteroids. htroduction of Plant Secondary metabolite			1 0

	Biosynthetic pathway and functions of alkaloid, terpenoid, phenol	
Ш	Plant conservation Definition and introduction of Biodiversity Plant Diversity in india, Hot spots In-situ and Ex-situ conservation	1 5
IV	National parks, Wild life sanctuaries, Biosphere reserve, Secret grove Botanical gardens, Some Important botanical garden, Germplasm bank, seed bank, pollen grain bank, Captive propagation	1 0

Suggested Readings:

1-Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.

2-A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders Of Crops (pb)ISBN :

9788177543377Edition: 01Year: 2011Author: Pathmanabhan G, Vanangamudi M, Chandrasekaran CN,

Sathyamoorthi K, Babu CR, Babu RC, Boopathi PNPublisher : Agrobios (India)

3. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.

4. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing

Company.5.Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.

6. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.

7. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Book. Agencies.

8. Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.

9. Mathews, C.K., Van Holder, K.E. & Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.

10. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.

11. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.

12Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.

13. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biologyof plants, 2000, I.K. International.

14. Ramesh Gupta. Efficacy, Safety and Toxicity brings together all current knowledge regarding nutraceuticals and theirpotential toxic effects. 2016. Elsevier.

15. Harborne, J.B. 1973 . Phytochemical Methods. John Wiley & Sons, New York.

16. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition.Cold Spring Harbour Lab. Press, Pearson Pub.

This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods: • Seminar/ Presentation on any topic of the above syllabus • Test with multiple choice questions/ short and long answer questions Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th . The eligibility for this paper is 10+2 with any subject

Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.