Institute of Science, Nagpur

(An Autonomous Institute of Govt. of Maharashtra)

Department of Botany



M. Sc. Semester I and II Syllabus as per NEP 2020

To be implemented from 2023-2024

Teaching and Examination Schemes:

Teaching and Examination Schemes Two Year M.Sc. (of four semesters) programme is as follows.

Table 4: M.Sc. Semester I

			Paper Code		Teaching Scheme (hrs)				Evaluation Scheme			
	a				Theory	Tutorial	Practical					
Sr No	Category	Name of the course (Title of the Paper)		Level	Th	Tu	Р	Credit	Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
1	DSC	Paper 1:- Cell and MolecularBiology	M-BO511T		4			4	3	80	20	40
1	DBC	Paper 2:- Ethnobotany andMedicinal Plants	M-BO512T		4			4	3	80	20	40
2	DSE	Elective:- a.Phycology b.Mycology c.Palynology	M-BO513TPC M-BO513TMY M-BO513TPN	6.0	4			4	3	80	20	40
3	DSE /DSC	Lab(BasedonPaper1, Paper2)	M-BO514P				12	6	6	100	50	75
4	RM	Research Methodology	M-BO515TRM		4			4	3	80	20	40
					16		12	22		420	130	

Table 5	: M.Sc.	Sem- II
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					Teaching Scheme (hrs)				Evaluation Scheme			
				Coursecode Level	Theory	Tutorial	Practical	-		Lvardation	benefile	
Sr No	Course Category	Name of the course (Title of the Paper)	Coursecode		Th	Tu	Р	Total Credit	Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
		Paper 1:- PlantMetabolism	M-BO521T		4			4	3	80	20	40
1	DSC	Paper 2:- Plantbiodiversity&Conservation	M-BO522T		4			4	3	80	20	40
2	DSE	Elective:- a. Plant growthRegulator b.Hydrobiology c. Paleobotany	M- BO523TPG M- BO523THY M- BO523TPB	6.0	4			4	3	80	20	40
3	DSE /DSC	Lab (BasedonPaper1, Paper2)	M-BO524P				12	6	6	100	50	75
4	OJT / FP	Internship / Apprenticeship / Field Project (Related to DSC)	M-BO525P				8	4	4-6	80	20	50
	12 20							22		420	130	
	Cumulative Credits for : PG Diploma in Major Subject Core = 28 Electives = 8 RM = 4 OJT / FP = 4 44								·			
		Exit option: PG Diploma after First Year PG Degree :- Cumulative Credits required for PG Diploma (After First Year Degree) = 44										

Table (6: M.Sc.	Sem-	III
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					Teaching Scheme (hrs)				Evaluation Scheme			
~	~		Courseade		Theory	Tutorial	Practical					
Sr No	Course	Name of the course (Title of the Paper)	Consecoue	Level	Th	Tu	Р	Credit	edit Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
1	DSC	Paper 1:- Plant SystematicsandTaxonomy	M-BO631T		4			4	3	80	20	40
		Paper 2:- PlantEcology	M-BO632T		4			4	3	80	20	40
2	DSE	Elective:- a.AppliedMycology and PlantPathology b.Reproductive Biology ofAngiosperms c.PlantDevelopment	M- BO633TAM M- BO633TRB M- BO633TPD	6.5	4			4	3	80	20	40
3	DSE /DSC	Lab (BasedonPaper1, Paper2)	M-BO634P				12	6	6	100	50	75
4	RP	Research Project / Dissertation (Core)	M-BO635PRP				8	4		50	50	50
							20	22		390	160	

Table 7: M.Sc. Sem- IV

					Teaching Scheme (hrs)							
Sr	Course	y Name of the course (Title of the Paper)		Leve 1	Theor	Tutoria	Practica	Total	Evaluation Scheme			
N o	Categor		Coursecod e		y Th	Tu	P	Credi t	Duration of Examinatio n (Hrs)	End Semester Evaluatio n (ESE)	Continuou s Internal Evaluation (CIE)	Minimu m Passing Marks
	DSC	Paper 1:- CMBII	M-BO641T		4			4	3	80	20	40
1		Paper 2:- PlantBiotechnology	M-BO642T		4			4	3	80	20	40
2	DSE	Elective:- a. EvolutionaryBiolog y b.AestheticBotany c.PlantPhysiology	M- BO643TEB M- BO643TAB M- BO643TPP	6.5	4			4	2	80	20	40
3	DSE /DSC	Lab (BasedonPaper1, Paper2)	M-BO644P				8	4	6	80	20	50
3	OJT	Research Project / Dissertation (Core)	M- BO645POJT				12	6		75	75	75
					12		24	22		395	155	
Cumulative Credits for PG in Major Subject (One Year PG Degree) = 26 Electives = 8 RP = 10							Electives = 8 RP = 10	44				
Cumulative Credits for PG in Major Subject (Two Year PG Degree) = 54 Electives = 16 RM = 4 OJT / FP = 4 RP = 10						Electives = 16 RP = 10	88					
Cumulative Credits required for PG in Major Subject (One Year PG Degree) = 44 Cumulative Credits required for PG in Major Subject (Two Year PG Degree) = 88												

Semester	Theory	Practical	Total Marks
1	400	150	550
II	300	250	550
III	300	250	550
IV	300	250	550
For Honors	1300	900	2200

Table 8: Table showing total marks in theory and Practical semester wise

Total Credits:

Cumulative Credits required for PG in Major Subject (One Year PG Degree) = 44 Cumulative Credits required for PG in Major Subject (Two Year PG Degree) = 88

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Semester	Course Code	Title of Paper
	M-BO511T	Cell and Molecular Biology
	M-BO512T	Ethnobotany and Medicinal Plants
Ι	M-BO514P	DSCLab
		Elective
	M-BO513TPC	a. Phycology
	M-BO513TMY	b. Mycology
	M-BO513TPN	c. Palynology
	M-BO521T	Plant Metabolism
	M-BO522T	Plant biodiversity & Conservation
II	M-BO524P	DSC Lab
		Elective:
	M-BO523TPG	a. Plant Growth Regulator
	M-BO523THY	b. Hydrobiology and Limnology
	M-BO523TPB	c. Paleobotany
	M-BO525P	Internship / Apprenticeship (Related to DSC)

M. Sc. Semester-I

Discipline Specific Course –DSC Paper 1

Cell and Molecular Biology

M-BO511T

Objectives:

- 1. Understanding the structures and functions of the cell wall, plasma membrane and plasmodesmata
- 2. Understanding the structures and functions of cell organelles, cytoskeleton, nuclear envelope, and structure of DNA
- 3. Understanding various types of stresses and defense mechanisms in plants and apply this knowledge.

Outcomes:

After successful completion of the course the students will be able to

- 1. Know the cell wall & cellular organization of the eukaryotic and prokaryotic cells
- 2. Learn the cell cytoskeleton and its role
- 3. Learn and apply techniques of stress related problems in plants

DSC	-Paper 1	Hours: 4 Hours/Week	Marks: 80+20=100	Credit: 4
		Un	it-I	
1. 2. 3.	Cell wall: Str Plasma memb for ATPases; aquaporins; r Plasmodesma	ucture; function; biogene orane: Membrane archited membrane transport-ion eceptors. ata: Structure, role in mov	sis and growth. cture (fluid mosaic model); sites carriers, channels, pumps and vement of molecules and	15 Hrs
	macromolecu	lles; comparison with gap Uni	junction.	
1	Cellular orga	nelles: Ultra-structure an	d function of golgi complex	15 Hrs
2.	lysosomes, p chloroplast a Cell shape an microfilamen movements,	neroxisomes, endoplasmic ind plant vacuoles. ind motility: The cytoskelents, intermediate filament implications in cell divisi	e reticulum, mitochondria, eton; organization and role of s and microtubules; motor ion, flagellar & other movements.	15 1113
		Un	it-III	
1.	Nucleus: Ultr and Z forms, replication pr Nucleic acids	astructure, nuclear pores, replication in prokaryotic oteins, damage and repai	, nucleolus, DNA structure A, B c and eukaryotic cells, DNA r. s bases; Structure and function of	15 Hrs

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3.	nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.							
Unit-IV								
1.	Stress biology: Definition and classification of stress.	15 Hrs						
2.	Biotic stress: Plant defence mechanism (passive and active); HR and							
	SAR; modulation of plant metabolism in response to biotic stress: early and late response; production of ROS, induction of enzymes; PR proteins; R-genes.							
3.	Abiotic stress: Effect of water, temperature, salt and light stress on plants; developmental and physiological mechanisms protecting plants against environmental extremes.							

Suggested readings

- Atherly, A.G., Griton, J.R. and Mc Donald, J. F. 1999. The Science of Genetics. Saunders College Pub. Fort Worth, USA
- 2. Buchanan, B.B., Gruissem, W. and Jones, R. L. 2000 Biochemistry and Molecular Biology of Plants. American Soc. Of Plant Physiologists, Maryland, USA.
- 3. Bush, H. Rothblum, L. 1982. Vol. X. The Cell Nucleus RDNA part A. Academic Press.
- Dc, D. N. 2000 Plant cell vacuoles: An introduction. CSIRO Publication, Collingwood, Australia.
- 5. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology 8Ed. B. I. Waverly Pvt. Ltd., New Delhi.
- 6. Jones R, Ougham H, Thomas H and Waaland S 2013 The Molecular life of plants. Wiley-Blackwell Publ., USA
- 7. Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc., USA.
- 8. Kleinsmith, L.J. and Kish, V.M. 1995 Principles of Cell and Molecular Biology (2ndEdi.)Harper Collins Coll. Publisher, New York, USA.
- 9. Krishnamurthy, K.V. 2000 Methods in Cell wall Cyto-chemistry. CRC Press, Boca Raton, Florida
- 10. Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P., Baltimore, D. and Dar nell, J. 2000

Molecular Cell Biology Edi. W.H. Freeman and Co., New York, USA

- 11. Russel, P. J. 1998 Genetics (5th Edi.) The Banjamin/ Cummings Publishing Com. Inc., USA
- 12. Wolf, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA
- 13. Taiz, L. and Zeiger, E. 1998: Plant Physiology. Sinaucr Associates, Inc., Publishers, Massachus, USA

M. Sc. Sem. I

Discipline Specific Core Course (DSC-2)

Ethnobotany and Medicinal Plants

M-BO512T

Objectives:

- 1. The course is designed to provide an understanding for the contribution of plants to traditional (alternative) and modern medicines worldwide.
- 2. To provide traditional knowledge of plants and medicine,
- 3. Understanding therapeutic uses of plants.
- 4. Contribution of medicinal plants to alternative and modern medicines, some medicinal plants of the India, and the future of medicinal plants will be discussed.

Course Outcome

After studying this course, the students will:-

- 1. Understand the utility of plants as medicines
- 2. Able to Prepare of basic herbal medicinal products
- 3. Apply the cultivation practices
- 4. Understand The storage, packaging and marketing of herbal medicines
- 5. Able to work with individual plant and plant products

DSC-II Theory	Hours: 4Hours/Week	Marks: 80+20=100	Credit: 4			
Unit-I						
Ethnobotany						
 Introduction, interdisciplina context; Majo styles. Plants beverages c) Methodology Ancient Lite places. Indigenous M origin plants medicinal sy medicine. Un therapy, polyl 	concept, scope and ary science. The relevan or and minor ethnic group s used by the tribals: a) Resins and oils and misce of Ethnobotanical studie rature d) Archaeological History, Scope and Iedicinal Sciences; Defini s used in ayurvedic treat stems, Basis of Siddha hani: History, concept: Un herbal formulations.	objectives; Ethnobotany as an ce of ethnobotany in the present as or Tribals of India, and their life o Food plants b) intoxicants and llaneous uses. es :a) Field work b) Herbarium c) findings e) temples and sacred Importance of Medicinal Plants. tion and Scope-Ayurveda: History, tments. Siddha: Origin of Siddha system, plants used in Siddha noor-e- tabiya, tumors treatments/				
	Unit-II					

Role of ethnobotany in modern Medicine					
 Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) Azadiractha indica b) Ocimum sanctum c) Vitex negundo. d) Gloriosa superba e) Tribulus terrestris f) Pongamia pinnata g) Cassia auriculata h) Indigofera tinctoria. Role of ethnobotany in modern medicine with special example Rauwolfiaserpentina, Trichopuszeylanicus, Artemisia, Withania. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases. 					
Unit-III					
Important Indian Medicinal Plant	15 Hrs				
1.1Plant parts used as powder: Identification and utilization of Amla (Embelica officinalis), Behra (Terminalia bellerica), Harad (Terminalia chebula), Turmeric (Curcuma longa), Garlic (Allium sativum), Bitter guard (Momordica charantia), Black plum (Syzygiumcumini), Fenugreek (Trigonella foenumgraecum), Cinnamon (Cinnamomum verum), Sarpgandha (Rauwolfia serpentina), Black pepper (Piper nigrum), Ashwagandha (Withaniasomnifera), Psyllium husk (Plantego ovata)					
1.2 Plant parts used as juice/ decoctation: Identification and utilization of Amla (<i>Embelica officinalis</i>), Ginger (<i>Zingiber officinalis</i>), Onion (<i>Alium cepa</i>), Bottle guard (<i>Lagenaria siceraria</i>), Basil (<i>Oscimumsantum</i>), Arjun (<i>Terminalia arjuna</i>), Neem (<i>Azadirachta indica</i>), Gwarpatha (<i>Aloe vera</i>), Brahmi (<i>Bacopa monnieri</i>), Giloy (<i>Tinospora cordifolia</i>), Shankhpushpi (<i>Convolvulus prostrate</i>), Bael (<i>Aegle marmelos</i>)					
1.3 Plant Parts Used as Lotion and Ointments: Identification and utilization of Gwarpatha (<i>Aloe vera</i>), Fenugreek (<i>Trigonella foenumgraecum</i>), Pot marigold (<i>Calendula officinalis</i>), Neem (<i>Azadirecta indica</i>)					
1.4 Plant Parts Used as Oil: Clove (Syzygiumaromaticum), Neem (Azadirecta indica), Coconut (Coccus nucifera), Nilgiri (Eucalyptus sp.)					
1.5 Plant Parts Used as Surgical Fibres, Sutures and Dressings: Identification and utilization of cotton (<i>Gossipium</i> sp.), Jute (<i>Corchorus capsularis</i>), Banana (<i>Musa</i> sp.)					
1. 1.6 Plant Parts Used as Poultice: Identification and utilization of Turmeric					

(Curcuma longa), Nilgiri (Eucalyptus sp.), Ginger (Gingiber officinalis),	
Garlic (Allium sativum), Onion (Alium cepa), Dhatura (Dhatura sp.), Aak	
(Calotropis sp.), Arandi (Ricinus communis)	
Unit IV	
Ethnobotany and legal aspects	15 hrs
 Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding. 	

M. Sc. Semester-I

DSC Lab

Cell and Molecular Biology and Ethnobotany and Medicinal Plants- Laboratory work

DSC-I Lab1	Hours: 6	Paper Code – M-BO514P	Credit:
	Hours/Week		3

Part 1: Cell and Molecular Biology

1. To study salivary gland chromosomes of Chironomas and Drosophila.

2. To isolate mitochondria and determine the activity of its marker enzyme SDH.

3. To isolate bacterial and plant DNA and quantify them by spectrophotometric method.

4. To demonstrate the semi-permeability of the plasma membrane.

- 5. To study the activity of Na/K ATPase.
- 6. To demonstrate different components of cytoskeleton in the suitable material.
- 7. To perform flagellar staining.
- 8. Isolation of DNA and preparation of Cot-curve.
- 9. Demonstration of vital structure and functions of cell

10. To study the activity of PAL in the seedlings challenged with elicitors.

11. To study the induction of antioxidant enzymes in the seedlings challenged with elicitors.

12. To study the effect of water stress on the seedling growth and its chlorophyll content.

13. To study the effect of temperature stress on the seedling growth and its chlorophyll

content.

14. To study the effect of salt stress on the seedling growth and its chlorophyll content. Part 2: Ethnobotany and Medicinal Plants

- 1. Identification of locally available common medicinal plants
- 2. Basic preparation of herbal products as kadha, powder (Ex. Neem leaf, moringa leaf, tulsi leaf, giloy, arandana),
- 3. Preparation of Juice (Ex. Amla, Aloe vera), Trifala,
- 4. Preparation of Chyavanprash,
- 5. Preparation of Amla candy, herbal tea, etc.
- 6. Study the various plants product having medicinal properties available in kitchen.
- 7. Study and documentation of commercial production of at least five medicinal plants. (Using website/ You Tube)
- 8. Submission of digital photo album of at least ten medicinal plants with brief description.
- 9. Study of basic tools/ instruments/ apparatus used in making herbal medicines.

- 10. Cultivation maintenance and reporting of at least five medicinal plants within college campus.
- 11. Educational visit to herbal medicine factory/small processing unit/ medicinal agriculture field and submission of project report. (At least 01)

Suggested Readings

- 1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
- 2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
- 3. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 4. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi 1981
- 5. Lone et al, Palaeoethnobotany
- 6. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- 7. S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
- 8. Colton C.M. 1997. Ethnobotany Principles and applications. John Wiley and sons Chichester
- 9. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah.
- Rajiv K. Sinha Ethnobotany The Renaissance of Traditional Herbal Medicine INA SHREE Publishers, Jaipur-19969) Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd.
- 11. CSIR Cultivation and Utilization of Medicinal Plants

M.Sc. Semester-I DSC Lab 1 Cell and Molecular Biology and Ethanobotany M-BO514P

Question paper

Time : 6 Hours		Max marks : 100
Q. 1 One long experiment A	20	
Q.2 One short experiment B 20		
Q.3 Interpretation on the given data C	20	
Q. 4 Spotting	10	
Q. 5 Viva-voce 10		
Q. 6 Practical Record and field diary	20	

M. Sc. Semester-I

Discipline Specific Elective (DSE-I)-

Phycology

M-BO513TPC

Objectives

- 1. To understand the salient features and economic importance of algal diversity
- 2. To study the structure and reproduction of various genera mentioned in the field of lower plants.
- 3. To familiarize the salient features and economic importance of various algal groups.

Outcome of the course

- 1. Students will understand the morphology and organization of the thallus and their role in medicine, industrial and food.
- 2. Students will understand the interrelationship of various algal groups
- 3. Understand the contributions of famous Indian phycologists and centers of Algal Research in India.
- 4. Study their ecological and economic importance.

DSE-I Theory	Hours:	Marks: 80+20=100	Credit:
Elective	4Hours/Week		4
	Un	it-I	
1. General accord	unt of phycology, Contri	butions of Indian Phycologist,	15 Hrs
2. Classification	and general characte	ers of Algae, Criteria for algal	
classification	, F.E. Fritch classification	n of algae,	
3. Diverse habit	ats of Algae, Range of t	hallus organization, Algal pigments	
and its signif	ficance in classification,	ultra-structure of flagella, eyespot	
and pyrenoids	s,		
4. Algal reprod	luction- (vegetative, ase	exual and sexual), life cycles and	
molecular phy	ylogeny of algae, fossil a	lgae.	
	Un	it-II	
1. General feat	ures, range of vegetative	e structure, reproduction, life cycle	15 Hrs
and phylogen	y, brief knowledge of the	e following genera	
2. Chlorophyta	:Chlamydomonas, H	ydrodictyon, Ulva, Cladophora,	
Pithophora, C	Chara and Nitella.		

2		
3.	Xanthophyta :Botrydium and Vaucheria	
4.	Bacillariophyta : Nitzhia and Cyclotella	
5.	Phaeophyta : Ectocarpus, Dictyota, Padina and Sargassum	
6.	Rhodophyta : Polysiphonia, Ceramium, Gelidium and Gracilaria	
7.	Cyanophyta : Anabaena, Spirulina, Oscillatoria and Lyngbya	
8.	General characteristic of the following divisions Cryptophyceae,	
	Dinophyceae, Euglenophyceae and Chrysophyceae,	
	IInit-III	
1.	Useful and harmful aspects of Algae -Algae as source of food for human,	15 Hrs
	animal feed, Nutraceuticals; Pharmaceuticals, biofuel, bio-ethanol,	
	biofertilizers, industrial applications of algae.	
2.	Role of algae in CO2 sequestration, pollution indicator, bioremediation	
	and soil fertility.	
3.	Sources of Nitrogen and its assimilation, importance and activity of	
	biofertilizers, biotechnological implication and Biological Nitrogen	
	fixation.	
4	Symbiotic algae and their role in other plants	
	Symolotic algae and their fole in other plants.	
	Unit-IV	
1.	Mass cultivation of algae- seaweed cultivation methods, Microalgae	15 Hrs
	Culturing techniques and photo bioreactor-based production;	
	Downstream processing. heterotrophic production.	
2.	Algal Bloom - Bioluminescence, Bloom formation and Eutrophication:	
3	Harmful algal blooms and toxin production: Bloom control measures and	
5.	algal toxins	
Λ	Spirulina- Nutritional Value Cultivation market value	
+.	Spiruma Tutritional value, Cuttvation, market value.	

Suggested Readings

- Fritsch, F.E. 1979. The structure and Reproduction of Algae Vol. I & II. Bishan Singh, Mahendra Pal Singh, Dehradun. Delhi.651 pp.1999.
- 2. O.P. Sharma. 2011, Algae, TATA McGraw-Hill, India.
- 3. Prescott, G.W. 1984. Algae: A review, Bishan Singh, Mahendra Pal Singh. Dehradun.
- 4. Kumar, H.D. Introductory Phycology. 2nd Ed. Affiliated East-West Press, New
- 5. Morris, I. 1986. An introduction of Algae. Cambridge University Press U.K.
- 6. R. E. Lee. 2008. Phycology, 4th Ed. Cambridge University Press
- 7. V.J. Chapman. 2015. The algae, Springer
- 8. Pandey, S.N., S.P.Misra and P.S. Trivedi. 2002. A Textbook of Botany Volume II. Vikas Publishing House Pvt Ltd, New Delhi.

- 9. Sharma, O.P. 2008. Textbook of Algae, Tata McGraw Hill
- 10. Round, F.E.1986. The Biology of Algae. Cambridge University Press, Cambridge
- 11. Desikachary, T.V. (1984). Cyanophyta. ICAR, New Delhi.

M. Sc. Semester-I

Discipline Specific Elective Course –DSE-I

Mycology

M-BO513TMY

Objectives:

- 1. Understanding life cycles, economic importance of fungi.
- 2. Application implementation of classification, life cycles, economic importance of fungi.

Course Outcome

After completion of this course students will able to know

- 1. Identify the structure and life cycles of various fungi.
- 2. Understand economic importance of fungi and apply this knowledge.

DSE-Theory Elective	Hours: 4Hours/Week	Marks: 80+20=100	Credit: 4
	Uni	it-I	
General accoun classification);	t: Classification of Fungi	(recent trends and criteria used in	15 Hrs
Physiology of F symbionts); Fung cycle.	u ngi (with reference to big gal Cytology; Heterothalli	otrophs, hemibiotrophs, sm, heterokaryosis, parasexual	
Fungal diversity growth and beha	in different ecosystems, e viour.	ffect of environment on fungal	
	Uni	t-II	
Comparative st	udy, classification and ev	olutionary trends in the following:	15 Hrs
Myxomycota : P to Physarium and	rotist characters and general Plasmodiophora	ral account with special reference	
	Un	it-III	
Comparative st	udy, classification and ev	olutionary trends in the following:	15 Hrs
Eumycota:			
i. Oomycetes: Sa	prolegnia, Synchytrium, I	Phytophthora, Peronospora,	
ii. Zygomycetes:	Mucor, Rhizophus, Synce	ephalastrum, Cunninghamella	

Unit-IV	
Comparative study, classification and evolutionary trends in the following:	15 Hrs
iii. Ascomycetes: Saccharomyces, Phyllactinia, Chaetomium, Xylaria	
iv. Basidiomycetes: Melampsora, Puccinia, Ravenelia, Ustilago, Polyporus.	
v. Deuteromycetes: Helminthosporium, Fusarium, Colletotrichum.	

Suggested Readings:

- 1. Agrios, G.N. (1980) Plant Pathology, academic Press, INC, New York.
- 2. Ainsworth, G.C. and A.S.Sussman (eds). The Fungi, An advance Treatise Vol.I, II, III & IV Academic Press, New York.
- 3. Alexopoulos, C.J. (1962). Introductory Mycology John Wiley Eastern Pvt.Ltd.
- 4. Alexopoulos, C.J. and Mims C.W. (1979). Introductory Mycology 3rd Edition, John Wiley and Sons, Inc. Wiley, New York.
- Alexopoulos, C.J., Mims and Black well (1996) 4th ed. John Wiley and Sons, Inc. Wiley, New York
- 6. Aneja, K.R. (1993) Experimental in Microbiology, Plant Pathology & Tissue Culture, WiswaPrakashan, New Delhi.
- 7. Bessey, E.A. (1950) Morphology and Taxonomy of Fungi. The Blakiston co. Philadelphia.
- 8. Bilgrami, K.S. and H.C.Dube (1985) A text Book of Modern Plant Pathology, Vikas Publication House, New Delhi.
- 9. Barnett, J.H. (1968) Fundamentals of Mycology. The English Language Book Society and Edward Arnold Publication, Limited.
- 10. Mehrotra, R.S. and K.R.Aneja (1998) An Introduction to Mycology, New Age Intermediate Press.
- 11. Pelzer, M.J., Jr.Cahn, E.C.S. and N.R.Krieg (1993) Microbiology, Tata McGraw Hill.
- 12. Schlegel, H.G. (1996) General Microbiology, 7th Edition, Cambridge University Press.
- 13. On line Journals available on UGC -VSAT

M. Sc. Semester-I

Discipline Specific Elective Course –DSE-I

Palynology

M-BO513TPN

Course Objectives:

- 1. Understanding the structure of pollen & pistil and their importance.
- 2. To Study pollen morphology, pollination, floral adaptations to diff. Pollinators, applications of pollen biology.
- 3. Knowledge on different types of honeys. **Course Outcomes:**
- 4. After successful completion of the course the students will be able to
- 5. Understand the different aspects of pollen, pistil and pollination Applying knowledge with reference to agriculture, horticulture, medicine.
- 6. To get acquainted with reproductive plant organs as stamen & Pistil
- 7. To know the various pollination methods, plant-pollinator interactions, various pollinating agents useful for plant breeding experiments.

DSE- Ele	Theory ective	Hours: 4Hours/Week	Marks: 80+20=100	Credit: 4
		Uni	t-I	
1.	General aspe	ects of Palynology		15 Hrs
2.	Microsporog	enesis: Stamen initiation,	, anther differentiation- anther	
i	initiation, Ant	ther wall, Tapetum, struct	ure and functions, its role in	
]	pollen develo	pment, Pollen/microspore	e and wall development,	
]	production an	d deposition of sporopoll	enin.	
3. 1	Pistil: Structu	are and function of stigmation	and style, stigma receptivity and	
i	its importance	2		
		Uni	t-11	
1. 1	Pollination	Biology -Origin of po	llination biology, Pollination in	15 Hrs
;	angiosperms-	types of pollination,		
2. :	floral adaptat	ion to different pollinator	rs (mode, style) flowers pollinated	
1	biotically and	abiotically (wind, water)	,	
3.	Pollination-pl	ant interactions, special	devices associated with pollinator	
;	attraction - p	ollen, nectar, Elaiophores	s, resin glands, osmophores, floral	
:	scent and perf	fume flowers.		
		Uni	it-111	

1.	Phylogeny of Pollen and spores, Systematic palynology-	15 Hrs
	monocotyledoneae and dicotyledoneae, evolutionary trends among	
	pollen grains based on palynotaxonornical works,	
2.	Pollen morphology of Angiosperms.: Introduction- Pollen units,	
	polarity, symmetry, Shape, size, Apertures size, shape of the pollen	
	grain, sporoderm stratification,	
3.	Apertures-NPC System of classification, Apertural types, Exine	
	ornamentation, LO analysis, evolutionary trends in exine structure,	
	trends of evolution in apertural pattern,	
4.	Techniques for the preparation of pollen slides, LM, SEM and TEM	
	studies of pollen and its significance.	
	Unit-IV	
2.	Melittopalynology- Pollen analysis of honey-methods, qualitative and	15 Hrs
	quantitative, social organization of honey bees, foraging behavior,	
	geographical and floral origin of honey, unifloral and multifloral honey,	
3.	Applied Melissopalynology - Bees as pollinators, role of apiaries in	
	crop production, Role in Agriculture/ Horticulture, Pollen loads, analysis,	
	Bee pollen, chemical composition, utility, and its role in curing various	
	human ailments.	

Suggested Readings:

- 1. Agashe S. N. Paleobotany (1997) -Plants of the past their evolution paleoenvironment and applications in exploration of Fossil.
- Agashe S. N. Palynology and its Applications Oxford and IBH Publishing Co. Pvt. Ltd. NewDelhi. Alexander M.P. (1969). Differential staining of aborted and nonaborted pollen Stain Techno144:117-122.
- 3. Alexander, M.P. (1987). A method for staining pollen tubes in pistil. Stain Technol 62, 107-112.
- 4. Alexander, M.P., Ganeshan S. (1990). An improved cellophane method for in vitro germination of recalcitrant pollen. Stain Technol 64:225-227. Archaeology, Rev. Palaeobot. Palyno/21:171-185,
- 5. Baker, H.G. 1954. Aperture membranes in Studies of Pollen Morphology and Taxonomy. Newphytologist,54(3),
- 6. Bane1jee, U.C. 1965,etal.Exine plasticity during pollen grain maturation. J.palynol.:70-89,
- 7. Bane1jee, U.C.1967.ULtrastructureof the tapetal membranes in grasses. Grana palynologia: 7,2-3,
- 8. Bhattacharya K., Majumdar M. and Gupta Bhattacharya S. (2006). A text book of Palynology.New Central Book Agency(P)Ltd.,Kolkata
- 9. Bhojwani, S.S. and S.P. Bhatnagar. 1978. The Embryology of Angiosperms. Vikas Publishing House, NewDelhi,
- 10. Bir Bahadur 1998. Nectary biology. Dattsons publications, NagpurBombay, Bradley, D. E. 1958. The study of pollen grain surfaces in the electron microscope New

Sc. and M. Sc. Sem. I & II Botany Syllabus as per NEP 2020 To be implemented from 2023-24

Phytologist Volume57, Issue2: 226-229

- 11. Caulton Eric, Agashe S. N. -Pollen and Spores applications with special emphasis on Aerobiology and Al lergy 15.
- 12. Cresti, M., Gori P., Pacini E. (eds.) (1988) Sexual reproduction in higher plants. Springer, Berlin Heidelberg New YorkTokyo.
- Cronquist, A. 1968. The evolution and classification of flowering plants, Nelson,London Dafni Amots, Hesser Michel, Paeini Ettore - Pollen and Pollination-Springer Wien New York
- 14. Davis. P.H. and V.H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd.London,
- Doyle James A(2005) Early evolution of angiosperm pollen as inferred from molecular and morphological phylogenetic analyses, Grana, 44:4, 227-251, DOI: 10.1080/00173130500424557
- 16. EI-Gazzar and M.K. Hamza. 1973. Morphology of the twin Pollinia of Asclepiadaceae. Pollen et spores XV(3-4)
- 17. Erdtman, G. 1945. Pollen Morphology and Plant Taxonomy IV Labiatae, Verbenaceae, Avicenniaceae. SvenskBotanisk Tidskrift.39(3),
- 18. Erdtman, G. (1966). Pollen morphology and plant taxonomy angiosperms hafner. New York. Erdtman, G. (1969). Handbook of Palynology. Hafner, New York
- 19. Erdtman, G. 1952. Pollen Morphology and Plant Taxonomy (An Introduction to Palynology-1, Angiosperms). Aimqvist, and Wicksell,Stockholm,
- 20. Erdtman, G. 1956. Current Trends in Palynological Research Work Grana Palynologica (N.S.)1:2, Erdtman, G. 1960. The Acetolysis method revised description Su. Bot. Tidskr.54(4).
- 21. Erdtman, G. 1964. Palynology. In: W.B. Turrill (Editor) Vistas in Botany. Macmillan Go., New York, Vol.4:23-54.
- 22. Faegri, K. 1975..(3rd Revised Ed.) Text Book of Pollen Analysis. Blackwell ScientificPubl. Oxford, Heslop-Harrison, J. (1987). Pollen germination and pollen tube growth. Int. Rev. Cytol. 107:1-78.
- 23. Heslop-Harrison, J. 1962. Origin of Exine. Nature, 195 (4846):1069-1071
- 24. Heslop-Harrison, J. 1971. (Editor). Pollen: Development & Physiology. Butterworths, London,
- 25. Heslop-Harrison, J. 1976. The adaptive significance of the exine. Academic Press. London, Linn. Soc. Symp. Serl:27-37,
- 26. Shivanna K.R. (1984). The evaluation of pollen quality and a further appraisal of the fluorochromatic (FCR) test procedure. Theor. Appl. Genet 67:367-375.
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- 28. Jain A., Shivanna, K.R. (1988b). Storage of pollen grains in organic solvents. Effects of solvents on pollen viability and membrane integrity. J. Plant Physiol.132:499-502.
- 29. Knox. R.B., Williams, E.G., Dumas, C. (1986). Pollen, pistil and reproductive function in crop plants.Plant Breed.Rev.4:9-79.
- 30. Maheshwari, P, 1978. An Introduction to the Embryology of Angiosperms, Tata McGraw- Hill Publ. Co. NewDelhi
- 31. Nair, P.K.K. 1966.Essentials of Palynology. Asia Publ. House, Bombay,
- 32. Nair, P.K.K-. 1970.Pollen morphology of Angiosperms. Scholar Publ.

House,Lucknow,

- 33. Nair. P.K.K. 1965.Pollen Grains of Western Himalayan Plants.Asia Publ. House.of pollen vedamse Book (P) Ltd. NewDelhi.
- 34. Plummer, D.T (1987), An introduction to practical biochemistry (3rd edn). MeGraw-Hill.London (Tata Mc-Graw-Hill Edition, 1988).
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- Shivanna, K, R. (1982,). Pollen-pistil-interaction and control of fertilization. In: Johri B.M. (ed.). Experimental embryology of vascular plants. Springer, Berlin Heidelberg New York, pp, 131-174.
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- 39. Shivanna, K.R. and Rangaswami, N.S. 1992. Pollen Biology: A laboratory manual. Narosa Publishing House, NewDelhi.
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- 41. Swamy, B.G.L. and K.V. Krishnamurthy. 1980 From Flower to Fruit. Tata McGraw-Hill Publisher, Talde U.K. 1994.Advances in Mycology and Aerobiology-Dr ST Tilak commemoration volume.
- 42. Tilak S.T. 1982. Aerobiology, VaijyantiPrakashan, Aurangabad
- 43. Tilak S.T.1989. Recent researches in Ecology, Environment and Pollution. Today & Tomorrow Pub., New Delhi
- 44. Tilak S.T. 1987 "Air monitoring practical Manual", VaijantiPrakashan, Aurangabad. Tilak S.T. 2009. Aeromycology. Bharati Printing Press,Pune.
- 45. Tilak S. T. 1989. Atlas of airborne pollen grains and fungal spores. Vaijayanti Prakashan, Aurangabad. Tilak S. T. 1989. Env. Ecology and Aerobiology. Today & Tomorrow. s Printers, New Delhi.
- 46. Vishnu-Mittre. 1964. Contemporary thought in Palynology. Phytomolphology. 14(1): 101.
- 47. Walker, J.W. and J.A. Doyle. 1975. The basis of angiosperm phylogeny: Palynology. Ann. Missouri. Bot. Gard, 62. 664-723,

	M. Sc. Seme	ster-I	
	Research Meth	odology	
	M-BO515TRM (0	Credits 4)	
RM-TheoryHours: 4Marks:CHours/Week80+20(Internal)=100it		Cred it: 4	
Course	Objective		
 Acun Endif Acun Acun<!--</th--><th>uirea comprehensive derstandingofresearchmethodolog hancetheabilitytocriticallyevaluate ferenttypes ofresearch. quireskillsindatacollection, analysi echniques. evelop eproficiency intechnical writing, rese wearch ethics and academic integrity.</th><th>yanditsfundamentalconcepts. eandselectappropriateresearchmo s,andinterpretationusingvarious earchreporting,andadherenceto</th><th>ethodsfor statistic</th>	uirea comprehensive derstandingofresearchmethodolog hancetheabilitytocriticallyevaluate ferenttypes ofresearch. quireskillsindatacollection, analysi echniques. evelop eproficiency intechnical writing, rese wearch ethics and academic integrity.	yanditsfundamentalconcepts. eandselectappropriateresearchmo s,andinterpretationusingvarious earchreporting,andadherenceto	ethodsfor statistic
Course O Ur dir Ap hp Ap Int res De an	atcome: Afterlearningresearchmeth aderstandanddescribethecharacteris agbasic,applied,andpatent-oriented oplyscientificthinkingandproblemic rocess. oplydescriptiveandinferentialstatist erpretresearchdataandunderstandthe earch,andapplyappropriateresearch velop skills in technical writing, r dorganizationofresearchdocument	odologycourse,studentswillbeabl sticsofdifferenttypesofresearch, research. dentificationtechniquesintherese cicalanalysistechniquestoanalyze concept ofhypothesisanditsimpo nethods. esearch reporting, and the prope sandgainawarenessofresearcheth	eto nclu arc and ortancein er structure nics,acade
	Unit-I	angpiagiarismandacademicma.	practice.
	Researchbasicsandperc	eptionofresearch	15 Hrs
i. ii.	Definition, Generalandspecificc esofresearch(basic, applied and StepsofAction(basic) research, o ch, characteristics of investigator	haracteristicsofresearch,typ patentoriented). bjectivesofbasicresear rs.	
ın. iv.	Scientificthinking- characters,stepsinprocessofscie midentification,criteriaforselect ntificproblems. Reviewofliterature- meaning,need,andobjectives,str sofliteraturecollection,Simplery (review methodnaper thesic) Si	ntificthinking,Stepsinproble ingproblem,andsourcesofscie uctureofreviewofliterature,sourcesofreading/understandingpape	ce er lit
	eraturereview.		

Unit-II	
Basicsofhypothesisand research methods	15 Hrs
i. Definitionofhypothesis,assumption,andpostulate,nature,functionandin ortanceof hypothesis,characteristicsofgo hypothesis,kindsofhypothesis	np ood
ii. Definitionandtypesofresearchmethods,characteristicsofsurvey methods,Typesofsurveymethods:Questionnairesurveyand theiradvantages	
iii. Experimentalmethod-	
definition, basic assumption, Types of variables (controls) in experiments, Steps of experimental methods, Classification of experiments or experimental procedures.	
iv. Casestudymethod- definition,objectives,typesofcasestudymethods,Stepsofcasestudy method	
Unit-III	
Datacollection tables and granks.	15 Hrs
	15 1115
i. Needfordatacollection, meaning of data, Nature of data, variables,	
ii. Typesofdata(variables):Nominalvariable.Ordinalor	
rankvariable,intervalandratio	
variable, Ethical consideration during data collection	
iii.	
Statisticalanalysisofdata:Descriptiveandinperennial,Meaningofparan	net
Mean(andtypesofmeans)Basicstructure	de
Range.OuartileDeviation.Meanabsolutedeviation.Standarddeviation.	.sta
ndarderrors, merits, and demerits of measures, tables and graphs showing	
descriptive measures	
Probabilitydistribution,Shapeofnormalcurve,Areasunder standardnormalc	urve,
for hypothesistesting, chi-square test,Type-Iand Ilerror,onewayANOVA,StructureofANOVAtable	edure Гуре-
iv. Basic structure of Graph, Bar graph, pie chart, histogram, scat	ter
plot,timeseries graph,Line graph,Basicstruct oftable,Meaningfultables	ıre
Unit-IV	
Technical writing research reporting research ad this and a lagistic research	15 Unc
i. Structure of the sis. structure of research paper structure of proje	ect 15 mis
report, structure of project proposal.	

ii.	Annotatedbibliographies:Structureandorganization,Criticalthink
	ing,Evaluating information.
iii.	Academicintegrity, skills (rules) for good academic practice, unders
	tandingplagiarismand academic malpractice.
iv.	To get acquainted with the laboratory Equipment's) Laminar air
	flowchamber / Table
v.	Environmental growth cabinet b)Vortex shaker/ Mixer
	c)Electrophoreticunit
vi.	Serological water bath (with shaking facility)

References/Books:

- 1. Shanti Mishra, & Alok, S. (2011). *Handbook of Research Methodology: A Compendium forScholars & Researchers*. EducreationPublishing.
- 2. Singh, Y. kumar. (2006). *Fundamentals of Research Methodology and Statistics*. New AgeInternationalPublishers.
- 3. Walliman, N. (2010). Research Methods The Basics. Routledge Taylor and Francis Group.

M. Sc. Semester-II

Discipline Specific Core Course –DSC-III

Plant Metabolism

M-BO521T

Objectives :

1. To know Carbohydrates Metabolism in living plant system.

2. To understand Amino Acid Metabolism and Lipid Metabolism.

3. To understand Nitrogen and sulphur Metabolism.

Course Outcome

After completion of this course students will able to know

1. Importance of Carbohydrates Metabolism in living plant system.

2. Importance of Amino Acid Metabolism and Lipid Metabolism.

3. Importance and role of Nitrogen and sulphur Metabolism.

DSC-I T	heory Hours: 4 Hours/Week	Marks: 80+20=100	Credit: 4
	Un	it-I	
 1. 2. 3. 	Concept of Metabolism: Introduce pathways, regulation of metabolism (allosteric, covalent modulation are Carbohydrate Metabolism: Con- carbohydrates Biosynthesis of starch and sugars, and sucrose, Interaction between H Triose phosphate pools.	ction, anabolic and catabolic m, role of regulatory enzymes nd Isozymes). nposition, structure and function of catabolism (degradation) of starch Hexose Pentose Phosphate and	15 Hrs
	Un	it-II	
1. 2. 3.	Lipid Metabolism: Composition, Fatty acid biosynthesis, membristorage lipids. Phospholipids and of Synthesis and breakdown of trig cycle, gluconeogenesis and its root seed germination, α oxidation.	structure and function of lipids rane lipids, structural lipids and derived lipids (steroids). glycerides, β -oxidation, glyoxylate de in mobilization of lipids during	15 Hrs

	Unit-III	
1.	Metabolism of amino acids: Composition, structure and function of	15 Hrs
	amino acids, Amino acid biosynthesis in Plants	
2.	Protein metabolism: Composition, structure (Ramchandran plot.	
	secondary, tertiary and quaternary structure) and function of Proteins	
	Unit-IV	
1.	Nitrogen metabolism: Overview of nitrogen fixation, Nitrate and	15 Hrs
	ammonium assimilation	
2.	Sulphur Metabolism: Sulphur chemistry and fixation, uptake and	
	transport, reductive sulphate assimilation pathways, synthesis and	
	function of glutathione and its derivatives.	
3.	Secondary metabolites: Cutin, Waxes, Suberins, Biosynthesis of	
	terpenes, phenolic compounds. Nitrogenous compounds and their	
	roles. Secondary metabolite and Plant defense	

Suggested Readings

- Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
- Buchanan, B., Gruissem, G. and Jones, R. (2000). Biochemistry and Molecular Biologyof Plants, American Society of Plant Physiologists, USA.
- Davies P J. (2004). Plant Hormones: Biosynthesis, Signal Transduction, Action.
 3rdEdition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
- 4. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley and Sons, U.S.A. 4th Edition.
- Nelson, D.L., and Cox, M.M. (2008). Lehninger Principles of Biochemistry (5th ed.).W.H.Freeman& Co., New York.
- Taiz, L., Zeiger, E., (2014). Plant Physiology. Sinauer Associates Inc., U.S.A. 6 Th Edit

M. Sc. Semester-II

Discipline Specific Core Course –DSC-IV

Plant Biodiversity and Conservation

M-BO522T

Objective:

- 1. Understanding Biodiversity of India and World.
- 2. Understanding need of plant conservation;
- 3. Understanding importance of National parks, Biospheres, botanical gardens etc.
- 4. Understand the vegetation types around them.

Outcome:

- 1. Learn and apply the knowledge of Biodiversity and conservation methods.
- 2. Learn and apply the knowledge of conservation methods.
- 3. Learn and apply techniques of Botanical gardens etc.
- 4. Learn and understanding value of rare and threatened plant.

	+. Learn and un	derstanding value of fare a		
D	SC-IV Theory	Hours: 4	Marks: 80+20=100	Credit:
		Hours/Week		4
		Uni	t-I	1
1.	Theory of land l	oridge, theory of continen	tal drift, polar oscillations and	15 Hrs
	glaciations.			
2.	Centre of origin	of plant – Vavilov's conc	ept, types. Phytogeographical	
	regions - concep	t, phytogeographical regio	ons of India.	
3.	Vegetation types	s of India– Composition a	nd distribution of evergreen, semi	
	evergreen, decidu	ious, scrub, mangroves, sł	noal forests and grasslands. An	
	account of the ve	getation of the Western G	hats.	
	Unit-II			
1.	Biodiversity: D	efinition, types of biodiv	ersity - habitat diversity, species	15 Hrs
	diversity and gen	netic diversity,		
2.	Global and Ind	ian species diversity. SI	DG's in biodiversity conservation.	
	Values of Biodi	versity – Economic and	aesthetic value, Medicinal and	
	timber vielding	plants. NTFP. Threats to b	iodiversity.	
		L.	5	
		Uni	t-III	
1.	Biodiversity Ho	tspots and Hottest hotsp	ot, Biodiversity hot spots of India,	15 Hrs
	Concept of ender	nism and endemic species		
2.	Conservation m	ethods – In-situ and ex-si	tu methods,	
3.	Conservation of	Biodiversity: Conservati	on of genetic diversity, species	
	diversity and eco	system diversity. Social a	oproaches to conservation.	

	Biodiversity awareness programmes, Sustainable development	
	Unit-IV	
1.	IUCN- General Account, categories, Commissions, role in conservation;	15 Hrs
	Red Data Book	
2.	Protected areas- Sanctuaries, National parks, Biosphere reserves.	
3.	Wetlands and Mangroves Coral Reefs- Types, importance, artificial reefs,	
	conservation measures Botanical gardens, Seed Banks; In-vitro repositories;	
	Cryobanks,	

Discipline Specific Core Course Laboratory Exercise

Plant Metabolism and Plant Biodiversity and Conservation(M-BO524P)

Laboratory Exercise	Hours: 12 Hours/Week		Credit: 6		
	Part 1: Plant Metabolism				
1. Effect of time and enzyme concentration on the rate of enzyme action (e.g. acid phosphatase, nitrate reductase).					
2. Estimation of stres	ss induced amino acid (Pro	line)			
3. Determination of t	otal carbohydrates by Anth	nrone method.			
4. Extraction of seed	proteins depending upon s	solubility.			
5. Determination of s inhibitors.	succinate dehydrogenase ad	ctivity, its kinetics, & sensitivity to	0		
6. Separation of isozy electrophoresis.	6. Separation of isozymes of esterases, peroxidases by native polyacrylamide gel electrophoresis.				
7. Estimation of total	l fats in fatty seeds.				
8. Separation of Alka	8. Separation of Alkaloids/Phenols by TLC.				
9. Estimation of Phenols by chemical method.					
10. Extraction of seco	10. Extraction of secondary metabolites from callus tissue.				
11. Qualitative analy	sis of secondary metabolite	es.			
12. Detection of seco	ondary metabolites by TLC	(any one)			
13. Profile study of se	econdary metabolites by T	LC (any one)			
14. Separation of Am	nino acids by chromatogra	phic techniques			
15 Spectrophotomete	15 Spectrophotometer estimation of secondary metabolites.				
16 Estimation of phy	16 Estimation of phytoalexins.				
Part 2: Plant Biodiversity and Conservation					
1. A trip to the	grass land/ forest/ water be	ody to get acquainted with their pl	lant species.		
2. Demonstration	on of different types of veg	getation sampling methods – trans	sects and		
quadrats.					
3. To determine	e minimum size and numbe	er of quadrats required to study gr	cassland.		

- 4. To determine minimum size and number of quadrats required to study Forest area.
- 5. Qualitative parameters of distribution of plant species, Frequency, Density, Basal cover, dominance, Abundance and IVI.
- 6. To determine the homogeneity of vegetation by Raunkier's frequency diagram.
- 7. To determine diversity indices (Shannon-Weiner, species richness, B-diversity) from given data.
- 8. Population structure study of dominant tree species of the locality.
- 9. To study the various methods of conservation- In-situ and Ex-situ.

Based on Biostatistics

- 1. Calculate mean, variance, standard deviation and coefficient of variation for comparing two means related to given ecological data.
- 2. Calculate mean, variance, and to use t-test for comparing two means related to given ecological data.
- 3. To find out association between important grassland species from the given data using chi- square test.
- 4. To find out relationship between two ecological variables using correlation analysis.
- 5. To perform the one-way ANOVA from the given data.

Suggested Readings:

- 1. Sharma, P.D. 2018. Fundamentals of Ecology.Rastogi Publications.
- 2. Odum E.P. (1975): Ecology By Holt, Rinert& Winston.
- 3. Oosting, H.G. (1978): Plants and Ecosystem Wadworth Belmont.

 Kochhar, P.L. (1975): Plant Ecology. (9th Edn.,) New Delhi, Bombay, Calcutta-226pp., 5. Kumar, H.D. (1992): Modern Concepts of Ecology (7th Edn.,) Vikas Publishing Co., New Delhi.

6. Kumar H.D. (2000): Biodiversity & Sustainable Conservation. Oxford & IBH Publishing Co Ltd. New Delhi.

7. Newman, E.I. (2000): Applied Ecology, Blackwell Scientific Publisher, U.K.

8. Chapman, J.L&M.J. Reiss (1992): Ecology (Principles & Applications). Cambridge University Press, U.K.

9. Malcolm L. Hunter Jr., James P. Gibbs, Viorel D. Popescu, 2020. Fundamentals of Conservation Biology, 4th Edition.Wiley-Blackwel.

10. Saha T. K., 2017. Ecology and Environmental Biology.Books and Allied Publishers.

M.Sc. Semister -II

Discipline Specifice Core Course Laboratory Exercise (M-BO524P)

Time : 6 hrs.

Max Marks: 100

1 To perform given major Plant metabolism experiment (A) And Report Findings.	15
2 To perform the manor plant metabolism experiment (B) And report Findings.	10
3 To perform given major Ecological Experiment (C)	15
4 To perform given minor Ecological Experiment (D)	10
5 Spotting	20
6 Viva – Voce	05
7 Practical Record and Excursion Report	05

	M. Sc. Sei	nester-II			
	Discipline Specific Elective (DSE) DSC II				
	Palaeol	ootany			
	M-BO52	23TPB			
DSE-II Theory	Hours: 4	Marks: 80+20=100	Credit:		
Elective	Hours/Week		4		
 Course Obje Geological Ph Learn Systema 	ctive: Understanding the enomenon,Geological Tim atics ,Reconstruction and N	Science of Petrology,Classification on Scale Nomenclature,Types of preservation	f Rocks,		
Learn early lan	nd Plants				
Understanding	g Diversification in Primit	ive Gymnosperm			
Understanding Deccan Intertr	g formation of Deccan trap rappean flora of India	s and Intertraps, age and its floristic of	composition		
Course Outcome: A	fter completion of the cour	rse the students will able to			
Learn various	types of rocks, Geological	Time Scale			
Learn Systema	atics ,Reconstruction and N	Nomenclature, types of Preservation			
Learn and Ear	ly land plants				
Understand D	Diversification in Primitive	Gymnosperm			
• Understand the formation of Deccan traps and Intertraps, age and its floristic composition					
Deccan Intertrappean flora of India					
	Uni	t-I			
1. Introduction	to the Science of Petrol	ogv:	15 Hrs		
The classifica	tion of rocks i.e.Endogen	etic and Exogenetic (Igneous,			
Metamorphic	and Sedimentary) and the	eir brief account.			
2. Geological col	lumn and time scale.				
3. Fossilisation:	Modes of Preservation (Ty	rpes)			
4. Preparation an	d age determination techn	iques.			
5. Systematics, 1	Reconstruction and Nom	enclature.			
6. Application	of Palaeobotany in oil ex	ploration.			
	Unit	-11			
1. Life in Preca	mbrian		15 Hrs		
2. Greening of I	Earth – Speculation.				
3. Rhyniopsida-	Rhynia				
4. Horneophytop	sida-Horneophyton				
5. Arborescent	Lycopods of Carbonifero	us:			
6. Lepidodendro	n, Lepidophlois, Lepidocar	rpon, Lepidostrobus, Stigmaria.			
7. Diversity of l consideration	Devonian:-Shpenopsida-	Its origin and evolutionary			
8. Sphenophyllal	es-Sphenophyllum				
9. Calamitales-C	alamites				

	Unit-III	
1. 2. 3. 4.	Pteridosperms:- Lyginopteridales: Lyginopteridaceae, Diversification in primitive Gymnosperm;- Cycadeoidales- Cycadeoidaceae, Williamsoniaceae Caytoniales-Caytoniaceae More Diversification in Primitive Gymnosperm contd.:-	15 Hrs
	Cordaitales, Glossopteridales, Pentoxylales.	
	Unit-IV	
1. 2. 3. 4.	 Study of Deccan Intertrappean flora of India: Formation of Deccan traps and Intertraps, age and its floristic composition in relation to Pteridophytes (<i>Azolla, Salvinia, Surangea</i>), Gymnosperms (<i>Mohgaostrobus, Harrisostrobus</i>) Angiosperms (<i>Palmoxylon, Palmocarpon, Triccoccites, Enigmocarpon, Chitaleypushpam, Sahnianthus, Sahnipushpam</i>). Paleoclimate and Paleogeography of Deccan Intertraps. 	15 Hrs

*Note:- Different plant groups are to be studied with key genera for their morphology and anatomy of vegetative and reproductive parts

List of Books / References / Online Resources

- 1. Agashe S.N.(1995)-Palaeobotany, Plants of the past ,their evolution, palaeoenvironment and application in exploration of fossil fuels.Oxford &IBH publishing company-New Delhi.
- 2. Andrews H.N.(1961)-Studies in Palaeobotany, Willey and Sons –New York.
- 3. Arnold, C.A. (1947)-An Introduction to Palaeobotany, MC-Graw Hills., New York
- 4. Beck, C.B. and Wight, D.C. (1988)-Progymnosperm, In origin and evolution of Gymnosperms, Columbia Uni. Press-New York.

5. Beck, C.B.(1976)-Current status of the Progymnospermosida, Review of Palaeobotany and Palynology

- 6. Darrah, W.C.(1960)-Principles of Paleobotany.
- 7. Erdtman,G(1957)-Pollen and Spore morphology and plant taxonomy.(An introduction to palynology) Hafner Publishing Comp-New York.
- 8. Chandra, S. and Surange, K.R. (1979)-Revision of the Indian species of Glossopteris, Monograph, Birbal Sahni Institute of Palaeobotany.
- 9. Hoffmeister, W.S. (1960)-Palynology has an important role in oil exploration. World oil-150:1001-140.
- 10. Meyen, S.V.(1987) Fundamentals of Palaeobotany Chapman and Hill, London, New York.
- 11. Parihar ,N.S.(1995) Essentials of Palaeobotany, Central Book Allahabad.
- 12. Sahni, B.(1964)- Revisions of Indian fossils plants, -III(Monocotyledons) -BSIP-Lucknow.
- 13.Stewart, W.N.& Rothwell,G.V. (1993)-Palaeobotany and Evolution of Plants, Cambridge Univ., Press-Cambridge.

14. Venkatchala, B.S & Maheshwari, H.K. (1991)-Palaeobotanical Researches in India. Jour. Ind. Bot. Society-70;1-12

- 15. Wadia, D.N(1953)-Geology of India, Mac, Millan-Co.London.
- 16 Prasad, K.N. (1999). An introduction to palaeobotany, APH Pub.
- 17.Cleal, J. Christopher. &B.A.Thomas (2009)Introduction to Plant Fossils, Cambridge Univ., Press-Cambridge.
- 18.Willis, K.J. & McElwain, J. C.(2014). The Evolution Of Plants(second edition)OXFORD University Press

JOURNALS

1.Palaeobotanist

- 2.Geophytology
- 3.Botanique
- 4. Review of Palaeobotany and Palynology
- 5. Journal of India Botanical Society
- 6. American Journal of Botany
- 7. International Palaeobotanical Organization (News), Bulletin
- 8.Palaeontographica
- 9.Nature
- 10.Botanical Gazette
- 11.Bull. of Botanical Survey of India
- 12.Bull. of Survey of India
- 13.Current Science

M. Sc. Semester-II

Discipline Specific Elective – Plant Growth regulator

M-BO523TPG

Course Objectives: -

- 1. To provide basic information about different aspects of phytohormones and plant growth regulators and their applications in agriculture;
- 2. Physiological functions and mechanism of action of various plant hormones and knowledge in plant growth regulation acquired by the students will be useful for achieving higher productivity of crops.

Course Outcome

- 1. Students will understand about different aspects of phytohormones and plant growth regulators and their applications in agriculture
- 2. Students will understand the physiological functions and mechanism of action of various plant hormones
- 3. Students will apply the knowledge of plant growth regulation acquired by them for achieving higher productivity of crops

DSE II Theory	Hours: 4	Marks: 80+20=100	Credit: 4
Elective	Hours/Week		
	Uni	t-I	
Definition and classi	fication of plant growth r	egulators- Hormones, endogenous	15 Hrs
growth substances and synthetic chemicals, Plant promoters and Plant Inhibitors.			
Endogenous grow	th regulating substan	nces other than hormones.	
Brassinosteroid, triacontanol, salicylate, polyamines, jasmonates. concept of			
death hormone			
Unit-II			
Discoery, Site of svi	nthesis, bio-assay, biosvi	thetic pathways and metabolism.	15 Hrs
Physiological effects of individual group of hormones – Auxins, Gibberllins,			
cytokinins, Abscisic acid and Ethylene and Brassinosteroids. Physiology of fruit			

Set, growth, development, ripening, premature drop and abscission.		
Manipulating fruit development and storage quality using growth regulators.		
Unit-III		
Signal perception and signal transduction, hormone binding receptors, hormone	15 hrs	
induced changes in gene expression and specific functions of different		
hormones-Auxins- cell elongation, Gibberellins-germination of dormant seeds,		
Cytokinins-cell division. Retardation of senescence of plant parts, Abscisic acid		
stomatal closure and induction of drought resistance, Ethylene- fruit		
ripening.Specific signaling pathways of Auxins, Gibberellins, cytokinins, ABA,		
ethylene and brassinosteroids		
Growth Retardant: Maleic hydrazide, Jasmonic acid, Uniconazole,		
Paclobutrazol		
Unit-IV		
Interaction of hormones in regulation of plant growth and development	15 Hrs	
processes. Rooting of cuttings-Flowering. Apical dominance, molecular aspects		
of control of reproductive growth and development. Synthetic growth		
regulators- Classification, their effect on plant growth and development.		
Practical utility in agriculture and horticulture.		

Suggested Readings

- 1. Taiz L and Zeiger E. Plant Physiology. 3rd edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts PP. 690. (2002).
- 2. Moore TC. Biochemistry and Physiology of Plant Hormones. 2nd Ed Springer-Verlag, NY, NY pp. 330. (1989).
- 3. Nickell LG. Plant growth regulators. Springer-Verlag, Berlin, Heidelberg, New York pp. 173. (1982).
- 4. Plant Hormones: Physiology, Biochemistry and Molecular Biology Editors Peter J. Davies. Publisher Springer DordrechtDOIhttps://doi.org/10.1007/978-94-011-0473-9

M. Sc. Semester-II

Discipline Specific Elective – Hydrobiology and Limnology

M-BO523THY

Course Objectives

- 1. To study Physical, chemical and Biological parameters of the Inland Water bodies
- 2. To Know Distribution and dynamics of freshwater bodies
- 3. To know Classification and general characteristics of lotic and lentic water bodies.
- 4. To understand the impact of human activities on water bodies.

Course Outcomes :

Students will develop an understanding of

- 1. The diversity of biological, physical and chemical characteristics of lakes
- 2. Lake ecosystem function (energy flow and biogeochemical cycling)
- 3. The diversity and ecology of organisms in lakes
- 4. Human impacts on lakes (e.g., water quality) and remediation strategies
- 5. The role of aquatic ecosystem science in society

DSE II Theory	Hours:	Marks: 80+20 = 100	Credit: 4
Elective	4Hours/Week		
	Uni	t-I	
1. Physical and	chemical characteristics o	f water, freshwater	15 Hrs
environment			
2. Lentic environment: General consideration, physico-chemical factors,			
and their influence,			
3. Lotic environment: General consideration, physico -chemical factors,			
and their influence			

Unit-II	
1. Phytoplankton nature and adaptation of plankters, periodicity and	15 Hrs
succession, vertical distribution, productivity and factors influencing it.	
2. Study of phytoplanktons : Terminology, population, adaptations	
Distribution, productivity and succession Primary productivity and	
measurement of growth rate and natural mortality.	
Unit-III	ł
1. Aquatic plants: characteristics, classification, zonation, seasonal	15 Hrs
variations, quantity produced chemical composition distribution in	
different waters, limnological role.	
2. Eutrophication and algal blooms: Definition factor: responsible for water	
quality, use of algal blooms and their control measures.	
Unit-IV	
 Distribution, community structure in fresh and marine water. Role of algae as indicators of pollution and its concept. Algae in waste water treatment, use of algal bacterial system in sewage and other waste effluents, Bio monitoring of water quality. Algae stabilization pond. 	15 Hrs

Suggested Readings

- 1. Reynolds, C.S.2007. Ecology of Phytoplankton. Cambridge, Cambridge University Press.
- Bronmark, C. and L.A. Hansson. 2017. The biology of lakes and ponds. 3rd Edition. New York, Oxford University Press
- Wetzel, R. G. (2001). Limnology: lake and river ecosystems. San Diego, Academic Press.
- 4. Lynn, K and Cech, T. (2010). Introduction to Water Resources and Environmental Issues. Cambridge, Cambridge University Press.

M. Sc. Semester-II			
Internship/Apprentiship (Related to DSC) M-BO525P			