K. C. E. Society's
Moolji Jaitha College
An 'Autonomous College' Affiliated to
K.B.C. North Maharashtra University, Jalgaon.
NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle)
UGC honoured "College of Excellence" (2014-2019)
DST(FIST) Assisted College

KNOWLEDGE IS POWER
ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय
क.ब.चौ. उत्तर महाराष्ट्र विद्यापीठ, जळगाव संलग्नित
'स्वायत्त महाविद्यालय'
नॅकद्वारा पुनर्मानांकित श्रेणी – 'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स' (२०१४-२०१९)
डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 01/08/2023

NOTIFICATION

Sub :- CBCS Syllabi of M. Sc. in Botany (Sem. I & II)

Ref. :- Decision of the Academic Council at its meeting held on 26/07/2023.

The Syllabi of M. Sc. in Botany (First and Second Semesters) as per **NATIONAL EDUCATION POLICY - 2020** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2023-24.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

Near Samarth Colony, Jalgaon - 425 002. (Maharashtra, India) | Ph. : +91 257 - 2237363, 2234281 | e-mail : mjcollege@kces.in | Website : mjcollege.kces.in
समर्थ कॉलनी जवळ, जळगांव – ४२५ ००२. (महाराष्ट्र, भारत) । दूरध्वनी क्र. : +९१ २५७–२२३७३६३, २२३४२८१ । ई–मेलः mjcollege@kces.in । वेबसाईटः mjcollege.kces.in

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to KBC North Maharashtra University, Jalgaon

KNOWLEDGE IS POWER

ESTD. 1945

SYLLABUS

M.Sc.- I Botany

Under Choice Based Credit System (CBCS)

and

as per NEP-2020 Guidelines

[w.e.f. AcademicYear:2023-24]

Preface

Skilled human resource is a prerequisite in higher education, and it is to be acquired through in-depth knowledge of theoretical concepts and hands-on laboratory methods of the subject. The present syllabus of M.Sc. part I in the subject of Botany has been prepared as per the guidelines of UGC, NEP-2020 and Government of Maharashtra. It cultivates theoretical and practical know-how of different fields of Botany. The contents of the syllabus have been prepared to accommodate the fundamental aspects and advanced developments in various disciplines of Botany and to complement the needs of various applied sectors of Botany. Besides this, the students will be enlightened with knowledge in the newer areas of Bioinstrumentations, Genetics and plant breeding, Ecology, phytogeography, plant metabolism, tissue culture, microbial fermentations, IPR, Patents, bioethics etc. Furthermore, the syllabus is structured to cater to Botany's present and future needs in the research field, industrial and environmental sectors, Entrepreneurship etc., emphasizing imparting hands-on skills. Hence, the curriculum is endowed with more experiments that shall run hand-in-hand with theory. The detailed syllabus of each paper is appended with a list of suggested readings.

The overall curriculum of one/ two-year covers plant taxonomy, lower cryptogames, biostatics, plant pathology, plant biotechnology, plant physiology and biochemistry, cell biology, molecular biology and microbial genetics, industrial and applied botany, environmental botany, and also covers various advance biotechniques such as genetics and plant breeding, bio-analyticaltechniqes, Tissue culture etc. Furthermore, the syllabus is structured to cater to Botany's present and future needs in the research field, Industrial and Environmental Sector, Entrepreneurship etc., emphasizing imparting hands-on skills. Hence, the curriculum is endowed with more experiments that shall run hand-in-hand with theory. The detailed syllabus of each paper is appended with a list of suggested readings.

Program Outcomes (PO) for M.Sc. Program

Upon successful completion of the M.Sc. program, student will be able to:

PO No.	PO
PO 1	Understand the fundamental principles of science along with their applied aspects
PO 2	Aquaint the skills in handling sophisticated scientific instruments
PO 3	Relate various scientific phenomena and their relevancies in the day-to-day life.
PO 4	Analyse experimental data critically and systematically to draw the conclusions.
PO 5	Develop various skills such as communication, teamwork, social, research and entrepreneuership etc., which will help in expressing ideas and views clearly
PO 6	Develop interdisciplinary approach for overall development .
PO 7	

Program Specific Outcome PSO (M.Sc. Botany):

After completion of this course, students are expected to learn/understand the:

PO No.	PSO
PSO 1	Understand the various plant groups lowar as well as highe w.r.t. Morphology, Anatomy and reproduction
PSO 2	To study and classify the algae, fungi, bryophytes and lichens
PSO 3	To study the higher plants with respect to their morphology and reproduction
PSO 4	To know the applied aspects of phycology, mycology and paleobotany
PSO 5	To know and understand the range of variations in angiospermic families and families of biological importance

PSO 6	Methods of transformation of plants and to underst and alternative biotechnological methods
PSO 7	To incorporate with knowledge of scientific research its different methods and tools
PSO 8	To oncorporate the knowledge of vommunity sturcuture different omteractions in environment, environmental hazards and its impact

Credit distribution structure for two years/one-year PG MSc programme

Level	Sem	Major (Core) Subjects		Minor Subjects	OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)				
6.0	I	DSC-1 (4T) DSC-2 (4T) DSC-3 (4T) DSC-4 (2P)	DSE-1(2T) A/B DSE-2(2P) A/B	RM (2T)	OJT/Int (2)	22	First year PG OR One year PG diploma after 3year UG
	II	DSC-5 (4T) DSC-6 (4T) DSC-7 (4T) DSC-8 (2P)	DSE-3(2T) A/B DSE-4(2P) A/B	RM (2T)	OJT/Int (2)	22	
	Cum. Cr.	28	8	4	4	44	
	Exit option: PG diploma (44 Credits) after three year UG degree						
6.5	III	DSC-9 (4T) DSC-10 (4T) DSC-11 (4T) DSC-12 (2P)	DSE-5(2T) A/B DSE-6(2P) A/B	--	RP (4)	22	Second year PG after 3 year UG OR PG degree after 4 year UG
	IV	DSC-13 (4T) DSC-14 (4T) DSC-15 (2P) DSC-16 (2P)	DSE-7(2T) A/B DSE-8 (2P) A/B	...	RP (6)	22	
	Cum. Cr.	54	16		4+10	88	
2 Years-4 Sem. PG Degree (80-88 credits) after Three Year UG Degree or 1 Year-2 Sem PG Degree (40-44 credits) after Four Year UG Degree							

Sem- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **T**- Theory, **P**- Practical,
RM- Research Methodology, **OJT**- On Job Training, **Int**- Internship, **RP**- Research Project,
Cum. Cr. : Cumulative Credits

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
6.0	One-year PG Diploma program after 3 Yr Degree	40	44	2	1
6.5	Two-year master's Degree program After 3-Yr UG Or PG Degree after 4- Yr UG	80	88	4	2

M.Sc. Botany Course Structure

Semester	Course Module	Credit	Hours/ week	TH/ PR	Code	Title
I	DSC	4	4	TH	BOT-DSC-511	Phycology, Mycology and Bryology
	DSC	4	4	TH	BOT-DSC-512	Pteridophytes, Gymnosperms and Paleobotany
	DSC	4	4	TH	BOT-DSC-513	Taxonomy of Angiosperms
	DSE	2	2	TH	BOT-DSE-514A	Lichenology and Plant Pathology
	DSE	2	2	TH	BOT-DSE-514B	Plant Biotechnology
	DSC	2	4	**PR**	BOT-DSC-515	Practical Based on BOT-DSC-511, BOT-DSC-512 and BOT-DSC-513
	DSE	2	4	**PR**	BOT-DSE-516A	Practical's Based on BOT-DSE-514A
	DSE	2	4	**PR**	BOT-DSE-516B	Practical's Based on BOT-DSE-514B
	DSC	4	4	TH	BOT-RM-517	Research Methodology
II	DSC	4	4	TH	BOT-DSC-521	Ecology and Phytogeography
	DSC	4	4	TH	BOT-DSC-522	Plant Physiology and Biochemistry
	DSC	4	4	TH	BOT-DSC-523	Genetics, Plant Breeding and Evolution
	DSE	2	2	TH	BOT-DSE-524A	Biostatistics
	DSE	2	2	TH	BOT-DSE-524B	Plant Metabolism
	DSC	2	**4**	**PR**	BOT-DSC-525	Practical Based on BOT-DSC-521, BOT-DSC-522 and BOT-DSC-523
	DSE	2	**4**	**PR**	BOT-DSE-526A	Practical's Based on BOT-DSE-524A
	DSE	2	**4**	**PR**	BOT-DSE-526B	Practical's Based on BOT-DSE-524B
	OJT	4	**8**	**OJT**	BOT-OJT-527	On Job Training

DSC	**:**	Department-Specific Core course
DSE	**:**	Department-Specific elective
TH	**:**	Theory
PR	**:**	Practical

Exam Pattern

Theory / Practical	Credit	Internal	External
Theory	**4**	**40**	**60**
Theory	**2**	**20**	**30**
Practical	**4**	**40**	**60**

External Theory Examination (60 marks)

- External examination will be of 3 hours duration for each theory course. There shall be 5 questions each carrying equal marks (12 marks each) while the tentative pattern of question papers shall be as follows;
- Q1 attempt any 4 out of 5 sub-questions; each 3 marks.
- Q2, Q3, Q4 attempt any 2 out of 3 sub-questions; each 6 marks.
- Q5 attempt any 3 out of 4 sub-questions, each 4 marks

External Practical Examination (60 marks):

- Practical examination shall be conducted by the respective department at the end of the semester. Practical examination will be of minimum 3 hours duration and shall be conducted as per schedule. There shall be 05 marks for journal, 10 marks for *viva-voce*. Certified journal is compulsory to appear for practical examination.

Internal Theory/ Practical Examination (40 marks):

- Internal theory assessment of the student by respective teacher will be comprehensive and continuous, based on written test/ assignment. The written test may comprise of both objective and subjective type questions.
- Internal practical examination should be conducted by respective department as per schedule given. For internal practical examination student should perform at least one major and one minor experiment and should have completed journal.

F. Y. M. Sc.
Semester-I
BOT-DSC-511- Phycology, Mycology and Bryology

Total Hours: 60 **Credits: 4**

Learning objectives	• To study the morphology and systemic position of Algae • To study the morphology and systemic position of Fungi • To study the morphology and systemic position of Bryophytes • To study the Industrial applications of Algae, Fungi and Bryophytes	
Course outcomes	After studying this course the students will be able to : • Get the knowledge of the morphology and systematic position of Algae • Aquainted with the knowledge of morphology and systemic position of Fungi • Get the idea of application of Algae, Fungi and Bryophytes in Industry.	
Unit	**Topic Particular**	**Hours**
Unit I	General characteristics and classification of algae; reproduction, heterocyst and akinete development, algal pigments, food reserves, flagellation, their phylogenetic and taxonomic importance. Distribution, structure and reproduction in Chlorophyta and Charophyta.	**15**
Unit II	Range of thalli and reproduction in Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta; Algal blooms, Biofertilizers, Algae as food, feed and uses in industry. General characteristics and taxonomy of fungi; Cell Ultrastructure; Heterothallism, Heterokaryosis and Parasexual cycle; Asexual & Sexual reproduction, Nutrition, Fungal Sex hormones; Structure, nutrition and reproduction in Mastigomycotina and Zygomycotina. Structure, nutrition and reproduction in Ascomycotina, Basidiomycotina and Deuteromycotina; General characteristics of slime moulds	**15**
Unit III	Fungi in Industry, secondary metabolites, medicine, food and agriculture; Mycorrhizae: Types and significance, Mycotoxins	**15**
Unit IV	Distribution, structure and reproduction in Anthocerotales, Sphagnales, Funariales, Polytrichales, Bryales	**15**
References	1. Bold, H and Wynne M. J. (1978) Algal structure and reproduction. Prentice Hall of India Pvt. Ltd. New Delhi, India. 2. Chapman, V.J. and Chapman D.J. (1979) The Algae. English Language Book Society and Mc. millan, Co, London, U.K. 3. Fritsch, F.E.(1979) The Structure and reproduction of Algae Vol. I and II. Vikas Pub. HousePvt. Ltd. New Delhi, India. 4. Gupta J.S (1981) A Text Book of Algae, Oxford & IBH Publishing Co. Mumbai, India. 5. Khan M. (1970) Fundamentals of Phycology Bishen Singh Mahendra Pal Singh, Dehradun, India. 6. Lee, R.E. (1989) Phycology. Cambridge University Press, Cambridge, U.K 7. Morris, I (1967) An Introduction totThe Algae, Hutchinson University Press, U.K.	

	8. Prescott, G.W. (1969). The Algae. Thomas Nelson and Sons Ltd, Nashville, USA 9. Round, F.E. (1973) The Biology of the Algae. Edward Arnold, London, U.K. 10. Sharma, O.P.(1950)A text book of Algae. Tata McGraw Hill, New Delhi, India. 11. Smith, G.M. (1950). Fresh water Algae of United States. McGraw Hill Book Company, New York, USA. 12. Sambamurty A. V. S. S. (2005) A Text Book of Algae. I. K. International Mumbai, India. 13. Vashishta B.R. (2010) Botany Part- I Algae S. Chand & Company Ltd. New Delhi, India. 14. Watson, E.V. (1971) Structure and Life of Bryophytes.3 rd Edn. Hutchinson University Library, London, UK. 15. Vashista, B.R., Sinha, A.K., Kumar, A.(2008) Botany for degree students-Bryophyta, S. Chand Publication, New Delhi, India. 16. Eames, E.J. (1983) Morphology of Vascular Plants. Stanford University Press.USA. 17. Cavers, F. (1976) The interrelationships of the Bryophytes. S.R. Technic, Ashok Rajpath, 18. Chopra, R.N. and Kumar, P.K. (1988) Biology of Bryophytes. John Wiley & Sons, New York, USA. 19. Kashyap, S.R. (1929) Liverworts of the Western Himalayas and the Punjab Plain (illustrated): Part 2. Chronica Botanica, New Delhi. 20. Parihar, N.S. (1980) Bryophytes: An introduction to Embryophyta. Vol.I.Central Book Depot, Allahabad, India. 21. Prem Puri (1981) Bryophytes: Morphology, Growth and Differentiation. Atma Ram and Sons, New Delhi, India	

F. Y. M. Sc.
Semester-I
BOT-DSC-512- Pteridophytes, Gymnosperms and Paleobotany

Total Hours: 60 **Credits: 4**

Learning objectives	• To study the diversity of Pteridophytes in India • To study the diversity of Gymnosperms in India • To study the evolutionary trends and affinities of living gymnosperms with respect to external and internal features. • To study the important fossil types in different groups of plants and Indian fossil records. • To study applied aspects of Palaeobotany	
Course outcomes	After successful completion of this course, students are expected to: ● Know Diversity of Pteriodophytes in India ● Learn diversity of Gymnosperms in India ● Aquire Knowledge of living gymnosperms with respect to external and internal features. ● Familiar with the important fossil types in different groups of plants and Indian fossil records. ● Know the applied aspects of Palaeobotany	
Unit	**Topic Particular**	**Hours**
Unit I	Classification and origin of Pteridophytes; Fossil pteridophytes; Stelar theory; Telometheory; Heterospory: occurrence, causes and significance. Economic importance of pteridophytes. Comparative study of Psilopsida, Lycopsida, Sphenopsida and Pteropsida with reference to structure, reproduction and life cycle.	15
Unit II	Classification of gymnosperms up to the rank of orders. General account of Pteridospermales, Glossopteridales, Caytoniales, Bennettitales, Pentoxylales, Cordaitales	15
Unit III	General account of Cycadales, Ginkgoales, Coniferales, Ephedrales, Gnetales and Welwitschiales. Distribution of Gymnosperms in India, Economic importance of gymnosperins.	**15**
Unit IV	Principles of Palaeobotany; Geological time scale; Process of fossilization and Paleobotany in India.Types of fossils. **i)Fossil Angiosperms and Techniques for fossil study** a) Monocot: Palmoxylon, Rhizopalmoxylon, Cyclanthodendron, Tricoccites. b) Dicot:Sahnipushpam, Sahnianthus, Enigmocarpon. **ii) Techniques for fossil study** a) Petrifaction: Ground thin section, Peel method, Microtomy, X-rayradiography technique. b) Compression:Maceration, Transfer technique, Excavation technique	**15**

References	1. Andrews, H.N. (1961) Studies in Palaeobotany, New York, London 2. Banks, H.P. (1970) Evolution and plants of the Past. McMillan Press Ltd. London. 3. Ganguli H.C. and Kar A. K. (2001) College Botany Vol. II Book and Allied Press. Ltd. Calcutta, India. 4. Pande B.P. (1994) Gymnosperms. Handand Co.New Delhi, India. 5. Saxenaand Sarabhai, R.M. (1972) Text Book of Botany,Vol.II, Embryophyta Ratan Prakashan Mandir, Agra, India. 6. Shukla, A. C. and S.P. Misra (1982) Essentials of Palaeobotany Vikas Publishing House Pvt.Ltd. Delhi, India. 7. Seward, A.C. (1969) Fossil Plants Vol. I to IV, Hafner Publ. Co. New York, USA. 8. Sporne K.R.(1967) Morphology of Gymnosperms Hutchinson Univ. Library. 9. Wilson N. Stewart and Gar W. Rothwell (1993) Palaeobotany and Evolution of Plants- II. Cambridge Univ. Press. Cambridge. 10. A. Rashid (1999) An introduction to Pteriophyta. Vikas publishing house Pvt. Ltd. New Delhi, India. 11. Gangulee and Kar (2006) College Botany. New Central Book Agency, Delhi, India. 12. Parihar, N.S. (1976) Biology and Morphology of Pteridophytes. Central Book Depot, Delhi, India. 13. Sharma, O.P. (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi, India.	

F. Y. M. Sc.

Semester-I

BOT-DSC-513- Taxonomy of Angiosperms

Total Hours: 60 **Credits: 4**

Learning objectives	• To study conceptual development of 'taxonomy'. • To study different systems of classifications of angiosperms • To study characters of biologically important families of angiosperms • To study range of variations in angiospermic families • To study various rules, principles and recommendations of plant nomenclature • To know modern trends in taxonomy	
Course outcomes	After successful completion of this course, students are expected to: ● Know the taxonomic development ● Aquire the knowledge of plant systematics ● Aquire Knowledge of plant identification ● Get the knowledge of biological importance of various plant families ● Understand the modern trends in taxonomy	
Unit	**Topic Particular**	**Hours**
Unit I	**Introduction:** i) Taxonomy and Systematics : Conceptual Development ii) Aims and Principles	**15**

	iii) Diversity of angiosperms with respect to : a) Form, structure and function b) Evolutionary status of Angiosperms **Systems of classification:** i) Artificial system: Linnaeus ii) Natural system: de Candolle, Bentham & Hooker iii) Phylogenetic system: Engler and Prantl, Hutchinson and Dahlgren. General Evolutionary Trends in Angiosperms	
Unit II	**ICBN – Principles of priority and their limitation** i) Scientific names and Common names ii) International Code of Botanical Nomenclature (ICBN) iii) Principles of the code I-V iv) Type method (Typification) v) Author citation vi) Rejection of names vii) Retention of names viii) Conservation of names ix) New Name **Taxonomic evidence:** i) Chemotaxonomy – micromolecules - primary and secondary metabolites. Macromolecules –protein, nucleic acids, polysaccharides. ii) Taxonomy in relation to Anatomy, Embryology, Palynology, Ecology, Cytology and serology. iii) Molecular taxonomy – RFLP	**15**
Unit III	**Study of diagnostic characters and economic importance of following families:** Oleaceae, Magnoliaceae, Tiliaceae, Sapindaceae, Boraginaceae, Bignoniaceae, Casuarinaceae, Amaryllidaceae, Orchidaceae, Rhamnaceae, Musaceae, Cyperaceae and Poaceae.	**15**
Unit IV	**Discussion with respect to salient features and points of biological importance of the following families:** Sarraceniaceae, Lentibulariaceae, Drosseraceae, Nepenthaceae, Cuscutaceae, Orobanchaceae, Balanophoraceae, Refflesiaceae, Santalaceae, Loranthaceae, Podostemaceae, Rhizophoraceae, Cactaceae, Orchidaceae, Aristolochiaceae	**15**
References	1. Naik, V.N. (1984). Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company Ltd., New Delhi. 304pp. 2. Singh, G. (1999). Plant Systematics – Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 35pp. 3. Sharma, O. P. (1958). Plant Taxonomy. Tata McGraw Hill Publishing Company Ltd., New Delhi.482pp. 4. Gurucharan Singh (2008). Plant Sytematics – Theory and Practices. Oxford and IBH Publishing Co. Pvt. Td. New Delhi. 5. Michael G. Simpson (2010). Plant Systematics. Elsevier Academic Press. USA. 6. Pandey S.N. and Mishra. S.P. (2009). Taxonomy of Angiosperms. Ane	

	Books Pvt. Ltd. New Delhi. 7. Pandey, B.P.(2012). Taxonomy of Angiosperms. S. Chand and Company Ltd., New Delhi. 8. Rajkumar Gupta. (2006). Text book of Systematic Botany. CBS Publishers. New Delhi. 9. Subrahmanyam, N.S. (1995). Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd. New Delhi. 10. Stuessy, T. F. (2002). Plant Taxonomy and Biosystematics. Edward Arnold, London. 11. Porter. C. L., (1982) – Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi 12. Cronquist, A. (1968). Evolution and Classification of Flowering Plants. Thomas & Nelson (Pvt.) Ltd., London.	

F. Y. M. Sc.

Semester-I

BOT-DSE-514A- Lichenology and Plant Pathology

Total Hours: 30 **Credits: 2**

Learning objectives	• To Know the events of symbiosis and Lichenization • To study the term 'Lichen' and their classification • To know the systematic position of Lichens • To know the biological diversity of Lichens	
Course outcomes	After successful completion of this course the students will able to_ • comprehend the events of symbiosis and lichenization. • They can discuss term of lichen. • They can discuss the systematic position of lichens. • They can discuss biological diversity of lichens.	
Unit	**Topic Particular**	**Hours**
Unit I	Classification and distribution of Lichens, thallus organization, physiology and reproduction, Lichens as bioindicators, bioprospection, Lichenometry.	07
Unit II	General introduction, history and principles of Plant Pathology; Classification of Plant Diseases; Pathogenesis and defence mechanism; Role of environmental factors, forecasting and plant disease epidemiology.	08
Unit III	Important diseases caused by fungi, bacteria, viruses, mycoplasma and nematodes: Transmission and disease cycle, symptoms and management through physical, chemical, cultural, biological and regulatory methods	**07**
Unit IV	Integrated Pest and Disease Management.	**08**
References	1 Ainsworth, Sussman and Sparrow (1973) The fungi. Vol IV A & IV B. Academic Press. London, U.K. 2. Alexopolous C. J., Minms C.W. and Blackwell M. (1999) (4th edn) Introductory Mycology. Willey, New York, USA.	

	3. Dube H.C. (2004) An Introduction To Fungi. Vikas Publishers. New Delhi, India. 4. Kendrick B. (1994) The Fifth Kingdom (paperback), North America, New York Publisher:3rd edn. 5. Kirk et al. (2008) Ainsworth and Bisby's Dictionary of fungi, 10th edn. CABI International, Walling ford.UK. 6. Mehrotra R.S. and Aneja K.R. (1990) An Introduction To Mycology. New Age Publishers, New Delhi, India 7. Sharma O.P. (2010) A Text Book of Fungi. S. Chand's Publication, New Delhi, India 8. Sharma, P.D. (1998) The Fungi. Rastogi Publications, Merrut, India.	

F. Y. M. Sc.

Semester-I

BOT-DSE-514B- Plant Biotechnology

Total Hours: 30 **Credits: 02**

Learning objectives	• To provide the students to understand the function of plant hormones and their molecular mechanisms, • To know different methods for transformation of plants or plant cells, including their specific advantages and applications • To define the terms transcriptomics, proteomics, interactomics, metabolomics and systems biology, and describe their importance in plant biotechnology research, • To learn alternative plant biotechnology methods that can replace genetic modification	
Course outcomes	After completion of this course, the student will be able to: • Understand the function of plant hormones and their molecular mechanisms • know different methods for transformation of plants or plant cells, including their specific advantages and applications • define the terms transcriptomics, proteomics, interactomics, metabolomics and systems biology, and describe their importance in plant biotechnology research, • learn alternative plant biotechnology methods that can replace genetic modification	
Unit	**Topic Particular**	**Hours**
Unit I	Definition, Basic concepts, Principles and scope of Biotechnology Recombinant DNA technology, basic concept in genetic engineering, tool and techniques of recombinant DNA technology. Enzymology of genetic engineering. Restriction enzymes, DNA ligase, Polymerase etc. Cloning vehicles: Plasmids, Cosmids, Lambda phage, Charon phage, shuttle vectors, 2μ DNA plasmids, yeast plasmids, M13 vector. Fermentation and enzyme technology	08
Unit II	Biotechnology - Scope, potentialities and constrains. Enzymes in genetic engineering - exonucleases, endonucleases, restriction endonucleases, S I nucleases, DNA ligases, reverse transcriptase and alkaline phosphatase. Gene cloning vectors - Plasmids, Phages, Cosmids, Transposons, Primary vectors and plasmids - expression vectors.	07

Unit III	Selection of genes, Gene libraries, Genomic and cDNA library - Gene transfer methods, Genetic organization of Ti plasmids, Ti plasmid mediated transfer - Agrobacterium tumifaciens, DNA mediated transfer. Calcium phosphate, PEG, DEAE, via liposomes - Microinjection - Macroinjection, microprojectile, and electroporation, - Selection of clones,marker and reporter genes in screening methods. Hybridizations - colony,Southern, Northern, Western Blotting.	**08**
Unit IV	DNA fingerprinting, gene therapy and genetic counselling. Use of transposons in genetic analysis: Transposon tagging and its use in identification and isolation of genes. Elementary Knowledge of next generation sequencing. Biosafety regulation: Physical and Biological containment	**07**
References	1.Tropp, B. E. (2012). Molecular Biology. Fourth Edition, Jones and Bartlett India Pvt. Ltd, New Delhi. 2.Howe, C., (2007). Gene Cloning and Manipulation. 2nd Edition. 3.Watson, D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R. (2008). Molecular Biology of Gene. 6th Edition, Cold Spring HarborLaboratory Press Cold Spring Harbor, New York, U.S.A. 4.Clark, D., Pazdernik, N., McGehee, M. (2018). Molecular biology. 3rd Edition. 5.Freifelder, D. (1990). Molecular Biology. 2ndEdition,Narosa Publishing HouseNew Delhi. 6.Nicholl, D. S. T. (2008). An Introduction to Genetic Engineering. 3rd Edition. 7.Plant Molecular Biology - Genetic Analysis of Plant Development and Metabolism. Springer-Verlag, New York, London. 8.Grierson, D. and Covey, S. (1984). Plant Molecular Biology, Practical Approach. IRL Press, Oxford, Washington DC. 9.Henry, R. J. (2005). Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK. 10.Shaw, C. H. and Brown. T.A. (1988, 2020). Gene Cloning and DNA Analysis: An Introduction. 8th Edition. 11.Primrose, S. B. and Twyman, R. (2006). Principles of Gene Manipulation and Genomics. 7th Edition. 12.Tewari, K. K. and Singhal, G. S. (1997). Plant Molecular Biology and Biotechnology. Narosa Publishing House, New Delhi.	

F. Y. M. Sc.
Semester-I
BOT-DSC-515- Practical Based on BOT-DSC-511 , BOT-DSC-512 and BOT-DSC-513.

Total Hours: 60 **Credits: 2**

Learning Objectives	• To acquaint the students about the morphology, biology and importance of algal forms, fungal forms, Bryophytes, Peridophytes, gymnosperms and angiosperms • • To help the students to identify the angiosperms families with specific key characters;	
Course Outcomes	• The course will enable students to know the lower and higher plants, their vegetative and reproductive structures and their importance. • They will also able to identify the angiosperms families with specific key characters;	
Sr. No.		
1	Study of families of flowering plants (Any 10): According to Bentham and Hookers system Any 4 of Polypetalae, Any 4 of Gamopetalae, Any one Apetalae, Any one monocotyledonae.	
2	Preparation of Artificial Key based on vegetative characters and floral characters. Identification of genus and species of with the help of Flora.	
3	Submission of any 10 species of herbarium of Locally available wild flowering plants which are not in the categories of rare, threatened,endangered or vulnerable etc	
4	Study of External morphology, wood anatomical features by double stained preparations by taking T.S., T.L.S. and R.L.S. of ANY SIX of the followings: *Pinus,Thuja, Cedrus, Cupressus, Araucaria, Agathis, Podocarpus, Cryptomeria, Juniperus and Taxus*	
	Morphological, Anatomical and Reproductive studies of the following)	
5&6	Lycopodium, Isoetes,Ophioglossun, Osmunda.	
7&8	Marsilea, Salvinia, Azolla (Any two)	
9&10	Marchantiales: Plagiochasma, Targionia, Asterella Conocephallum &Dumortiara. (At least 2)	
11&12	Types of fossils Angiosperm fossils (Any 4) Monocots.: a) Palmoxylon b) Rhizopalmoxylon c) Cyclanthodendron d) Tricoccites Dicots. : a) Dicot stem b) Dicot leaf impressions Fructification: a) Enigmocarpon b) Sahnianthus c) Sahnipushpam	

13	Chlorophyta: Any 2 forms Charophyceae- Chara, Nitella.	
14	Xanthophyceae – *Vaucheria*, *Botrydium* Bacillariophycece- *Navicula, Pinnularia,Fragillaria, Synedra, Nitzchia, Cymbella,Cyclotella, Pleurosigma, Gyrosigma, Coconeis,(* any2 forms)	
15	Preparation of cotton blue, Lactophenol and culture medium – PDA Representative Genera belonging to following subdivisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth et al. (1973). Myxomycotina – (Any 2 genera) Mastigomycotina – (Any 2 genera) Zygomycotina – (Any 2 genera) Ascomycotina - (Any 2 genera)	
References	1. Ganguli H.C. and Kar A. K. (2001) College Botany Vol. II Book and Allied Press. Ltd. Calcutta, India. 2. Gangulee and Kar (2006) College Botany. New Central Book Agency, Delhi, India. 3. Parihar, N.S. (1976) Biology and Morphology of Pteridophytes. Central Book Depot, Delhi, India. 4. Sharma, O.P. (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi, India. 5. Pandey S.N. and Mishra. S.P. (2009). Taxonomy of Angiosperms. Ane Books Pvt. Ltd. New Delhi. 6. Pandey, B.P.(2012). Taxonomy of Angiosperms. S. Chand and Company Ltd., New Delhi. 7. Rajkumar Gupta. (2006). Text book of Systematic Botany. CBS Publishers. New Delhi. 8. 4. Kendrick B. (1994) The Fifth Kingdom (paperback), North America, New York Publisher:3rd edn. 9. 5. Kirk et al. (2008) Ainsworth and Bisby's Dictionary of fungi, 10th edn. CABI International, Walling ford.UK. 10. 6. Mehrotra R.S. and Aneja K.R. (1990) An Introduction To Mycology. New Age Publishers, New Delhi, India	

F. Y. M. Sc.
Semester-I
BOT-DSE-516A- Practical Based on BOT-DSC-514A.

Total Hours: 60 **Credits: 2**

Learning Objectives	• To study the lichens their types and economic importance • To study the description and identification of plant diseases with their symptoms, causes, pathogens and control measures	
Course Outcomes	The students will be able to • Learn the lichens their types and economic importance • Know the description and identification of plant diseases with their symptoms, causes, pathogens and control measures	
Sr. No.		
1	Study of morphology of Crustose lichen	
2	Study of morphology of fruitocose lichen	
3	Study of morphology of foliose lichen	
4	Study of T. S. Of fruitocose lichen	
5	Study of T. S of any foliose lichen	
6	Economically important species of Lichens(Colour, Perfume, Food etc.)	
7	Isolation of aquatic fungi by baiting in the laboratory	
8	Basic techniques in plant pathology.	
9	Isolation of fungal plant pathogens.	
10	Isolation of mycorrhiza from soil.	
11	Isolation of *Rhizobia* from root nodules.	
12	Isolation of fungal pathogen from seeds.	
13	Isolation of post harvest fungal pathogens from fruits.	
14	Study of forest diseases (any three).	
15	Study of diseases caused by bacteria and viruses (any two), Mastigomycotina and Plasmodiophorales (any three).	
References	1 Ainsworth, Sussman and Sparrow (1973) The fungi. Vol IV A & IV B. Academic Press. London, U.K. 2. Alexopolous C. J., Minms C.W. and Blackwell M. (1999) (4th edn) Introductory Mycology. Willey, New York, USA.	

	3. Dube H.C. (2004) An Introduction To Fungi. Vikas Publishers. New Delhi, India. 4. Kendrick B. (1994) The Fifth Kingdom (paperback), North America, New York Publisher:3rd edn. 5. Kirk et al. (2008) Ainsworth and Bisby's Dictionary of fungi, 10th edn. CABI International, Walling ford.UK. 6. Mehrotra R.S. and Aneja K.R. (1990) An Introduction To Mycology. New Age Publishers, New Delhi, India 7. Sharma O.P. (2010) A Text Book of Fungi. S. Chand's Publication, New Delhi, India 8. Sharma, P.D. (1998) The Fungi. Rastogi Publications, Merrut, India.	

F. Y. M. Sc.

Semester-I

BOT-DSE-516B- Practical Based on BOT-DSC-514B.

Total Hours: 60 **Credits: 2**

Learning Objectives	• To Explain the various components of plant tissue culture media • To establish and maintain plants in tissue culture and micropropagation • To develop understanding of techniques for tissue culture	
Course Outcomes	The students will be able to • To Explain the various components of plant tissue culture media • To establish and maintain plants in tissue culture and micropropagation • To develop understanding of techniques for tissue culture	
Sr. No.		
1	Study of laboratory safety measures and various instruments used for plant biotechnology: Laminar air Flow cabinet, pH meter, Autoclave, Mechanical shaker and Electrophoresis, Spectrophotometer, Centrifuge (any four)	
2&3	Preparation of stock solutions of MS (Murashige & Skoog, 1962) : Basalmedium and plant growth regulator.	
4	Preparation of explants and inoculation on nutrient media for callus induction.	
5	Sub-culture of callus and regeneration of plants from callus.	
6	Hardening techniques of tissue culture plantlets.	
7	Isolation and culturing of anther for haploid production.	
8	Techniques for shoot tip /root tip/ eye bud culture.	
9	Isolation of DNA using any sutaible method	
10	DNA separation with the help of gel electrophoresis	

11	Isolation of Protein using any sutaible method	
12	Separation of protein with the help of SDS gel electrophoresis	
13	Study of Gene transfer techniques	
14	Study of Protoplst isolation methods (By photograph)	
15	Study of protoplast fusion techniques (By photograph)	
References	1.Tropp, B. E. (2012). Molecular Biology. Fourth Edition, Jones and Bartlett India Pvt. Ltd, New Delhi. 2.Howe, C., (2007). Gene Cloning and Manipulation. 2nd Edition. 3.Watson, D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R. (2008). Molecular Biology of Gene. 6th Edition, Cold Spring HarborLaboratory Press Cold Spring Harbor, New York, U.S.A. 4.Clark, D., Pazdernik, N., McGehee, M. (2018). Molecular biology. 3rd Edition. 5.Nicholl, D. S. T. (2008). An Introduction to Genetic Engineering. 3rd Edition. 6.Plant Molecular Biology - Genetic Analysis of Plant Development and Metabolism. Springer-Verlag, New York, London. 7.Grierson, D. and Covey, S. (1984). Plant Molecular Biology, Practical Approach. IRL Press, Oxford, Washington DC. 8.Henry, R. J. (2005). Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK. 9.Shaw, C. H. and Brown. T.A. (1988, 2020). Gene Cloning and DNA Analysis: An Introduction. 8th Edition. 10.Primrose, S. B. and Twyman, R. (2006). Principles of Gene Manipulation and Genomics. 7th Edition.	

F. Y. M. Sc.
Semester-I
BOT-RM-517- Research Methodology

Total Hours: 60 **Credits: 4**

Learning objectives	• To know the philosophy of Science • To incorporate with knowledge of fundamentals of Research Methodology • To provide the platform to study the process of tools and techniques used in Plant science research	
Course outcomes	After successful completion of this course, students are expected to: • know the philosophy of Science • They will be incorporated with knowledge of fundamentals of research methodology • Student will get the platform to study the process of tools and techniques used in Plant science research	
Unit	**Topic Particular**	**Hours**
Unit I	**Research Methodology** Meaning of Research and Scientific temper, objectives of research, Types of research, Research approaches. Significance of Research, Research and scientific methods, Research processes, Criteria of good Research	15
Unit II	**Research design** • Meaning, concepts, Types of research design i) For Classical Subjects ii) For Applied subjects • Research question and formation of hypothesis • Directional and non-directional hypothesis • Various methods of research- survey, historical, experimental, causal, comparative, genetic etc.	15
Unit III	**Data Collection with respect to classical and applied subjects** • Selection of appropriate method for data collection • Tools of data collection • Collection of primary data • Collection of data through questionnaire and schedules • Collection of secondary data • Reliability and validity of research tools	**08**
Unit IV	**Writing Research Report** • Format and Style • Review of related literature- its implication at various stages of research • Major findings, conclusion and suggestions • Citation of references • Bibliography	**07**

References	1. Best and Kahn, Research Methodology, PHI Limited 2. D. Varlaxmi P. Sursh Narayana and T. Pullaih Research methodology in Plant Sciences, Scientific publisher 3. Mukul Kumar, Research Methodology and Techniques in Botany Centrum press 4. Kothari, C.R. Research Methodology (Methods and Techniques), New age Publisher 5. Kerlinger, Foundation of research 6. Fundamentals of modern statistical methods by Rand R. Wilcox 7. Power Analysis for Experimental research A Practical Guide for the Biological, Medical and social Sciences by R. Barker Bausell. Yi-Fang Li Cambridge University, Press. 8. Design of experience: Statistical Principles of research design and analysis, by Robert O. Kuehl Brooks/cole	

F. Y. M. Sc.
Semester-II
BOT-DSC-521- Ecology and Phytogeography

Total Hours: 60 **Credits: 4**

Learning objectives	• To make the students familiar with the variety of ways that organisms interact with both the physical and the biological environment. • To Develop an understanding of the differences in the structure and function of different types of ecosystems. • To allow students to understand the threats of environment, Green house effect, Ozone layer depletion, causes and its impact • To Develop an appreciation of the natural world through direct experience with local ecosystems.	
Course outcomes	After successful completion of this course, students are expected to: • Become familiar with the variety of ways that organisms interact with both the physical and the biological environment. • Develop an understanding of the differences in the structure and function of different types of ecosystems. • Understand the threats of environment, Green house effect, Ozone layer depletion, causes and its impact • Develop an appreciation of the natural world through direct experience with local ecosystems.	
Unit	**Topic Particular**	**Hours**
Unit I	Introduction to ecology, and environmental terminology, population dynamics, vegetation organization and development: population characteristics, population growth forms, population structure (distribution, aggregation, isolation territoriality) energy partitioning , r - and k-selection, concept of carrying capacity; Wild life sanctuaries, botanical gardens	15
Unit II	Concepts of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, competition, ecological niche, succession, mechanism of ecological succession (relay floristic and initial floristic composition facilitation, tolerance and inhibition models), concept of climax	15
Unit III	Ecosystem organization, structure and function: primary production (methods of measurement), energy dynamics (tropic organization, energy flow pathway, energy quality, ecological efficiencies), biogeochemical cycles	**15**
Unit IV	Pollution and climate change: kinds, sources and effects of pollution, Green house gases (CO_2, CH_4, N_2O, CFCs), Green-house effect and global warming, ozone layer depletion and ozone hole, acid rain. Environmental impact assessment, threatened and endangered plant species, role of diversity in ecosystem stability, general account of remote sensing and its application, sustainable development. Major terrestrial biomes, biogeographical area of India, major vegetations	**15**

References	Odum, E. P. and Barret G.W. 2005. Fundamentals of Ecology. Cengage publication Odum, E.P., 1983. Basic Ecology., Saunders College Publishing Singh, J.S., Singh S.P. and Gupta S.R. 2006. Ecology Environment and Resource Conservation. Anamaya Publishers	

F. Y. M. Sc.
Semester-II
BOT-DSC-522- Plant Physiology and Biochemistry

Total Hours: 60 **Credits: 4**

Learning objectives	• To demonstrate an understanding of how water moves in plants at both molecular and organismal levels. • To develop an understanding of the biochemical processes of photosynthesis, glycolysis, citric acidcycle, and electron transport • To provide scientific study of the cell and molecular plant biology and physiology, water relations and transpiration and mineral nutrition, especially nitrogen metabolism • To give the knowledge of fundamental processes such as photosynthesis, respiration and plant hormone functions	
Course outcomes	After successful completion of this course, students are expected to: • Understand how water moves in plants at both molecular and organismal levels. • Develop an understanding of the biochemical processes of photosynthesis, glycolysis, citric acidcycle, and electron transport • Understand the scientific study of the cell and molecular plant biology and physiology, water relations and transpiration and mineral nutrition, especially nitrogen metabolism • Know the fundamental processes such as photosynthesis, respiration and plant hormone functions.	
Unit	**Topic Particular**	**Hours**
Unit I	Membrane transport and translocation of water and solutes, membrane transport proteins; Transpiration, mechanism of stomatal opening and closing; Mineral Nutrition, Enzymes: General characteristics and classification, active sites, isosymes, coenzymes Regulation of enzyme activity and allosteric mechanism, kinetics of enzyme catalysis; Michaelis-Menton equation.	15
Unit II	**Photosynthesis:** Historical background, photosynthetic pigments and light harvesting complexes, photolysis of water, photosystems I and II; mechanism of electron and proton transport, Carbon assimilation: Calvin cycle, Photorespiration (C2 Cycle) and C4 cycle; CAM pathway; synthesis of starch and sucrose.	15
Unit III	**Respiration and Lipid metabolism:** Glycolysis, Kreb's Cycle Pentose phosphate Pathway, electron transport and ATP synthesis; Glyoxylate cycle; Alternate oxidase system, Structure and functions of lipids, fatty acid biosynthesis, lipid catabolism Nitrogen and sulphur metabolism: Biological nitrogen fixation, nodule formation and nod factors; mechanism of nitrate uptake and reduction; ammonia	**15**

	assimilation; sulphur assimilation. Secondary metabolites and their function	
Unit IV	**Photoperiodism;** Floral induction, genetic and molecular analysis; Vemalization; Phytochromes, cryptochromes; Biological clock and circadian rhythms; Biosynthesis, function and mechanisms of action of Auxins, Gibberellins, Cytokinins, Abscissic acid, Ethylene, Brasssinosteroids, Polyamines, Jasmonic acid and Salicyclic acid. Plant responses to biotic and abiotic stress, mechanism of tolerance, HR and SAR; Stress Proteins (HSP, LEA etc.); Water deficit, drought resistance salinity, metal, temperature, light and oxidative stress; Programmed cell death (PCD) in plants during vegetative and reproductive stages; Developmental and stress-induced PCD; PCD and senescence.	**15**
References	1. **Mukjerjee S. and Ghosh A.K. (2009)** Plant Physiology**.** New Central Book Agency; 3rd Revised edition 2. **Jain, A. K. (2003),** "Textbook of Physiology", Arichal Publishing Company. New Delhi. 3. **Salisbury F.F. and Ross C.W. (1992)**. Plant Physiology. (IV edition) Wordsworth Publishing Company. California, USA. 4. **Hopkins W.G. (1995)**. Introduction to plant physiology, John Wiley and Sons, New York,USA. 5. **Moore T.C. (1989)**. Biochemistry a n d Physiology of plant h o rmo n e s , Springer Verlag. New York, USA. 6. **Taiz L. And Zieger E. (1998)**. Plant physiology, Sinauer Associates Inc. and publishers, USA.	

F. Y. M. Sc.
Semester-II
BOT-DSC-523- Genetics, Plant Breeding and Evolution

Total Hours: 60 **Credits: 4**

Learning objectives	• To give the basic knowledge of Genetics • To provide students with knowledge of breeding practices. • To help the student to acquire the knowledge of fertilization barriers in cash crops at different genome level. • To help the students to get acquainted with the wholesome review on evolution
Course outcomes	After successful completion of this course, students are expected to: • know the basic knowledge of Genetics • get knowledge of breeding practices. • The course will help the student to acquire the knowledge of fertilization barriers in cash crops at different genome level. • The course will help the students to get acquainted with the wholesome review on evolution

Unit	Topic Particular	Hours
Unit I	**Linkage and Crossing Over** Chromosomal Linkage Kinds of Linkage- Complete Linkage, Incomplete Linkage Crossing Over, Mechanism of Crossing Over, Kinds of Crossing Over Tetrad Analysis, Cytological detection of crossing over Two Point Test Cross, Three Point Test Cross **Sex Linked Inheritance** X- linked inheritance- Color Blindness, Hemophilia Y- linked inheritance- Hypertrichosis, Beard in Goat **Human Genetics, Eugenics, and Euphenics** Pedigree Analysis Amniocentesis Twins Eugenics- Positive and Negative Eugenics, Euphenics	15
Unit II	**Plant Breeding** Scope, Importance, objectives and concept of Centers of origin of crop Plants Sexual, Asexual and Vegetative reproduction in crop plants Pedigree method for self-pollinated crops, Bulk method for cross pollinated crops, Back cross methods for Breeding, Hybrid Seed Production Self-pollination: Autogamy and Geitonogamy Cross pollination: Xenogamy and Allogamy	15
Unit III	**Population Genetics and Evolution** Hardy Weinberg's Law Changes in gene frequencies, mutation, selection, migration and genetic drift Origin of species, races and demes, Organic theory of evolution (Mayer's Experiment) Lamarckism and Neo Lamarckism; Darwin theory of evolution, Evolution at molecular level, eg. Myoglobin evolution, Mechanism in moths or industrial melanism, resistance of insects to pesticides, antibiotic resistance in bacteria, heavy metal resistance in plants	**15**
Unit IV	Concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution. Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.	**15**
References	1. Allord R. W. (1981). Principles of Plant Breeding, John Wileys & Sons. 2. Chopra V. L. (2004). Plant Breeding Oxford and IBH Publications, New Delhi, India. Gupta S. K. (2005). Practical Plant Breeding Agribios Publications, India.	

	3. Falconer D. S. and Mackey J. (1998). Introduction to Quantitative Genetics. Long Publishers 4. Gupta P. K. Cytogenetics Rastogi Publishers, Meerut, India. 5. Gupta P.K. and Tuchya T (1991). Chromosome Engineering in Plants: Genetics and evolution Elsevier Publishers 6. Mather K. and Jinks J. L. (1983). Introduction to Biometrical Genetics. Chapman and Hall. 7. Narayanan S. S. Singh P. (2007). Biometrical Techniques in Plant Breeding. Kalyani Publishers, India. 8. Natarajan and Gunasekaran M. (2005). Quantitative G e n e t i c s and Bio-metrical Techniques in Plant Breeding Kalyani Publishers, India. 9. Pohlman Bothafar D.N. (1972). Breeding Asian Field Crops Oxford and IBH, New Delhi, India. 10. Robert H. Tamarin (2004). Principles of Genetics 7th Edition McGraw-Hill Companies. Roy D. (2003). Plant Breeding Analysis and Exploitation of variation. Narosa Publication House 11. Sharma J. R. (2001). Principles and practice of Plant Breeding. Tata McGraw Hill, New Delhi, India. 12. Singh B. D. (2006). Plant Breeding Kalyani Publishers, India. 13. Singh P. (2006). Essentials of plant breeding Kalyani Publishers, India. 14. Singh Phundan. (2014). Essentials of Plant Breeding Kalyani Publishers; 5th Edition 15. Singh S. & Pawar (2006). Genetic Bases and Methods of Plant Breeding CBS Publishers, India. 16. P. S. Verma and Agarwal (2006) Cell biology, Molecular Biology, Genetic, Ecology and Evolution S. Chand Publication	

F. Y. M. Sc.
Semester-II
BOT-DSC-524A- Biostatistics

Total Hours: 30 **Credits: 2**

Course objectives	• To describe basic concepts of probability, random variation and commonly used statistical probability distributions. • To describe preferred methodological alternatives to commonly used statistical methods when assumptions are not met. • To distinguish among the different measurement scales and the implications for selection of statistical methods to be used based on these distinctions. • To study the principles of probability and variance
Course outcomes	After successful completion of this course, students are expected to: • To learn basic concepts of probability, random variation and commonly used statistical probability distributions. • To know to prefer methodological alternatives to commonly used statistical methods when assumptions are not met. • To distinguish among the different measurement scales and the implications for selection of statistical methods to be used based on these distinctions • To apply the principles of probability and variance

Unit	Topic Particular	Hours
Unit I	**Introduction of Biostatistics.** Collection and Classification of data: Sampling and types of sampling methods. Presentation of Data: Tabular, Graphical, Line Diagrams, Frequency Polygon, Frequency Curve, Scatter or Dot Diagram, Bar Diagrams, Pie Chart. Measures of central tendency - Mean, median, mode. Measures of dispersion: Range, standard error, standard deviation, co-efficient of variations.	08
Unit II	**Probability:** Sum rule, Product rule and Binomial expansion. Probability distribution: Normal, Binomial and Poisson. Kurtosis. Correlation and Regression: Types of correlation (linear, non-linear, positive and negative), difference between correlation and regression.	07
Unit III	**Analysis of variance (ANOVA):** Summary of steps involved in ANOVA. Test of hypothesis and tests of significance: Student's t-Test, Chi-square test, F-test. Introduction to life table. Parametric and Non-parametric test.	**08**
Unit IV	Experimental Designs: Introduction, Observational Investigation, Steps in Methodology and Designing, Guidelines on Methodology, Experimental Investigation, Use of Computers.	**07**
References	1. Danniel, W.W., (1987). Biostatistics. New York, John Wiley Sons. 2. Sundarrao, P.S.S and Richards, J. (2012). An introduction to Biostatistics, 5th edition. 3. Selvin, S., (1991). Statistical Analysis of epidemiological data, New York University Press. 4. Bishop, O.N. (1966). The Principles of Modern Biology: Statistics for Biology. Houghton Mifflin Company, Boston. 5. Freedman, P. (2017). The Principles of scientific research. New York, Pergamon Press. 6. Campbell, R.C. (1998). Statistics for Biologists. Cambridge University Press.	

F. Y. M. Sc.
Semester-II
BOT-DSC-524B- Plant Metabolism

Total Hours: 30 **Credits: 2**

Learning objectives	• To teach the mechanism of transport and translocation of water and analyze the mechanisms of acclimation and adaptation of plants to stress conditions. • To provide the knowledge of process of transpiration, photosynthesis and respiration and analyze these techniques in various groups of plants. • To Attain awareness on the nitrogen cycle and the role of microbes and plants in the nitrogen cycle. • To make them understand the role of plant growth regulators and photoreceptors in plant growth and development.	
Course outcomes	After successful completion of this course, students are expected to: • Understand the mechanism of transport and translocation of water and analyze the mechanisms of acclimation and adaptation of plants to stress conditions. • Understand the process of transpiration, photosynthesis and respiration and analyze these techniques in various groups of plants. • Aware on the nitrogen cycle and the role of microbes and plants in the nitrogen cycle. • Understand the role of plant growth regulators and photoreceptors in plant growth and development.	
Unit	**Topic Particular**	**Hours**
Unit I	Membrane transport and translocation of water and solutes: Plant –water relations, mechanism of water transport through xylem, phloem loading and unloading, passive and active solute transport, membrane transport of proteins. Signal transduction and sensory photobiology: Receptors, phospholipids signaling, phytochromes and cryptochromes.	07
Unit II	Photosynthesis: General concepts and historical background, steps of photosynthesis, Emerson's effect, two pigment systems, Calvin cycle, photorespiration and its significance. C4 cycle, CAM pathway Respiration: Glycolysis. TCA cycle, electron transport chain and ATP synthesis, pentose- phosphate pathway, glyoxylate cycle. Nitrogen fixation and metabolism: Biological nitrogen fixation, mechanism of nitrate uptake and reduction, ammonium assimilation.	08
Unit III	Plant growth regulators: Physiological effects and mechanism of auxins, gibberellins, cytokinins, ethylene, abscisic acid, polyamines, jasmonic acid, hormone receptors and vitamins and hormones, phytochrome and cryptochrome.	**07**
Unit IV	Stress physiology: Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance, water deficit and drought resistance, salinity stress, freezing and heat stress, oxidative stress.	**08**
References	• Buchanan, B.B, Gruissem W. and Jones, R.L. (1996). Biochemistry and Molecular Biology of plants by Enzymes: A practical introduction to structure, mechanism and data analysis. R. A. Copeland. • Devi, P. (2000). Principles and methods of Plant Molecular Biology,	

	Biochemistry and Genetics. Agrobios. • Huner, N.P.A, and Hopkins, W. G. (2008). Introduction to Plant Physiology. Wiley 4th Edition. • Scott, R.P.W. (1995). Techniques and Practice of Chromatography. Taylor and Francis, Routlledge. • Taiz, L; Zeiger, E; Moller, I. M. and Murphy A. (2014). Plant Physiology and Development.Publisher:Sinauer Associates IsanIm print of Oxford University Press. 6th Edition.	

F. Y. M. Sc.
Semester-II
BOT-DSC-525- Practical Based on BOT-DSC-521, BOT-DSC-522 and BOT-DSC-523.

Total Hours: 60 **Credits: 2**

Course Objectives	• To make them understand the analysis of organic as well as inorganic matter • To teach the preparation of various stains, fixatives etc. • To provide the techniques of breeding practices • make the students familiar with the variety of ways that organisms interact with both the physical and the biological environment	
Course Outcomes	After successful completion of this course the students will be able to- • Understand the analysis of organic as well as inorganic matter • Learn the preparation of various stains, fixatives etc. • Learn the techniques of breeding practices • Familiar with the variety of ways that organisms interact with both the physical and the biological environment	
Sr. No.		
1 & 2	Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.	
3	Determination of organic matter of different soil samples by Walkley & Black rapid titration method.	
4	Study of morphological adaptations of hydrophytes and xerophytes (four each).	
5	Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) Epiphytes, Predation (Insectivorous plants),	
6	Quantitative analysis of herbaceous vegetation for density and abundance and frequency and comparison with Raunkiaer's frequency distribution law in the college campus.	
7	Study of amalyse activity in germinating seeds.	

8	Demonstration: Geotropic Movement Phototrophic Movement Phloem loading experiment	
9 & 10	Morphological and anatomical variation in plants under stress (such as number of stomata / chl a /b ratio and anatomical variation)	
11	Preparation of Cytologicalfixative (Carnoy'sfluid I, II, Navashin's fluid etc.)	
12	Preparation of stains, Aceto-carmine/ aceto orcein, Haematoxylene, and Feulgen	
13&14	Squash and smear preparations to study Mitosis in onion root tips and Meiosis in Zea mays or Allium cepa or Rhoeo discolour flower buds (Aceto carmine or aceto orcein).	
15	Study of hybridization techniques	
References	7. Mukjerjee S. and Ghosh A.K. (2009) Plant Physiology. New Central Book Agency; 3rd Revised edition 8. Jain, A. K. (2003), "Textbook of Physiology", Arichal Publishing Company. New Delhi. 9. Salisbury F.F. and Ross C.W. (1992). Plant Physiology. (IV edition) Wordsworth Publishing Company. California, USA. 10. Hopkins W.G. (1995). Introduction to plant physiology, John Wiley and Sons, New York,USA. 11. Robert H. Tamarin (2004). Principles of Genetics 7th Edition McGraw-Hill Companies. Roy D. (2003). Plant Breeding Analysis and Exploitation of variation. Narosa Publication House 12. Sharma J. R. (2001). Principles and practice of Plant Breeding. Tata McGraw Hill, New Delhi, India. 13. Singh B. D. (2006). Plant Breeding Kalyani Publishers, India. 14. Singh P. (2006). Essentials of plant breeding Kalyani Publishers, India. 15. Singh Phundan. (2014). Essentials of Plant Breeding Kalyani Publishers; 5th Edition 16. Singh S. & Pawar (2006). Genetic Bases and Methods of Plant Breeding CBS Publishers, India. 17. P. S. Verma and Agarwal (2006) Cell biology, Molecular Biology, Genetic, Ecology and Evolution S. Chand Publication 18. Odum, E. P. and Barret G.W. 2005. Fundamentals of Ecology. Cengage publication 19. Odum, E.P., 1983. Basic Ecology., Saunders College Publishing 20. Singh, J.S., Singh S.P. and Gupta S.R. 2006. Ecology Environment and Resource Conservation. Anamaya Publishers	

F. Y. M. Sc.
Semester-II
BOT-DSE-526A- Practical Based on BOT-DSC-524A.

Total Hours: 60 **Credits: 2**

Course Objectives	● To apply common statistical methods for inference. ● To apply basic informatics techniques with vital statistics ● To perform data analysis for different variables	
Course Outcomes	After successful completion of this course students will be able to- ● Apply common statistical methods for inference. ● Apply basic informatics techniques with vital statistics ● Perform data analysis for different variables	
Sr. No.		
1.	Measures of central tendency and dispersal;	
2.	Probability distributions (Binomial and normal)	
3.	Sampling distribution.	
4.	Difference between parametric and non-parametric statistics; Levels of significance.	
5.	Hypothesis, Types of Hypothesis	
6.	Regression and Correlation	
7.	t-test	
8.	F test	
9.	Chi square test.	
10.	Analysis of variance	
11.	Graphic representation of data	
12.	Sum rule, Product rule and Binomial expansion	
13.	Summary of steps involved in ANOVA	
14.	Life tables	
15.	Computer application	
References	7. Danniel, W.W., (1987). Biostatistics. New York, John Wiley Sons. 8. Sundarrao, P.S.S and Richards, J. (2012). An introduction to Biostatistics, 5th edition. 9. Selvin, S., (1991). Statistical Analysis of epidemiological data, New York University Press. 10. Bishop, O.N. (1966). The Principles of Modern Biology: Statistics for Biology. Houghton Mifflin Company, Boston. 11. Freedman, P. (2017). The Principles of scientific research. New York, Pergamon Press. Campbell, R.C. (1998). Statistics for Biologists. Cambridge University Press.	

F. Y. M. Sc.
Semester-II
BOT-DSE-526B- Practical Based on BOT-DSC-524B .

Total Hours: 60 **Credits: 2**

Course Objectives	• To study all the internal activities of plants-those chemical and physical processes associated with life as they occur in plants. • This program focuses on the scientific study of the plant biology and physiology, water relations and transpiration and mineral nutrition, especially nitrogen metabolism	
Course Outcomes	After successful completion of this course students will be able to- • To understand all the internal activities of plants-those chemical and physical processes associated with life as they occur in plants. • This program helps them to know the scientific study of the plant biology and physiology, water relations and transpiration and mineral nutrition, especially nitrogen metabolism	
Sr. No.		
1 & 2	Determine diurnal fluctuations in titrable acid number (TAN) values of CAM succulents (e.g. Aloe, Bryophyllum, Kalanchoe-anyone)	
3 & 4	Determine the absorption spectrum of chlorophyll pigments and estimate theamount of Chl-a, Chl-b and total Chlorophylls by spectrophotometer method.	
5 & 6	Extraction and separation of free amino acid of germinating seed by circular paper chromatography.	
7	Extraction and separation of free sugars from ripe fruits by ascending paper chromatography.	
8	To extract and estimate the amount of Ascorbic acid present in green paper (raw)/ lemon (Fresh).	
9 & 10	Extraction and Detection of secondary plant metabolites from suitable plant material i) Alkaloids ii) Phenols iii) Terpenoids iv) Proteins.	
11	Estimation of amount of CO2 evolved during respiration (Germinating Pea seeds).	
12	Estimation of ether soluble fat oil of Ricinus /Arachis seeds by Sohxlet apparatus.	
13 & 14	To study the activity of lipase enzyme	
15	Effect of Hormones on the germination of seeds	
References	• Buchanan, B.B, Gruissem W. and Jones, R.L. (1996). Biochemistry and Molecular Biology of plants by Enzymes: A practical introduction to structure, mechanism and data analysis. R. A. Copeland. • Devi, P. (2000). Principles and methods of Plant	

	Molecular Biology, Biochemistry and Genetics. Agrobios. • Huner, N.P.A, and Hopkins, W. G. (2008). Introduction to Plant Physiology. Wiley 4th Edition. • Scott, R.P.W. (1995). Techniques and Practice of Chromatography. Taylor and Francis, Routlledge. • Taiz, L; Zeiger, E; Moller, I. M. and Murphy A. (2014). Plant Physiology and Development.Publisher:Sinauer Associates IsanIm print of Oxford University Press. 6th Edition.	

MSc I (Botany)
Semester II
BOT-OJT-527: Internship/ On Job Training

Hours: 120 **Credits: 4**

Course objectives	• To provide the students with actual work experience • To make aware prescribe standards and guidelines at work • To develop the employability of participating student • To avail an opportunities to eventually acquire job experiences	
Course outcomes	After successful completion of this course, students are expected to: • Get actual work experience with office and virtual exposure to various management styles, technical, industrial, and procedural systems • Acquaint the knowledge related to working hours, work protocols and guidelines • Understand the roles and responsibilities of employee as well as team work • Justify job experiences that match their potentials, skills, and competencies	
	Internship An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills. **On the job training** On the job training is a form of training provided at the workplace. During the training, employees are familiarized with the working environment they will become part of. Employees also get a hands-on experience using machinery, equipment, tools, materials, etc.	