Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

CIRCULAR NO.SU/Sci. & Tech./University Deptt./NEP/15/2023

It is hereby inform to all concerned that, the syllabi prepared by the Departmental Committee and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the following curriculum of All Post Graduate Degree Courses as per Norms of National Education Policy – 2020 under the Faculty of Science & Technology run at University Department, Dr.Babasaheb Ambedkar Marathwada University, Aurangabad** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabi of Department of BAMU, Aurangabad.	Semester
1.	M.Sc.Chemistry specialization Inorganic Chemistry, Organic Chemistry, Physical Chemistry and self supported Analytical Chemistry	Ist and IInd Semester
2.	M.Sc.Statistics	Ist and IInd Semester
3.	M.Sc.Mathematics	Ist and IInd Semester
4.	M.Sc.Physics	Ist Semester
5.	M.Sc.Food Technology	Ist and IInd Semester
6.	M.Sc.Drug Intermediates Technology	Ist and IInd Semester
7	M.Sc. Information Technology	Ist to IVth Semester
8.	M.Sc.Computer Science	Ist to IVth Semester
9.	M.Sc.Botany	Ist and IInd Semester
10.	M.Sc.Enviornmental Science	Ist and IInd Semester
11.	M.Sc.Artificial Intelligence.	Ist to IVth Semester
12.	M.Sc.Biochemistry	Ist and IInd Semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/NEP/2023/ 8743-51
Date:- 08.08.2023.

★★★★★

Deputy Registrar,
Academic Section

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2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

AURANGABAD

FACULTY OF SCIENCE & TECHNOLOGY

2 Years P. G. Programme in Science

(M. Sc.)

For University Department (Academic Autonomy)

As per National Education Policy – 2020

(To be implemented from Academic Year 2023 – 2024)

Course structure and Curriculum

(Outcome Based Credit System)

Subject: BOTANY

(Effective from 2023 – 2024)

Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

Prof. Dr. ARVIND S. DHABE
Chairman
Board of Studies in Botany,
Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad - 431004

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSIT, AURANGABAD

M. Sc. BOTANY SYLLABUS FOR UNIVERSITY DEPARTMENT AS PER NEP-2020

Illustrative Credit distribution structure for Two year P. G. programme with Multiple Entry and Exit option

Class: M. Sc. I year **ACADEMIC AUTONOMY** **Semester: I Semester**

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits	Scheme of Examination			
								Theory Maximum Marks 75		Practical Maximum Marks 25	
			Theory	Practical	Theory	Practical		CA 40%	SEE 60%	CA 40%	SEE 60%
Major Mandatory DSC	BOT/MJ/UD/500	Cell and Molecular Biology	3	-	3	-	14	30	45		
	BOT/MJ/UD/501	Biology & Diversity of Algae and Bryophytes	3	-	3	-		30	45		
	BOT/MJ/UD/502	Taxonomy of Angiosperms	3	-	3	-		30	45		
	BOT/MJ/UD/503	Practical based on BOT/MJ/UD/500 Cell and Molecular Biology	-	2	-	1				10	15
	BOT/MJ/UD/504	Practical based on BOT/MJ/UD/501 Biology & Diversity of Algae and Bryophytes		2	-	1				10	15
	BOT/MJ/UD/505	Practical based on BOT/MJ/UD/502 Taxonomy of Angiosperms	-	2	-	1				10	15
	BOT/MJ/UD/506	Horticulture Techniques	-	4	-	2				20	30
DSE (Choose any one from pool of courses)	BOT/DSE/UD/507	Crop Genetics and Plant Breeding – I	3	-	3	-	4	30	45		
	BOT/DSE/UD/508	Practical based on BOT/DSE/UD/507 Crop Genetics and Plant Breeding – I	-	2		1				10	15
		OR									
	BOT/DSE/UD/509	Mycology and Plant Pathology-I	3	-	3	-		30	45		
	BOT/DSE/UD/510	Practical based on BOT/DSE/UD/509 Mycology and Plant Pathology-I		2	-	1				10	15
		OR									
	BOT/DSE/UD/511	Taxonomy of Angiosperms – I	3	-	3	-		30	45		
	BOT/DSE/UD/512	Practical based on BOT/DSE/UD/510 Taxonomy of Angiosperms – I	-	2	-	1				10	15
		OR									
	BOT/DSE/UD/513	Advanced Plant Physiology and Biochemistry –I	3	-	3	-		30	45		
	BOT/DSE/UD/514	Practical based on BOT/DSE/UD/513 Advanced Plant Physiology and Biochemistry –I	-	2	-	1				10	15
RM	BOT/RM/UD/549	Research Methodology	4	-	4	-	04				
			16	12	16	06	22 CREDITS				

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Class: M. Sc. I year ACADEMIC AUTONOMY Semester: II Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits	Scheme of Examination			
								Theory Maximum Marks 75		Practical Maximum Marks 25	
			Theory	Practical	Theory	Practical		CA 40%	SEE 60%	CA 50%	SEE 50%
Major Mandatory DSC	BOT/MJ/UD/550	Cytology and Genetics	3	-	3	-	14	30	45		
	BOT/MJ/UD/551	Plant Development and Reproduction	3	-	3	-		30	45		
	BOT/MJ/UD/552	Biology and Diversity in Fungi and Microbes	3	-	3	-		30	45		
	BOT/MJ/UD/553	Practical based on BOT/MJ/UD/550 Cytology and Genetics	-	2	-	1				10	15
	BOT/MJ/UD/554	Practical based on BOT/MJ/UD/551 Plant Development and Reproduction		2	-	1				10	15
	BOT/MJ/UD/555	Practical based on BOT/MJ/UD/552 Biology and Diversity in Fungi and Microbes	-	2	-	1				10	15
	BOT/MJ/UD/556	Botanical Techniques	-	4	-	2				20	30
DSE (Choose any one from pool of courses)	BOT/DSE/UD/557	Crop Genetics and Plant Breeding – II	3	-	3	-	4	30	45		
	BOT/DSE/UD/558	Practical based on BOT/DSE/UD/557 Crop Genetics and Plant Breeding - II	-	2	-	1				10	15
		OR									
	BOT/DSE/UD/559	Mycology and Plant Pathology-II	3	-	3	-		30	45		
	BOT/DSE/UD/560	Practical based on BOT/DSE/UD/559 Mycology and Plant Pathology-II	-	2		1				10	15
		OR									
	BOT/DSE/UD/561	Taxonomy of Angiosperms – II	3	-	3	-		30	45		
	BOT/DSE/UD/562	Practical based on BOT/DSE/UD/561 Taxonomy of Angiosperms – II	-	2	-	1				10	15
		OR									
	BOT/DSE/UD/563	Advanced Plant Physiology and Biochemistry –II	3	-	3	-		30	45		
	BOT/DSE/UD/564	Practical based on BOT/DSE/UD/563 Advanced Plant Physiology and Biochemistry –II	-	2	-	1				10	15
RM	BOT/FP/UD/559	OJT/FP/ Internship	-	4	-	4	04				
			12	20	12	10	22 CREDITS				

Class: M. Sc. II year ACADEMIC AUTONOMY Semester: III Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits	Scheme of Examination			
								Theory Maximum Marks 75		Practical Maximum Marks 25	
			Theory	Practical	Theory	Practical		CA 40%	SEE 60%	CA 50%	SEE 50%
Major Mandatory DSC	BOT/MJ/UD/600	Biology and Diversity of Pteridophytes and Gymnosperms	3	-	3	-	14	30	45	-	-
	BOT/MJ/UD/601	Plant Ecology and Conservation	3	-	3	-		30	45	-	-
	BOT/MJ/UD/602	Plant Biotechnology	3	-	3	-		30	45	-	-
	BOT/MJ/UD/603	Practical based on BOT/MJ/UD/600 Biology and Diversity of Pteridophytes and Gymnosperms	-	2	-	1		-	-	10	15
	BOT/MJ/UD/604	Practical based on BOT/MJ/UD/601 Plant Ecology and Conservation	-	2	-	1		-	-	10	15
	BOT/MJ/UD/605	Practical based on BOT/MJ/UD/602 Plant Biotechnology	-	2	-	1		-	-	10	15
	BOT/MJ/UD/606	Industrial Technology	-	4	-	2		-	-	20	30
DSE (Choose any one from pool of courses)	BOT/DSE/UD/607	Crop Genetics and Plant Breeding – III	3	-	3	-	4	30	45	-	-
	BOT/DSE/UD/608	Practical based on BOT/DSE/UD/607 Crop Genetics and Plant Breeding - III	-	2	-	1		-	-	10	15
		OR									
	BOT/DSE/UD/609	Mycology and Plant Pathology-III	3	-	3	-		30	45	-	-
	BOT/DSE/UD/610	Practical based on BOT/DSE/UD/609 Mycology and Plant Pathology-III	-	2		1		-	-	10	15
		OR									
	BOT/DSE/UD/611	Taxonomy of Angiosperms – III	3	-	3	-		30	45	-	-
	BOT/DSE/UD/612	Practical based on BOT/DSE/UD/611 Taxonomy of Angiosperms – III	-	2	-	1		-	-	10	15
		OR									
	BOT/DSE/UD/613	Advanced Plant Physiology and Biochemistry –III	3	-	3	-		30	45	-	-
	BOT/DSE/UD/614	Practical based on BOT/DSE/UD/613 Advanced Plant Physiology and Biochemistry –III	-	2	-	1		-	-	10	15
RP	BOT/FP/UD/649	OJT/FP/Internship	-	4	-	4	04	-	-	40	60
			12	20	12	10	22 CREDITS				

Class: M. Sc. II year ACADEMIC AUTONOMY Semester: IV Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits	Scheme of Examination			
								Theory Maximum Marks 75		Practical Maximum Marks 25	
			Theory	Practical	Theory	Practical		CA 40%	SEE 60%	CA 50%	SEE 50%
Major Mandatory DSC	BOT/MJ/UD/650	Bioprospecting and Plant Resource Utilization	3	-	3	-	14	30	45	-	-
	BOT/MJ/UD/651	Pharmacognosy	3	-	3	-		30	45	-	-
	BOT/MJ/UD/652	Plant Physiology and Metabolism	3	-	3	-		30	45	-	-
	BOT/MJ/UD/653	Practical based on BOT/MJ/UD/650 Bioprospecting and Plant Resource Utilization	-	2	-	1		-	-	10	15
	BOT/MJ/UD/654	Practical based on BOT/MJ/UD/651 Pharmacognosy	-	2	-	1		-	-	10	15
	BOT/MJ/UD/655	Practical based on BOT/MJ/UD/652 Plant Physiology and Metabolism	-	2	-	1		-	-	10	15
	BOT/MJ/UD/656	Genetic Engineering and Bioinformatics	-	4	-	2		-	-	20	30
DSE (Choose any one from pool of courses)	BOT/DSE/UD/657	Crop Genetics and Plant Breeding – IV	3	-	3	-	4	30	45	-	-
	BOT/DSE/UD//658	Practical based on BOT/DSE/UD/657 Crop Genetics and Plant Breeding - IV	-	2	-	1		-	-	10	15
		OR									
	BOT/DSE/UD/659	Mycology and Plant Pathology-IV	3	-	3	-		30	45	-	-
	BOT/DSE/UD/660	Practical based on BOT/DSE/UD/659 Mycology and Plant Pathology-IV	-	2		1		-	-	10	15
		OR									
	BOT/DSE/UD/661	Taxonomy of Angiosperms – IV	3	-	3	-		30	45	-	-
	BOT/DSE/UD/662	Practical based on BOT/DSE/UD/661 Taxonomy of Angiosperms – IV	-	2	-	1		-	-	10	15
		OR									
	BOT/DSE/UD/663	Advanced Plant Physiology and Biochemistry –IV	3	-	3	-		30	45	-	-
	BOT/DSE/UD/664	Practical based on BOT/DSE/UD/663 Advanced Plant Physiology and Biochemistry –IV	-	2	-	1		-	-	10	15
RP	BOT/FP/699	FP	-	4	-	4	04	-	-	40	60
			12	20	12	10	22 CREDITS				

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSIT, AURANGABAD

M. Sc. BOTANY SYLLABUS FOR UNIVERSITY DEPARTMENT

Illustrative Credit distribution structure for Two year P. G. Programme with Multiple Entry and Exit option

Class: M. Sc. I year **ACADEMIC AUTONOMY** **Semester: I Semester**

Course code: BOT/MJ/UD/500

Course name: CELL AND MOLECULAR BIOLOGY

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I Cell Membrane

i) The fundamental structure of cell

ii) Plasma membrane: Molecular organization, current models and functions. Cell wall architecture, biosynthesis, assembly, growth and cell expansion.

iii) Plasmodesmata: Structure and role in movement of molecules and macromolecules

Unit II Cell Organelles

i) Chloroplast and Mitochondria: Ultrastructure, function and biogenesis. The organization of genome and patterns of gene expression.

ii) Vacuoles: Tonoplast membrane, ATPases, transporters, as storage organelle.

Unit III Other Cellular Organelles

i) Structure and functions of microbodies, Golgi apparatus, Lysosomes and Endoplasmic reticulum.

ii) Nucleus: Microscopic and submicroscopic organization. Structure and function of nuclear Envelope. The ultrastructure of nucleolus and its role in rRNA biosynthesis.

iii) Ribosomes: Structure and site of protein synthesis. Mechanism of translation, details of initiation, elongation and termination. The structure and role of RNA.

Unit IV Cytoskeleton

i) Organization and role of microtubules and microfilaments, Implications in flagellate and other movements.

Unit V Cell Cycle and its molecular aspects

i) Control mechanism, the role of cycline and cycline dependent kinases, Retinoblastoma and E_2F proteins. Cytokinesis and cell plate formation. Mechanism of programmed cell death (Apoptosis) and Senescence.

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Suggested Readings for BOT/MJ/UD/500 Theory

1. Lewin, B. 2000, Genes VII, Oxford University Press, New York.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D.I 999. Molecular Biology of the cell. Garland Publishing, Inc. New York.
3. Wolfe, S. L. 1993. Molecular and cellular biology. Wodsworth publishing company, California, U. S. A.
4. De, D. N. 2000. Plant cell vacuoles. An introduction. CSIRO Publication, Collingwood, Australia.
5. Kleinsmith, I. J. and Kish, V. M. 1995. Principles of Cell and Molecular Biology (End Edition). Harper Collins College publishers, New York, U.S.A.
6. Lodish, H., Berk, A., Zipursky, S. Z., Matsudaira, P., Baltimore, D. and Darnell, J., 2000. Molecular Cell Biology. (4th Edition). W.H. Freeman and company, New York, U .S. A
7. Click, B. R. and Thompson, J. E. 1998. Methods in Plant Molecular biology and biotechnology. CRC Press, BOCA RBTON Florida.
8. Glover, D. M. and Hames, B. D. (Eds.) 1995. DNA cloning I :: A practical approach, Core techniques, first edition, TASIRL Press al Oxford University Press, Oxford.
9. Gunning B. E. S. and Steer, M. W. 1996. Plant cell biology, structure and function. Jones and Bartlet Publishers, Boston, Massachusetts.
10. Hackett, P. B., Funchs, J. A. and Messing, J. W. 1998. An Introduction to recombinant DNA techniques : Basic experiments in gene manipulation. The Benjamin Cummings Publishing Company, Inc. Memno Park, California.
11. Hall, J. L. and Moore, A. L. 1983. Isolation of membranes and organelles from plant cells. Academic Press, London, U.K,
12. Harris, N. and Opataks, K. J. 1994. Plant Cell Biology : A practical approach. IRL Press at Oxford University Press, Oxford, U. K.
13. Shaw, C. H. (Ed.) 1988. Plant Molecular Biology: A Practical Approach. IRL Press, Oxford.

Review Journals

1. Annual review of plant physiology and molecular biology.
2. Current advances in Plant Sciences.
3. Trends in Plant Sciences.
4. Nature reviews: Molecular and Cell Biology.

Course code: BOT/MJ/UD/501

Course name: BIOLOGY & DIVERSITY OF ALGAE AND BRYOPHYTES

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I. i. Introduction and history of phycology with special reference to Indian work.

ii. Algae in diversified habitats (Terrestrial, fresh water, marine).Algal blooms.

iii. Criteria used in classification of algae, pigments, reserve food and flagella and important systems of classification of algae.

Unit II. A general account of thallus organization, reproduction and life history of algae. Study of important groups of algae with reference to General account, cell structure and method of reproduction and their economic importance -

a) **Cyanophyta:** *Nostoc, Oscillatoria, Rivularia* and *Spirulina*
b) **Chlorophyta:** Volvocales (*Chlamydomonas, Volvox*), Oedogonials (*Oedogonium, Cladophora*), Zygnematales (*Spirogyra, Zygnema*and *Cosmarium*)
c) **Xanthopyta**: *Botrydium* and *Vaucheria.*
d) **Bacillariopyta**: *Pinularia* and *Navicula*
e) **Phaeophyta:** *Ectocarpus* and *Sargassum.*
f) **Rhodophyta**: *Batracospermum* and *Polysiphonia*

Bryophytes:

Unit III. Characteristic features, classification, distribution, Habit and Habitat of Bryophytes.

Unit IV. External and internal morphology, reproduction, gametophytes and sporophytes, phylogeny and interrelationships of the orders:

- Sphaerocarpales, Takakiales, Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Andreales, Bryales.

Unit V. Bioprospecting of Algae and Bryophytes: BGA bio-fertilizers, Freshwater and Marine algae as food and fodder, Algae in industry. Role of algae in human welfare. Ecological and Economic importance of Bryophytes.

Suggested Readings on Biology & Diversity of Algae and Bryophytes

Algae:

1. Chapman V. J. & D. J. Chapman (1983). The Algae, The MacMillan Press Ltd., London.
2. Desikachary T. V. (1959) Cyanophyta, ICAR, New Delhi.
3. Fritsch F. E. (1961). The Structure and Reproduction of the Algae, Vol.I & H, Cambridge University Press, London.
4. Kumar H. D. (1988) Introductory Phycology, Affiliated East-West Press Pvt. Ltd., New Delhi.
5. Prescott G. W. (1969). The Algae: A Review, Thomas Nelson .and Sons Ltd., Melbourne.
6. Round F. E. (1981). The Ecology of Algae, Cambridge University Press, London.
7. Smith G. M. (1950). The fresh water algae of the United states, McGrawIIill Hoc Co., New York.
8. Vijayraghavan & Sunita Kumari (1995). Chlorophyta, Bisen Singh Mahendra P. Singh, Dehra Dun.
9. Sharma O. P. (2018), A text Book of Algae, Tata Mc Graw Hill, New Delhi
10. Bilgrami, K. S. (2020), A text Book of Algae,
11. Arungnam N., Ragland Anita and Kumarion N, (2018), Fundamentals of Algae and Bryophytes, Saras Publication, Tamil Nadu
12. Samba Murty A. V. S. S. (2020), A text book of Algae, Wiley Publication, New Delhi

Bryophytes:

1. Smith (1955) Cryptogamic Botany I & II, McGraw-Hill, New York.
2. Prem Puri (1980) Bryophytes, Atmaram& Sons, Delhi.
3. Parihar N. S. (1991) Bryophytes, Central Book Dept., Allahabad.
4. Verdorn - (1932) Manual of Bryology, TheHegue.
5. Bower P. O. (1935) Primitive; land Plants, Macmillan and Co., London.
6. Campbell (1940) Evolution of land Plants, Stanford University Press.
7. Kashyap S. R. (1929, 1932), Liverworts of Western Himalays and the Pan); plain, Vol. I & II, The University of Punjab, Lahore.
8. Tewari, Shiv Datt and Giri Bala Pant (2005) Bryophytes of Kumaun Himalaya. Publisher-Bhishan Singh Mahendra Pal
   Singh- Dehradun.

Course code: BOT/MJ/UD/502

Course name: TAXONOMY OF ANGIOSPERMS

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

UNIT- I: Angiosperms: Definition, its characteristic features and probable causes of their evolutionary success. Taxonomy: Definition, scope, principles, aims and objectives and functions of taxonomy. Phases of plant classification.

Phylogeny of Angiosperms: A general account of origin of Angiosperms with reference to time and place and possible ancestors: Euanthial theory (Bennettitales, Caytoniales, Gnetales, Cycadales) and Pseudanthial theory (Pentoxylales, Pteridospermales, Glossopteridales).

UNIT- II: Categories of classification – Major, Minor and Infra-specific categories; Species Concepts, Speciation, Causes of variations in population. Brief history on account of artificial, natural, phylogenetic systems of classifications with special reference to Bentham and Hooker, Cronquist'system, Takhtajan's system and Broad outline of APG IV (2016) system of classification and its merits and demerits.

UNIT-III: Botanical Nomenclature: Concept of nomenclature, Binomial nomenclature and its advantages, formation of code, Melbourne Code 2012, Shenzhen Code 2018, Principles of International Code of Nomenclature of Algae, Fungi and Plants (ICN), ending of taxa names, Typification.

UNIT-IV: Taxonomic evidences: Morphology, anatomy, embryology, palynology, cytology, phyto-chemistry and numerical taxonomy. Taxonomic tools: Serological and molecular techniques, GIS, GPS, Use of computers in angiosperms taxonomy (Use of computer and data bases for identification of plants with the help of websites). Herbarium Techniques, Major herbaria of the World and India. Contributions of Herbarium BAMU.

UNIT-V: Angiosperm Families: Nymphaeaceae, Hydatellaceae, Magnoliaceae, Papaveraceae, Malvaceae, Leguminaceae, Sapotaceae, Apiaceae, Asteraceae, Rutaceae, Apocynaceae, Solanaceae, Liliaceae, Arecaceae and Poaceae.

Suggested Readings

1. Cole, A. J. 1969. Numerical Taxonomy. Academic Press. London.

2. Davis, P. H. and Heywood, V. H. 1973. Principles of AngiospermsTaxonomy. Robert E. Krieger Pub. Co. New York.

3. Daniel Mammen (2009) Taxonomy, Evolution at work, Narosa Publication, New Delhi.

4. Grant, V. 1971. Plant Speciation, Columbia, University Press, New York.

5. Grant, W. F. 1984. Plant Biosystematics, Academic Press, London.

6. Harrison, H . J. 1971. New concepts in Flowering Plant Taxonomy. Hieman Educational Book Ltd.,London.

7. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd. U. K.

8. Heywood, V.H. and Moore, D. M. 1984. Current Concepts in Plant Taxonomy, Academic Press, London.

9. Jones, A. D. and Wilbins, A. D. 1971.Variations and Adaptions in Plant species.Hieman&Co.Educational Ltd. London.

10. Jones S. B. Jr. &Luchsinger, A. E. 1986. Plant Systematics, (2nd Edition) McGraw-Hill Book Co. NewYork.

11. Naik V. N. (1989) Taxonomy of angiosperms, Tata Mc Graw Hill Co. Ltd. New Delhi

12. Naik V. N. (1998) Flora of Marathwada, Amrut Prakashan, Aurangabad

13. Radford, A. E. 1986 Fundamentals of Plant Systematics. Harper & Raw Publications, U.S.A.

14. Solbrig. O. T. & Solbrig D.J. 1979. Population Biology and Evolution. Addison Wesley Publication Co. Inc.U.S.A.

15. Stebbins, G. L. 1974 Flowering Plant- Evolution above Species Level. Edward Arnold Ltd., London.

16. Stace, C. A. 1989. Plant Taxonomy and Biosystamatics. (2nd Edition)Edward Arnold,, London.

17. Takhtajan A. L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.

18. Woodland D. W. 1991. Contemporary Plant Systematies. Prentice Hall, New Jersey1

Course code: BOT/MJ/UD/503

(Practical based on BOT/MJ/UD/500)

Course name: Practical - CELL AND MOLECULAR BIOLOGY

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. To determine mitotic Index in different plant materials.
2. Karyomorpholpgical studies from slide/photograph.
3. Induction of mitotic abnormalities through chemical treatment.
4. Demonstration of SEM and TEM organelles.
5. Demonstration of acid phosphatases and succinic dehydrogenase activity in plants.
6. Demonstration of native and SDS PAGE profiles of seed proteins.
7. Isolation of plant DNA and its quantitation by spectrophotometric method.
8. Separation of plant RNA by Agarose gel electrophoresis and visualization by ethidium bromide staining,
9. Demonstration of Western blotting.
10. Estimation of seed proteins by Lowry's method.

Course code: BOT/MJ/UD/504

(Practical based on BOT/MJ/UD/501)

Course name:

Practical - BIOLOGY & DIVERSITY OF ALGAE AND BRYOPHYTES

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

Algae :

1. Morphological study of algal forms: *Microsystis, Oscillatoria, Lyngbya, Nostoc, Anabacna, Scytonema, Tolypothrix, Rivularia, Gloeotrichia, Cahthrix, Chlamydomonas, Pandorina, Eudorina, Volvox, Hydrodictyon, Scenedesmus, Pedistruium,Ulothrix, Ulva, Odeogonium, Cladophora, Pithophora, Draparnaldia, Draparnidiopsis, Coleochaete, Cosmarium, Closterium, Caulerpa, Acetabularia, Chara, Nitella, Botrydium, Vaucheria, Pinnularia, Navicula, Fragillaria, Ectocarpus, Diciyota, Fucus, Batrachospermum, Polysiphonia, Corallina.*
2. Collection and submission of algae.

Bryophytes:

i. Vegetative Organization- *Marchantia, Riccia, Anihoceros, Porella, Sphagnum, Polytrichum.*

ii. Anatomical Organization: *Marchantia, Cyalhodhim, Anthoceros, Porella, Sphagnum.*

iii. Archegonia and Antheridia and their Organization: *Riccia, Marchantia, Porella, Anthoceros, Sphagnum.*

iv. Sporophytes: *Riccia, Marchantia, Pellia, Porella, Anthoceros, Funaria, Sphagnum, Polytrichum.*

v. Collection and submission of Bryophytes.

vi. Botanical excursion of about one week duration to any botanically rich location preferably outside the State.

Course code: BOT/MJ/UD/505

(Practicals Based on BOT/MJ/UD/502)

Course name: Practical - TAXONOMY OF ANGIOSPERMS

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Morphology: Terminologies related to Habit and life span, root, stem, leaves, inflorescence, Flower, fruits.
2. Phytography: preparation of scientific botanical description of plant specimens.
3. Study of at least 20 locally available families of flowering plants.
4. Identification of genus and species of locally available wild plants.
5. Preparation of botanical keys at generic level by locating key characters.
6. Knowledge of at least 10 medicinal plant species.
7. Knowledge of food plants (Cereals, Pulses, Fruits, Vegetables, Spices and Condiments)
8. Demonstration of the utility for secondary metabolites in the taxonomy of some appropriate genera.
9. Field trips within and around the University Campus, compilation of field notes and preparation of herbarium sheets of plants.
10. Botanical excursion of about one week duration to any botanically rich location preferably outside the State.

Course code: BOT/MJ/UD/506

Course name: Practical - HORTICULTURE TECHNIQUES

Course type: Major Mandatory Discipline Specific Course

Credit: 2, Contact Hours: 60 clock hours, 4 hours/ week

Marks: 50, Internal assessment: 20, External assessment: 30

1. Horticulture : 1.1 Introduction, Definition, Scope and importance of Horticulture
   1.2. Disciplines of Horticulture, i) Pomology ii) Olericulture iii) Floriculture iv) Ornamental horticulture v) Landscape horticulture
2. Study of Garden tools and equipment: Sprayer, Duster, Pruning knife, Sprinkler.
3. Study of propagation requirement: i) Media ii) Containers iii) Potting iv) Repotting Practicals
4. Study of propagation methods:
   4.1. Sexual Propagation: Advantages and Disadvantages, Various Scarification treatments to seed
   4.2. Asexual /Vegetative Propagation: Advantages and Disadvantages
   4.3. Natural methods of vegetative propagation: Bulb, Corm, Tuber, Rhizome, Runner, Offset, Sucker
5. Artificial methods of vegetative propagation **Cutting:**
   a) Definition b) Types of Cutting: i) Stem cutting - Soft wood cutting and Hard wood Cutting ii) Leaf Cutting iii) Root Cutting
6. Artificial methods of vegetative propagation **Layering:**
   a) Definition b) Types of Layering: i) Simple layering ii) Compound layering iii) Air layering/ Gootee
7. Artificial methods of vegetative propagation **Budding:**
   a) Definition b) Types of Budding – i) Shield/T – Budding ii) Patch Budding
8. Artificial methods of vegetative propagation **Grafting:**
   a) Definition b) Types of Grafting – i) Whip grafting ii) Tongue grafting
9. Preparation of preserved products: Mix fruit Jam, Papaya Jelly, Wood apple/Guava Jelly, Lemon/Orange Squash, Tomato ketchup
10. Visit to any one Nursery Unit, Commercial orchard and Fruit processing unit

REFERENCE BOOKS

1. Azad, K. C. and Sharma, V. K. (2000). Horticulture Technology (Vol. I&II). Deep and Deep Publications, New Delhi, India.

2. Bal, J. S. (1997). Fruit growing. Kalyani Publication, New Delhi, India.

3. Bose, T. (1996). Fruit tropical and Sub tropical. Naya Pracation , Calcutta, India.

4. Edmond, J. B., Senn, T. L., Andrew, F. S. and Halfacr, R. G. (1990). Fundamentals of Horticulture. Tata McGraw Hill Publishing Co. Ltd. New Delhi, India.

5. Girdhari Lal., Siddhappa, G. S. and Tandon, G. L. (1998). Preservation of fruits and vegetables. ICAR New Delhi, India.

6. Hartmann, H. T. and Kester, D. E. (1989). Plant propagation principles and practice. Prentice Hall of India (P) Ltd. New Delhi, India.

7. Khan, M. R. (1995). Horticulture and Gardening. Nirali Prakashan, Pune, India.

8. Sen, S. (1992). Economic Botany. New Central Book Agency, Calcutta, India. 9. Sharma, N. K. and Arora, S. K. (1985). New Routes to increase Brinjal production. Fmr. Parlim 20 (6) 11 - 12.

10. Sharma,V. K. (2004). Advances in Horticulture. Deep and Deep Publications, New Delhi, India.

11. Sharma, V. K. (1999). Encyclopedia of Practical Horticulture.

12. Singh, V. B. (1990). Fruits of NE Region. Wiley Eastern Limited, New Delhi, India.

13. Sonane, H. N., Deore, B. P. and Patil, S. K. (1984). Vaishali (RHR 51) A High yielding Variety of Brinjal for Maharashtra. Journal of Maharashtra Agriculture Uni. 9(3):341-342

14. Vishnu Swarup (1997). Ornamental horticulture. Macmillan Ltd. New Delhi, India.

15. Reddy, Mallikarjun and Rao, Aparna (2010). Applied Horticulture. Pacific Book International, Delhi, India.

16. Sharaf, Sandhya (2012). Green House Management of Horticulture Crops. Oxford book Co. New Delhi, India.

17. Sharon Pastor Simson, Martha C. Straus (2010). Basics of Horticulture. Oxford Book Co. New Delhi, India.

18. George, Acquaah (2008). Horticulture: Principles and Practices, 4th Ed. PHI Learning private Ltd. New Delhi, India.

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Course code: BOT/DSE/UD/507

Course name: Crop Genetics and Plant Breeding – I

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I: Crop genetic resources:

Importance of genetic Conservation, Global network for genetic conservation and utilization in major crops of the world. Institutes engaged in conservation and improvement of crop genetic resources.

Unit II: Food supplies, nutrition and crop breeding:

World food situation, Nutritional problems, Nutritional objectives, Contribution of M.S. Swaminathan and H.Y. Mohan Ram

Unit III: Methods of plant breeding:

Introduction, selection, Pure line selection, W. L. Johansons experiments on beans and their significance, Variety acclimatization, genetic significance of pollination methods, methods of breeding self and cross pollinated crops and asexually and vegetatively propagated crops.

Unit. IV: Incompatibility in plant breeding:

Types, nature, characteristics genetic and biochemical basis, methods of induction and overcoming, incompatibility as a tool in breeding crops.

Unit. V: Male sterility and Back cross

i. **Male sterility:** Definition and classification, Male sex expression and chemical Induction of male sterility, perspectives.
ii. **Back cross:** Genetic basis, Methodology in selection to character under transfer, Transfer of two or more characters, Inter-varietal. Inter-specific and intergeneric transfer.

Course code: BOT/DSE/UD/508

(Practical based on BOT/DSE/UD/507)

Course name: Practical - Crop Genetics and Plant Breeding – I

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Study of floral biology of different crop plants.
2. Demonstration of hybridization technique in self and cross pollinated crops.
3. Study of pollen germination and demonstration of incompatibility.
4. Demonstration of male sterility in Jowar.
5. Study of pollen fertility.
6. Study of pollen viability.
7. Karyotype analysis in crop plants such as *Tradescantia*, *Rheo*, Maize, Onion
8. Aneuploid analysis in crop plants.

Suggested readings for BOT/DSE/UD/507 and BOT/DSE/UD/508

1. Plant Breeding - B. D. Singh.
2. Plant Breeding - J. R. Sharma.
3. An Introduction of plant breeding - H. K. Chaudhary.
4. Evolution of crop plants - Edited by Simmonds N. W (1986)
5. Breeding field crops - Poehlrnann and Sleper.
6. Plant Breeding perspectives - Edited by Sheep and Mendnkasen.
7. Crop Breeding, P. B. Vose and S. G. Blixt
8. Genes. Chromosomes and Agriculture.Chrispels and Simmonds.
9. Principles of Genetics - Snusted and Simulants.
10. Manual of mutation breeding by FAO/IAEA.
11. Mutation Research -Aurebach.
12. Chemical mutagenesis - Fishbeiri *et al.*
13. Discussions in cytogenetics. Burnhan C. R. 1962
14. Genetics - Principles and analysis. Khush G. S. 1973
15. Genetics Principles and analysis. Haiti and Jones 1998
16. Molecular biology of the gene. Watson J. D. 1989

Course code: BOT/DSE/UD/509

Course name: Mycology and Plant Pathology-I

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

UNIT - I

1. Introduction and History of Plant Pathology
2. Classification of plant diseases: Symptomology of Fungal, Bacterial, Viral and Phytoplasmal diseases.

UNIT - II

1. Plant diseases caused by phanerogamic plant parasite- *Loranthus, Orobanche, Striga* and *Cuscuta.*
2. Nematode diseases – Root knot of Tomato caused by *Meloidogyne*.
3. General account of post – harvest fungal diseases of food crops, fruits and vegetables and their management.

UNIT – III: Plant diseases caused by Bacteria, Viruses, Phytoplasma

a. Plant diseases caused by Bacteria

1. Citrus canker
2. Angular leaf spot of Cotton
3. Leaf spot of Mango
4. Gummosis of Sugarcane
5. Wilt of Tomato
6. Soft rot and Scab of Fruits.

b. Plant diseases caused by Viruses

1. Yellow vein of mosaic of Bhendi (YVMV)
2. Papaya leaf mosaic
3. Bunchy top of Banana
4. Tomato leaf curl virus (TLCV)
5. Bud necrosis of Groundnut
6. Bean common mosaic
7. Tobacco mosaic virus

UNIT – IV: Fungal Diseases of Cereals, Pulses and Oil Seeds

a. Cereals

1. Ergot of Bajra
2. Loose smut of Wheat
3. Karnal bunt of Wheat
4. Grain smut of Sorghum
5. Loose smut of Sorghum
6. Downy mildew of Bajra
7. Common smut of Maize
8. Leaf spot of Rice

b. Pulses and Oil Seeds

1. Pigeon pea wilt
2. Blight of Grams
3. Tikka disease of Groundnut
4. Rust of Groundnut
5. White rust of Mustard
6. Sunflower rust
7. Damping off of seedling

UNIT – V: Fungal diseases of Fruit, Vegetables and Cash Crops

a. Fruits

1. Downy mildew of Grapes
2. Powdery mildew of Grapes
3. Mango Anthracnose
4. Citrus Gummosis

b. Vegetables

1. Powdery mildew of Cucurbits
2. Leaf spot of Tomato
3. Leaf spot of Brinjal
4. Chili Die-back

c. Cash Crop

1. Whip smut of Sugarcane
2. Cotton wilt
3. Rhizome rot of Ginger
4. Red rot of Sugarcane

Course code: BOT/DSE/UD/510

Course name: Practical - Mycology and Plant Pathology-I

(Practical based on BOT/DSE/UD/509)

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Collection and preservation of diseases specimens.
2. Sick Plot: Screening for crop disease and soil fungi
3. Symptomology, histopathology of disease from Mastigomycotina, Ascomycotina, Basidiomycotina, Deuteriomycotina.
4. Investigation of Diseases prescribed in theory.
5. Principal and working of instruments, Sterilization Methods.
6. Preparation of Media, stains and Isolation of Fungi from infected plants.
7. Culture and identification of Pathogen.
8. Virulence test for pathogens.
9. Visits to fields for study of diseases.

1. Agrios, G. N. (1969) Plant Pathology, Academic Press, New York.
2. Rangaswami, G. and A. Mahadevan (2001) Disease of crop plants in India, Printic Hall of India,Pvt. Ltd., New Delhi.
3. Gupta, V. K. and V. S. Paul (2001) Disease of vegetable crops. Kalyani Publ. Ludhiana,
4. Gupta, V. K. and S. K. Sharma (2000) Disease of fruit crops, Malyani Publ. Ludhiana.
5. Raychaudhari, S. P. and T. K. Nariani (1977), Virus and Mycoplasma disease of plants in India.Oxford and IBK Publ. Corp., New Delhi.
6. Bos L. (1999), Plant viruses, unique and intriguing pathogens. Backhugs Publ. Leiden.
7. Rangaswami, G. and S. Rajagopalan (1973), Bacterial plant pathology, T. N. Agri. Uni. Coimbatore.

Course code: BOT/DSE/UD/511

Course name: Taxonomy of Angiosperms – I

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

UNIT-I: **Angiosperms:** Characteristic features, Secrets of success of Angiosperms.

Taxonomy: Aims and objectives, Approaches, Principles of taxonomy, functions and phases of taxonomy; taxonomy as synthetic discipline.

Keys: Types, preparation and use

UNIT-II: **Phylogeny of angiosperms:** monophyletic and polyphyletic origin of angiosperms, herbaceous origin hypothesis, Various theories of origin of Angiosperms, origin of monocotyledons; molecular evidence to angiosperm origin, cradle of angiosperms.

UNIT-III: **Taxonomic hierarchy:** it's major, minor and intraspecific categories and ranks. Species as basic unit of classification. Criteria used for classification. A brief history of Pre-Darwinian and post Darwinian systems of classification with special emphasis on Thorne's, Dahlgren's, Takhtajan's and Cronquist's systems of classification, Outline of APG IV system of Classification.

UNIT-IV: **Concept of taxonomic character:** Definition of character, Unit character, analytical and synthetic, qualitative and quantitative, genetically and environmentally controlled, good and bad character, character weighing, taxonomic coefficient with examples.

UNIT-V: **Phylogenetic relationship:** Primitive and advanced characters, monophyletic, paraphyletic and polyphyletic, homology and analogy, parallel and convergent evolution, plesiomorphic and apomorphic characters. **Cladistics:** Operational Taxonomic Units (OTU), characters and coding, measuring of similarity, cladograms.

Course code: BOT/DSE/UD/512

(Practical based on BOT/DSE/UD/511)

Course name: Practical - Taxonomy of Angiosperms – I

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 20, External assessment: 25

1. To study variation in the population of a species.
2. Study of morphology of and general evolutionary trends in Inflorescences, flowers, stamens, carpels and fruits.
3. Study of different types of roots, stems, leaves, their modifications and evolutionary trends therein.
4. Taxonomic distribution of special units of pollen dispersal- bi celled pollen, tetrads, polyads andpollinia and pollen types.
5. Study of plant surface attributes with the help of SEM photographs.
6. Descriptions, sketching, classification and identification of at least 30 families represented in local flora.
7. Several one-day botanical excursions to botanically rich locations.
8. Botanical excursion of about one week to any botanically rich location preferable outside the State.

Course code: BOT/DSE/UD/513

Course name: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY – I

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I. **Plant Composition :** Structure and biochemical role of major plant constituents, carbohydrates and its derivatives, structure and classification of proteins, glycoproteins, peptidoglycans, lipids and glycoproteins, lipid and triglycerides, fatty acid, vitamins nucleic acids.

Unit II. **Pigments and metabolites:** Chlorophylls, phycobiliproteins, phenolics, sterols, alkaloids, carotenoids, phytochorme, anthocyanine, phenolics, porphyrins, organic acids, isolating these chemicals for human welfare.

Unit III. **Principles use and application** of Colorimeters, photometry flame photometers, spectrophotometry, chromatography (ion exchange, affinity, thin layer, high pressure liquid), gel filtration, electrophoresis, electro focusing and ultracentrifugation,

Unit IV. **Application of radioactive tracer technique** in biology, radioactive isotopes Autoradiography, Biophysical methods X ray diffraction, fluorescence UV, NMR and ESRAtomic absorption spectroscopy

Unit V. **Growth analysis:** Growth, growth curve, lag, log and senescence phase, growth rates AGR, RGR, NAR, LAP, LAI, CGR and LAD productivity potential of dwarf varieties, causes of dwarfism, morphological and physiological factors in relation to height. Yields of dwarf plants,

Course code: BOT/DSE/UD/514

(Practical based on BOT/DSE/UD/513)

Practical - Advanced Plant Physiology and Biochemistry – I

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Estimation of B - carotene with column chromatography.
2. Estimation of reducing sugars by Folin – Wu tube.
3. Estimation of cellulose by Cramption and Maynord Method.
4. Estimation of free fatty acids.
5. Estimation of nitrates.
6. Thin layer chromatographic technique.
7. Techniques of flame photometry: estimation of sodium and potassium.
8. Estimation of gross energy by chromic acid oxidation method.
9. Estimation of N by micro – K jeldhal methods.

Suggested Readings

1. Bajrachrys D. Experiment in Plant Physiology, Narosa Publishing House, New Delhi.
2. Bidwell R. G. S., Plant physiology: Mac Millan Publishers Co., New York.
3. Bormer, J. and Galston, A. W., Principles of plant physiology,
4. Hess, Plant physiology, Narosa Publishing House, New Delhi.
5. Datta, S. C., Plant Physiology, Willey Eastern Limited, Culcutta.
6. Devlin, R. M. and Hostan, F. H., Plant physiology, CBS Publishers and Distributors, New Delhi.
7. Fairley, J. L. and Kilgon, G. L., Essentials of Biological Chemistry, Earr west Press Pvt. Ltd., Delhi.
8. Goodwin T. W. & E. I. Mercer (2003) Introduction to Plant Biochemistry, CBS, New Delhi
9. Hess, D. Plant Physiology, Narosa Publishing House, New Delhi.
10. ICAR Handbook of Agriculture, ICAR, New Delhi.

11. Jayraman, J., Laboratory Manual in Biochemistry, New Age International Publishers, Mumbai.
12. Lehninger, A. L. Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
13. Mertz, E. T., Vakils, Elementary Biochemistry, Fetter and SimsonsPvt Ltd. Mumbai.
14. Mukharji S., A. K. Ghosh, Plant Physiology, New Central Book Agencies, Kolkatta.
15. Mukharji, S. and Ghosh, A. K. Plant Physiology. New Central Book Agencies, Kolkatta.
16. Mungikar, A. M. Bibliography of leaf protein in Marathwada University.
17. Nels R. Lersten (2014) Flowering Plant Embryology, Wiley, New Delhi
18. Noggle G. R. and Fritz, G.S., Introductory plant physiology, Prentice Hall, USA.
19. Noggle, G. R. and Fritz, G. S. Introductory plant physiology, Prentice Hall, U. S. A.
20. Pandey S. N. & Sinha B. K., Plant Physiology, Vikas Publishing House, New Delhi
21. Pine, N. W. (1971) Leaf protein, its preparation, quality and use, Blackwell Scientific Publ. U. K.
22. Salisbury F. N. and C. W. Ross, Plant physiology: CBS Publishers and Distributors, New Delhi.
23. Slyter, R. O. Plant Water Relationships, Academic Press, New York.
24. Telek, H. and Graham, LT. (1983) Leaf protein concentrates, AVI, Publishing Co., USA.
25. Vaidya, V. G., Sahasrabuddhe, K. R. and Khupse, V. S. Crop production and field experimentation Continental Prakashan, Pune - 30.
26. Wilkins M. B., Advanced plant physiology, English Language Book Society, London.

Course Code: BOT/RM/UD/549

Course Name: Research Methodology

Course type: Research Methodology Course

Credits: 4, Contact Hours: 60 clock hours, 4 hours/ week

Marks: 100, Internal assessment: 40, External assessment: 60

Course Objectives:

1. To define research and describe the research process and research methods
2. To understand qualitative research and methods used to execute and validate qualitative research
3. To know how to apply the basic aspects of the research process in order to plan and execute a research project.
4. To provide insight into the processes that lead to the publishing of research.
5. To be able to present, review and publish scientific articles

Course Outcomes:

Students will be able to -

- understand and explain research process
- do systematic literature survey, formulation of a research topic, study design, analysis and interpretation of data.
- to design a research approach for a specific research issue of their choice.
- select a suitable analytical method for a specific research approach.
- demonstrate a good understanding of how to write a research report.
- critically assess published quantitative research with regard to the statistical methods and approaches adopted
- create a research document for implementation research project

Course Contents:

Part – 1 (02 credit: 30 Contact Hours)

Unit - I: Research Fundamentals and Identification of Research Problem: (10 Hrs.)

Research Fundamentals

Introduction: Definition, objectives of the research, characteristics of the research, what makes people to do research, importance of research, Qualitative and Quantitative Research: Qualitative research - Quantitative research - Concept of measurement, causality, generalization, and replication. Merging the two approaches.

Identification of Research Problem

Defining the research problem: Identification of research problems, selection of research problem, facts one should know regarding selection of research problem, the process of research problem definition, some facts involved in defining research problem, Research Design: Concept and Importance in Research - Features of a good research design - Exploratory Research Design - concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Concept of Independent & Dependent variables, Case Studies,

Unit - II: Formulation of Research Problem **(10 Hrs.)**

Formulation of the problems: steps involved in defining a problem, formulation of the problems, Formulation of hypothesis: Concept of hypothesis, hypothesis testing, developing the research plan: implementation, interpreting and reporting the findings, Importance of hypothesis in decision making, Case Studies. Interpretation of Data. Measurement: Concept of measurement- what is measured? Problems in measurement in research- Validity and Reliability. Levels of measurement Nominal, Ordinal, Interval, Ratio.

Unit – III : Research Report and Proposal Writing **(10 Hrs.)**

Introduction, research proposal writing: costing, the research proposal, rationale for the study, research objectives, research methodology, target respondents, research Centres, sample size and sample composition, sampling procedures, research project execution, research units; An insight into research report and proposal, research project synopsis, research report writing : types of research reports, guidelines for writing reports; Steps in writing report, report presentation, typing the report, documentation and bibliography, formatting guidelines for writing a good research report / research paper, Paper Writing- Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Case Studies.

Part – II (02 credit : 30 Contact Hours)

Presentations, case studies, Assignments, Tutorials based on Unit I to III **(30 Hrs.)**

Students are expected to do the Followings

i) Select Broad topic of Research Project (to be implemented from second semester onwards)
ii) Read the Basic concepts / fundaments of broad topic
iii) Identify 10 SCOPUS / WEB OF SCIENCE Indexed Journals related to broad topic
iv) Search and download 20 research articles from above research Journals
v) Do systematic review of above 20 research articles
vi) While doing review of each of above mentioned 20 research articles, students are expected prepare notes on following points:

a) What are the objectives of the research article?
b) What methodology has been adopted?
c) What are prominent results?
d) How these results of relevant to the latest development of the subject?
e) What is novelty of research article?

f) What are prominent shortcomings of this research a presented in this research article?
g) What are your plans to address those shortcoming?

vii) Draft the fine-tuned title of research project
viii) Draft hypothesis
ix) Draft Objectives and Methodology
x) Draft expected outcome of the research project

At the end of the assignment, students are expected to prepare a report having following points

i) Fine-tuned title of Research Project
ii) Fundamental aspects of the fine-tuned research topic
iii) Hypothesis
iv) Objectives
v) Methodology
vi) Detailed Experimental plan
vii) Expected outcome
viii) References

References:

1. Research Methodology by Dr. S. L. Gupta, Hitesh Gupta; International Book House Pvt Ltd (**2013),** ISBN-10: 8191064278, ISBN-13: 978-8191064278
2. Basic Research Methods-Gerard Guthrie SAGE Publications, India, Pvt Ltd, New Delhi **(2010),** ISBN-10: 8132104579, ISBN-13: 978-8132104575
3. Research Methodology-methods and techniques By C. R. Kothari, New Age International Publishers **(2011)** ISBN 978-81-224-1522-3
4. Principles of Research Methodology- Phyllis G. Supino, Jeffrey S. Borer; Springer, Verlag New York **(2012),** ISBN-ebook: 1461433592, ISBN (Hardcover): 978-1461433590
5. Research Design Qualitative, Quantitative. and Mixed Methods Approaches- John W. Creswell; SAGE Publications Ltd, UK **(2011),** ISBN-9780857023452
6. Research Methodology -A Step-by-Step Guide for Beginners- Ranjit Kumar; Sage Publications Ltd. **(2010)**, ISBN- 1849203016.
7. Scientific Writing and Communication- Angelika Hofmann; Oxford University Press, US **(2010),** ISBN-13-: 978-0 199947560, ISBN-10: 01 99947562
8. Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded- Joshua Schimel, Oxford University Press, **(2011)**, ISBN: 9780199760237
9. Handbook of Scientific Proposal Writing- A. Yavuz Oruc; CRC Press, Taylor & Francis group **(2011)**, ISBN: 9781439869185

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Course code: BOT/MJ/UD/550

Course Name: Course Name: CYTOLOGY AND GENETICS

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I: Chromatin organization

i) Chromosome structure and packaging of DNA.
ii) Nucleosome organization, DNA Structure (A, B and Z forms)
iii) Organization of centromere and telomere.
iv) Karyotype analysis and the banding patterns.
v) Special types of chromosomes- Polytene, Lampbrush, B-chromosome and sex chromosomes.

Unit II: Structural and Numerical alterations in chromosomes

i) The origin, meiosis and breeding behaviour of duplication, deficiency, inversion, translocation heterozygotes, haploids, aneuploids and autopolyploids.
ii) The allopolyploids and evolution of major crop plants.

Unit III: Mutation

i) Historical perspective
ii) Spontaneous and induced mutations
iii) Physical and chemical mutagens
iv) Mode of action and molecular basis of gene mutations
v) Transposable elements and mutation induced by transposons
vi) Applications of various mutation techniques
vii) Role of mutations in crop improvement programme

Unit IV: DNA damage and repair mechanism

PROF. DR. ARVIND S. DHABE
Chairman
Board of Studies in Botany,
Dr. Babasaheb Ambedkar Marathwada University,

i) Fine structure of gene, cis- trans-test, introns and their significance in RNA splicing

ii) DNA damage and repair mechanism

iii) Initiation of cancer at cellular level. Proto-oncogenes and oncogenes

Unit V: Genetics of prokaryotic and eukaryotic organelles

i) Phage and Bacterial Genetics — mapping of the bacteriophage genome, genetic recombination in phage, transformation, transduction and conjugation in bacteria

ii) Genetics of mitochondria and chloroplast, cytoplasmic male sterility.

iii) Regulation of gene expression in prokaryotes and eukaryotes.

Suggested Reading:

1. Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D. 1989. Molecular Biology (Ed.) Garland Publishing Inc. New York.
2. Atherly, A. G., Girton, J. R. and McDonald, J. F. 1999. The Science of Genetics. Saunders College USA.
3. Burnham, C. R. 1962. Discussions in Cytogenetics, Burgess Publishing Co., Minnesota.
4. Busch. H. and Rothblum, L. 1982 Volume X. The cell nucleus: DNA part A, Academic Press.
5. Hartl, D. L. and Jones E. W. 1998. Genetics: Principles and Analysis (4^{ih} Ed.) Jones and Barew Publishers, Massachusetts, USA.
6. Khush, G. S. 1973. Cytogenetics of Aneuploids, Academic Press, New York, London.
7. Karp, G. 1999. Cell and Molecular Biology; Concepts and Experiments, John Wiley and Sons Inc. USA.
8. Lewin, B. 2000. Genes VII. Oxford University Press, New York, USA. Lewis, R. 1997. Human Genetics: Concepts and applications (2^{nd} Ed),WCB, McGraw Hill, USA.
9. Malacinski, G. M. and Friefelder, D. 1998. Essentials of Molecular Biology (3^{rd} Ed.), John and Bartlet Publishers Inc. London.Russel, P. J. 1998. Genetics (5^{th} Ed) The Benjamin / Cummings Publishing Company, Inc. USA.
10. Powar C. B. (2016) Essentials of Cytology, Himalaya Publishing House, New Delhi
11. Sen Sumitra, Dipak Kumar Kar and B. M. Johri (2005) Cytology and Genetics, Alpha Science Publications
12. Sharma A. K. and Sharma Archana (2016) Chromosome Techniques, Theory and Practice, Butterworth Publication
13. Snustad, D. P. and Simmons, M. J. 2000. Principles of Genetics (2^{nd} Ed.), John Wiley and Sons Inc. USA.

Course Code: BOT/MJ/UD/551

Course Name: Plant Development and Reproduction

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Plant Development

Unit I. **i. Meristems:** Organization of shoot and root apical meristem, various theories, Cytological and Molecular analysis of SAM, control of tissue differentiation especially Xylem and Phloem.

ii. Tissue systems: Differentiation and functions of different tissue systems such as epidermis, parenchyma, chlorenchyma, sclerenchyma, laticifers and glands.

i. Organ determination: Leaf, stem, root etc.

Unit II. **i. Vascular tissues:** Origin, structure and functions Xylem and Phloem elements and their taxonomic significance, Wood development in relation to Environment.

ii. Leaf: Growth and differentiation, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

iii. Root: Initiation and development; lateral roots, root hair, root microbe Interaction.

Plant Reproduction

Unit III. i. **Flower:** Structure and development

ii. **Pollination:** Types of pollination, attractions and rewards of pollination, pollination mechanism and vectors, breeding systems, structure of pistil, pollen interaction and fertilization.

Unit IV. **i. Male gametophyte:** Structure of anthers, micro-sporogenesis, role of tapetum, male sterility, pollen germination, pollen tube growth and development, pollen storage, pollen allergy, pollen embryos.

ii. Female gametophyte: Ovule development, megasporogenesis, organization of the embryo sac. Structure of the embryo sac.

Unit V. **i. Seed development and fruit growth:** Double fertilization,Endosperm development, Embryogenesis, Ultra-structure and nuclear cytology; Development of dicot and monocot embryos, poly-embryony, apomixes, embryo culture.

iv. Fruit development and seed dispersal mechanisms.

Suggested readings:

Bhojwani and Bhatnagar (2000) The Embryology of Angiosperms, S. Chand Pub. New Delhi

Burjes, J. (1985). "An Introduction to Plant cell development Cambridge University Press, Cambridge.

Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.

Chopra, V. L. (2001), 'Plant Breeding, Field Crops', Oxford, BH Pvt. Ltd, New Delhi.

Chopra, V. L. (2001), 'Plant Breeding; theory and practice', Oxford I BH Pvt. Ltd.

Cutler D. F. (1978). Applied Plant Anatomy, Longman, United Kindom

Cutter E. G. (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.

Cutter, E. G. 1978 Plant Anatomy - Experiments and interpretations' Part I and II, Edward Arnold

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

Esau, K, 1965. "Plant Anatomy" (Second edition; 7th reprint 1991), Wiley Eastern, New Delhi.

Fahn, A. 1974, Plant Anatomy, Pergmon Press, USA & UK.

Fahn, A. 1977, Plant Anatomy' (3rd edition, 1982).Pergamon Press, Oxford.

Forster, A. S. 1960. 'Practical plant anatomy D.vanNostrandcompany.Inc.

Fosket D. E. 1994, Plant, Growth and Development: A Molecular Approach, Academic Press.

Foskt D. E. 1994 'Plant growth and development' - A molecular approach Academic Press, Santiago.

Fritsch F. E. 1935, 1945, The Structure and Reproduction of Algae Vols.I and II.Cambridge University Press, Cambridge, UK.

Frugis Givoanna, 2020, Plant Development and Organogenesis: From basic principles to advanced research, M D P I

Hopkins W. G., 2006, The Green World: Plant Development, Chelsea House Publication

Howell S. H., 1998, Molecular Genetics of Plant Development, Cambridge University Press.

Howell, S. H., 1998, Molecular genetics of plant development, Cambridge University Press, Cambridge.

Hyndon, R,F. 1990, Plant Development - The Cellular Basis Univ. Hyman, London.

improvement Cambridge University Press. Cambridge.

Leyser O. and Day S. 2003, Mechanism of Plant Development, Blackwell Press

Maheshwari P., 2000, An introduction to the Embryology of Angiosperms,

Mauseth J. D.,1988, Plant Anatomy, The Benjamin/ Cummings Publisher, USA

Metcalf and Chalk, 1950, Anatomy of Dictotyledons vol. I & II, Clarendon Press.

Murphy, T. M. and Thompson, W. F. 1988, Molecular plant development, Prentice Hall, New Jersey.

Nair M. N. B., 1998, Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia. 11

Nels R. Lersten, 2014, Flowering Plant Embryology, Wiley, New Delhi

Pandey A. K., 2010, ntroduction to Embryology of Angiosperms,

Procton, M. and Yeo, P., 1973, 'The pollination of flowers', William Collins Sons, London.

Raghavan V., 1997, Molecular Embryology of Flowering Plants. Cambridge University Press.

Raghavan V. 2000, Developmental Biology of Flowering Plants, Springer, Netherlands

Raghavan, V., 1999, Developmental Biology of flowering plants', Springier Verlag, New York.

Raven, P. H., Evert, R. F. and Eicbhom, S. E. 1992 'Biology of Plants' (5th Edition), New York.

Richards A. J., 1986, Plant Breeding System, George Allen and Unwin.

Roberts, L. W., 1976, Cyto-differentiation in plants, Cambridge University Press, Cambridge.

Shivanna K. R., 2003, Pollen Biology and Biotechnology, Science Publishers.

Shivanna, K. R. and John, B. M., 1985, 'The angiosperm pollen structure and function', Willey Eastern Ltd., New York.

Shivanna, K. R. and Rangaswamy, N. S., 1992, 'Pollen Biology: A laboratory manual', Springer Verlag, Berlin.

Shivanna, K. R. and V. K. Sawhney, (Ed) 2005, 'Pollen Biotechnology for crop production and Improvement, Cambridge University Press.

Sleeves, T. A. and Sussex, L. M.1989, 'Patterns in plant development (7thedition) Cambridge Press, Cambridge.

Course Code: BOT/MJ/UD/552

Course Name: Biology and Diversity in Fungi and Microbes

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Fungi:

Unit I. a) Fungi - General characteristics in fungi.(Ultrastructure and Reproduction). General account and outline of Classification (Ainsworth 1973)

b) Economic importance of fungi –

Fungi in Agriculture (Biopesticides and Biofertilizers), Fungi in medicine Fungi in industry, Fungi as source of food (SCP, Mushrooms).

Unit II: Fungi as plant pathogens

- General account of different groups and type study of fungi as pathogen.
  - Mastigomycotina -*Phytophora, Albugo.*
  - Zygomycotina - *Rhizopus, Mucor.*
  - Ascomycotina -*Claviceps, Erysiphae,*
  - Basidiomycotina -*Puccinia, Ustilago,*
  - Deuteromycotina - *Alternaria, Aspergillus, Penicillium, Fusarium, Cercospora, Helminthosporium.*

Bacteria:

Unit- III.

a) General characters, ultrastructure, classification, Koch's postulates,

- Archaebacteria and Eubacteria.
- Economic importance of Bacteria,
- Role of bacteria in nitrogen fixation, Role of agrobacterium in GM crops.
- Bacteria as plant pathogens: Citrus canker, Angular leaf spot of Cotton. Soft rot of fruits.

Unit –IV Phytoplasma :

a) Phytoplasma: General Account, ultrastructure and economic importance

b) Phytoplasma as plant pathogens: Grassy shoot of Sugarcane, Little leaf of Brinjal, Sesamum phyllody

Unit- V Virus :

a) General account, ultrastructure, Transmission and multiplication of viruses.

b) Economic importance of viruses.

c) Virus carrying human diseases (HIV, COVID-19, SARI).

d) Viruses as plant pathogens: Tomato / Chilli leaf curl virus, Papaya leaf mosaic Virus, Yellow vein mosaic virus of Bhindi.

Suggested Reading:

1. U. Sinha and Sheela Shrivastava (1985) An Introduction to Bacteria, Vikas Publishing House Pvt. Ltd., New Delhi.

2. Burgey's Manual of Systematic Bacteriology, Vol. 1-4(1986-1989) Williams & Wilkins, Baltimore.
3. J. P, Verma (1992) The Bacteria, Malhotra Publishing House, New Delhi,
4. A. J. Salle (1974) Fundamental Principles of Bacteriology, Tata McGraw Hill Publishing Co. Ltd., New Delhi.10.
5. K. G. Hardy (1987) Plasmids - a Practical Approach, 1RL Press, Oxford, Washington D.C.
6. Bruce A. Voyles (2002) The Biology of Viruses, McGraw Hill, Boston.
7. Luria S. E., J. E. Darnel, D. Baltimore & A. Campbell (1978) General Virology, John Wiley & Sons, New York.
8) E. W. Mester, C.E. Roberts, M.M. Pearsall and B. J.Mc Carth- General Microbiology, Holt, Renehart & Winston, New York.
9. Powar & Daginawala (2004) General Microbiology Vol. II, Himalaya Publishing House, Mumbai.
10. R. F. Boyd (1984) General Microbiology, Times Mirror/Mosby College Publishing St. Louis.
11. S. B. Biswas & Amrita Biswas (1993) An Introduction to Viruses, Vikas Publishing House Pvt. Ltd., New Delhi.
12. V. K. Gupta & M. K. Behl (1994) Indian Plant Viruses & Mycoplasma, Kalyani Publishers, Ludhiana.
13. S. P. Raychoudhari & T. K. Nariani (1977) Virus & Mycoplasma Diseases of plants in India, Oxford & IBH Publishing Co., New Delhi.
14. K. B. Deshpande & P. B, Papadiwal (1979) A Laboratory course in Bacteriology, COSIP-ULP -Botany Publication, Marathwada University, Aurangabad.
15. P. B. Papdiwal (1980) Biotechniques, COSIP- ULP - Botany Publication, Marathwada University, Aurangabad.
16. Alexopoulous C.J., C. W. Mims & M. Blakwel (1996) - Introductory Mycology, John Wiley & Sons Inc.
17. Dube H. C. (1994) - An Introduction to Fungi ,Vikas Publishing House, New Delhi.
18) Sharma P. O. (2000) - Microbiology and plant pathology, Rastogi Publication, New Delhi.
19. Mukadam D. S. (1997) The Illustrated Kingdom of Fungi, Aksharganga Publication, Aurangabad.
20. Mukadam D. S. (2004) - Modern Topics in Fungi, Saraswati Printing Press, Aurangabad.
21. Rangaswami G. & A. Mahadevan (2001) - Diseases of Crop Plants in India., Prentice Hall of India, New Delhi.

Course Code: BOT/MJ/UD/553

(Practical based on BOT/MJ/550)

Course Name: Practical - Cytology and Genetics

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Induction of polyploidy in plants using colchicine. Different methods of application of colchicine.
2. Isolation of biochemical mutants following physical and chemical mutagenic
3. Isolation of chlorophyll mutants following physical and chemical mutagenic treatments.
4. Isolation of morphological mutants following physical and chemical mutagenic treatments.
5. Karyotype analysis in any two plant species.
6. Meiosis of complex translocation heterozygotes.
7. Meiotic behavior of monosomy in plants & its effect.
8. Meiotic behavior of trisomy in plants and its effect.
9. Mitotic/ meiotic chromosomal behaviour in mutagen treated materials.
10. Orcein and Feulgen staining of the polytene chromosomes of *Chironomus* larvae.
11. Study of chromosome pairing and disjunction in translocation heterozygote.
12. Utilization of banding technique for identification of chromosomes in karyotype.

Course Code: BOT/MJ/UD/554

(Practicals Based on BOT/MJ/OC/551)

Course Name: Practical - Plant Development and Reproduction

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Dermatology - trichomes and stomata and leaf anatomy of *Nerium, Terminalia* etc.
2. Mechanical tissues (Collenchyma, Sclerenchyma, Stone cells and Xylem), Secretary tissues (Mucilage Canals, Resin canals, Nectaries, and oil glands), laticifers (Latex cells and Vessels).
3. Vascular tissues and its constituents by sections and maceration, wood anatomy, TS, TLS and RLS
4. Abnormal secondary growth in *Dracaena, Bignonia, Aristolochia, Achyranthus, Nyctanthus, Salvadora, Beta, Mirabilis, Tinospora.*
5. Study of microsporogenesis and gamtogenesis in sections of anthers.
6. Examination of modes of anther dehiscence and collection of pollen grains for
7. Microscopic examination (maize, grasses, *Crotolaria, Tradescantia, Brassica, Petunia, Solanum* etc.)
8. Test for pollen viability using stains and *in vitro* pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
9. Estimation of percentage and average pollen tube length *in vitro*
10. Pollen storage, pollen pistil interaction, *in vitro* pollination.
11. Study of ovules and embryo sacs.
12. Field study of types of flowers and pollination mechanism. .
13. Study of nuclear and cellular endosperms.

Course Code: BOT/ MJ/UD/555

(Practical based on BOT/MJ/UD/552)

Course Name: Practical - Biology and Diversity in Fungi and Microbes.

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

01. Principal and working of instruments, Sterilization Methods.
02. Preparation of Media, stains and Isolation of Bacteria and Fungi from soil and infected plant tissues.
03. Gram staining of bacteria.
04. Morphology and Taxonomy of following fungi - *Albugo, Phytophthora, Mucor, Rhizopus, Plasmopara, Sclerospora, Taphrina, Claviceps, Chaetomium, Puccinia, Ustilago, Agaricus, Polyporus, Ganoderma, Cyathus, Lycoperdon, Geaster, Alternaria, Aspergillus, Penicillium, Helminthosporium, Cercospora, Curvularia, Fusarium, Rhizoctonia, Colletotrichum.*
05. Growth of Fungi on liquid and solid media — *Fusarium* and *Alternaria.*
06. Study of bacterial plant diseases - Citrus canker, Angular leaf spot of cotton, soft rot of fruits.
07. Study of Phytoplasma diseases - Little leaf of Brinjal, Sesamum phyllody, Grassy shoot of sugarcane.
08. Study of viral plant diseases - Papaya mosaic virus (PMV), Tomato leaf curl virus (TLCV), Yellow vein mosaic virus of Bhindi (YVMV), Tobbaco Mosaic Virus (TMV).
09. Collection and submission of fungal, bacterial, phytoplasma and viraldiseases of plants.

Course Code: BOT/MJ/UD/556

Course Name: Practical - BOTANICAL TECHNIQUES

Course type: Major Mandatory Discipline Specific Course

Credit: 2, Contact Hours: 60 clock hours, 4 hours/ week

Marks: 50, Internal assessment: 20, External assessment: 30

Unit I: Microscopy: Compound Microscope and its parts, their functions; Light Microscopy, Phase contrast Microscopy, flow cytometry and confocal microscopy in karyotype analysis. Principles, instrumentation, working and applications of - Fluorescence microscope, TEM, SEM; Biological sample preparation for electron microscopy SEM and TEM. Micrometry.

Unit II: Stains and Staining: Preparation and use of various stains used in botanical studies - Saffranine, Crystals Violet, Light Green, Erythrosine, Acetocarmine, Fuelgen, Basic Fucschin, Lactophenol, Cotton Blue, Iodine, Sudan IV, Fluoroglucinol, Carbolic acid etc. Sectioning and Maceration, Microtomy and Histochemistry.

Unit II: a) Ethical and Legal issues in Research: Legal permissions for collection of biological material from Local Biodiversity committees, Forest Department, State Biodiversity Board and National Biodiversity Authority.

b) **Plant Collection and Preservation** - Plant collection techniques, Voucher specimens, Herbarium techniques, Liquid preservation, Authentication of specimens, etc.

Sampling of Plant materials for Phytochemistry, DNA finger printing, Tissue Culture, Cytological, pathological studies etc.

Unit IV: Laboratory Techniques: Principles, instrumentation, working and applications of - UV-VIS spectrophotometry; IR (infra-red) spectrophotometry; Spectrofluorometry; Luminometry; Atomic spectrophotometry; Mass spectrometry; ESR (electron spin resonance) and NMR (nuclear magnetic resonance), Ultracentrifugation, TLC, fractionation, Electrophoresis, PCR, GISH, FISH techniques.

Unit V: Biostatistics: Calculation of mean, variance, standard deviation, standard error, coefficient of variation and to use 't' test for comparing two means related to ecological data. Hypothesis testing: Theory of errors – Type I and Type II errors, Null Hypothesis, z-test, Test of significance. lay out of field experiments.

Introduction to ANOVA, One-way & two way ANOVA, Dunett's test. Randomized Block Design and Latin Square. (5 problems to be solved in each category)

Suggested Readings:

1. Bauman R. P. Absorption Spectroscopy. John Wiley, New York Dixon R.N. Spectroscopy and Structure. Mathuen, London Sacks R.D. Emission Spectroscopy. John Wiley, New York.
2. Bell R. J. Introductory Fourier Transform spectroscopy. Academic Press, New Yrk. Colthup N.B., Daly L. H. and Wiberley S.E. Introduction to Infra-red and Raman Spectroscopy 2nd Ed. Academic Press. New York.
3. Dean J. and Rains T. Flame emission and atomic absorption. Dekker, New York. Brech F. Analysis in instrumentation. Vol. 6. Plenum, New York.
4. Grob R. L. Modern Practices of Gas Chromatography. 2nd Ed. John Wiley, New York.
5. Guilbault G. G. Practical Fluorescence: Theory, methods and Techniques. Dekker, New York.
6. Hames B. D. and Rickwood D. Gel electrophoresis of Proteins: A practical Approach 2nd Ed. IRL Press, Oxford.
7. Jensen Wiliam A. 2015, Botanical histochemistry- Principles and Practice-Agri-Horti Press New Dehli.
8. Kolthoff I. M. and Elving P. J. Treatise on analytical Chemistry, Wiley Interscience, New York.
9. Mungikar, A. M. (2003) Biostatistial Analysis. Saraswati Printing Press. Aurangabad.
10. Paterson D. D. 2008, Statistical Techniques in Agricultural research, J.V. Publishing House Jodhpur.
11. Pesez M and Bartos J. Colorimetric and Fluorometric Analysis of Organic Compounds and drugs, Dekker, New York. Becker R.S. Theory and interpretation of fluorescence and phosphorescence, Wiley interscience, New York.
12. Plummer David T. An Introduction to Practical Biochemistry-Third Edition- Tata Macgraw Hill. *Tata McGraw Hill*, New Delhi, 1990.
13. Senger R. S. Gupta Shalini, Sharma A. K., 2011, Laboratory Manual On Bioechonology- Studium Press India PVT LTD, New Dehli-2000
14. Sharma, B.K. Principal of analytical chemistry, Merut Publication, Merut.
15. Simpson C. F. Techniques in liquid chromatography, Wiley-Heyden, New York.
16. Watson I. J. Introduction to Mass spectroscopy, Raven, New York. Giddings J.C. Principles and Theory, Dynamics of Chromatogtraphy Part I Dekker, New York.
17. Willard H. F., Merritt L. L., Dean, J. A. and Settle F. A. Instrumental Method of analysis. CBS Publishers and distribution, New Delhi.18.
18. Williams D. A. R. and Mowthorpe D. J. Nuclear Maganatic Resonance Spectroscopy. John Wiley, New York.

Course Code: BOT/DSE/UD/557

Course Name: Crop Genetics and Plant Breeding – II

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I: Heterosis breeding:

Historical aspects, Interbreeding depression, Homozygous and heterozygous balance, Genetic basis of inbreeding, Genetic and physiological basis of heterosis, Heterosis and plant breeding.

Unit II: Mutation Breeding:

Mutagenesis, mutagens, Physical mutagens, ionizing and non-ionizing radiations, radio-sensitivity, cytological and genetic effects, chemical mutagens, mutagenic compounds, mode of action, molecular basis of mutations, mutagenic treatment schedules, Screening of mutation in population, mutation frequency, Frequency and spectrum of mutants, micro and macro mutants, mutagenic effectiveness and efficiency, environmental mutagenesis repair mechanism, Ames test, *In vitro* site directed mutagenesis.

Unit III: Resistance breeding:

i) **Disease resistance** - nature, mechanism of resistance, methodology problems and achievements.
ii) **Insect resistance:** Nature, mechanism of resistance, methodology, problem and achievements.
iii) **Drought resistance**: Importance, types, nature of resistance methods and examples.

Unit IV: Distant Hybridization:

Importance, Interspecific, intergeneric gene transfers, methodology, problem and remedial measures, Man-made species.

Unit V: Seed production and distribution:

Introduction variety evaluation, variety maintenance, availability of new varieties, seed production and regulation, seeds industry development. Breeding crops with special reference to Marathwada region like wheat, Jowar, Bajra, Cotton, Groundnut, Safflower *etc.*

Suggested Reading:

1. Plant Breeding - B. D. Sitigi.
2. Plant Breeding - J. R. Sharma.
3. An Introduction of plant breeding - H. K. Chaudhary.
4. Evolution of crop plants -Edited by Simmonds N. W (1986)
5. Breeding field crops - Poehlrnann and Sleper.
6. Plant Breeding perspectives - Edited by Sheep and Mendnkasen.
7. Crop Breeding, P. B. Vose and S. G. Blixt
8. Genes. Chromosomes and Agriculture.Chrispels and Simmonds.
9. Principles of Genetics - Snusted and Simulants.
10. Manual of mutation breeding by FAO/IAEA.
11. Mutation Research -Aurebach.
12. Chemical mutagenesis - Fishbeiri et al.
13. Discussions in cytogenetics. Burnhan C. R. 1962 -
14. Genetics - Principles and analysis. Khush G. S. 1973 -
15. Genetics Principles and analysis. Haiti and Jones 1998 -
16. Molecular biology of the gene. Watson J. D. 1989

Course Code: BOT/DSE/UD/558

(Practical Based on BOT/DSE/UD/557)

Course Name: Practical - Crop genetics and Plant breeding-II)

Course type: Discipline Specific Elective Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Induction of polyploidy in crop plants.
2. Study of seed protein profile by native and SDS-PAGE.
3. Estimation of leaf proteins, seed proteins in diploids and polyploids.
4. Designing of filed experiments.
5. Mutagenesis: Introduction of mutations through physical / Chemical mutagenic treatments and raising M1 & M2 generations. Assess in the effect of mutagens on different M1 parameters.
6. Study of mutagenesis data published in different journals and arriving at logical conclusions by providing theoretical reasons.
7. Report submission and deposition of rare seeds of wild plants from your area during practical exams.

Course Code: BOT/DSE/UD/559

Course Name: MYCOLOGY AND PLANT PATHOLOG – II

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Applied Mycology

UNIT – I: Diversity of Fungi

1. Diversity of Fungi – General account
2. Fungi in diversified habitats – soil water and air
3. Fungi on plant surface – Phyllosphere and Rhizosphere
4. Biology of some important fungi: *Saccharomyces, Aspergillus*
5. Isolation, identification, selection and strain improvement of some useful fungi.

UNIT – II: Biofertilizers

1. Glomeromycota – Recent trends in Mycorrhizal taxonomy
2. Isolation and multiplication of mycorrhizae; role in crop productivity and forestry.
3. Phosphate solubilizing fungi (PSF)

UNIT – III: Mushroom

1. General account of Oyster, White button, Paddy straw, Morels, Truffles and Poisonous mushrooms.
2. Cultivation and economics of *Agaricus bisporus, Pleurotus*
3. Medicinal and nutritional value of edible and poisonous mushrooms.
4. Effect of environmental, nutritional and chemical factors on mushroom cultivation (intensive and extensive cultivation methods).

UNIT – IV: Fungi as Biopesticides

1. Application of Biotechnology in disease management
2. VA Mycorrhiza
3. Fungi in plant disease control
4. Selection, production and formulation of fungal biopesticides and commercial use of biocontrol agents.
5. Exploitation of biocontrol agents by genetic manipulation

UNIT – V: Fungal Biotechnology

1. Fermentation methods and biomass production of fungi, growth kinetics, fermenter system scale up, fermentation processes.
2. Yeast genome – genetic analysis of yeast; Baker's yeast, food and feed yeasts Glycerol and adhesive, bio-polymer from yeasts.
3. General account of production and application of industrial fungal enzymes (amylases, cellulases, pectinases and chitinases).
4. General account of production and application of primary metabolites (Vitamins and Proteins).

5. General account of production and application of secondary metabolites (antibiotics, mycotoxins, pigments and alkaloids).
6. Environmental and regulatory aspects of using genetically modified microbes in the field.

Course Code: BOT/DSE/UD/560

(Practical based on BOT/ DSE/UD/ 559)

Course Name: Practical - MYCOLOGY AND PLANT PATHOLOGY – II

Course type: Discipline Specific Elective Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Collection and preservation of diseases specimens.
2. Preparation of Media, stains and isolation of Bacteria from infected plant.
3. Investigation of diseases caused by Bacteria, Phytoplasma, Viruses.
4. Study of Non parasitic diseases.
5. Virulence test for pathogens.
6. Production and assay of macerating enzymes.
7. Production and assay of polygalacturonase, cellulolytic enzymes, amylase.
8. Study of toxin production.
9. Effect of toxin on Seed Germination, Leaf Necrosis, Seedling.
10. Extraction and estimation of pigments in healthy and diseased plants.
11. Visits to fields for study of diseases.

Course Code: BOT/DSE/UD/561

Course Name: Taxonomy of Angiosperms – II

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

UNIT-I: Species: Various concepts of species, Plant speciation: allopatric/ abrupt/ sympatric/ hybrid/ apomictic speciation and isolation mechanism. Types of speciation: quantum, catastrophic, local, geographic and phyletic. Causes of variation in population, ecotypes and ecads, evolution and differentiation of species, adaptive radiations.

UNIT-II: **Botanical Nomenclature:** Principles of Plant Nomenclature; Scientific names: legitimate and illegitimate names, autonym, homonym, synonym, basionym, tautonym, alternative name, ambiguous name, superfluous name, naked name, conserved name, rejected name; procedure to describe new taxon; Latin diagnosis and description, effective and valid publication, coining of generic names and specific epithets; citation of names of author(s); Scientific Journals in plant taxonomy.

UNIT-III: **Taxonomic evidences:** Morphology, micro-morphology, ultrastructure systematics-SEM and TEM studies, anatomy, embryology, palynology, cytology, ecology, population biology, phyto-chemistry, molecular biology and numerical taxonomy.

UNIT-IV: a) **Herbarium:** History, Objectives and function of an herbarium, Types of herbaria, role of herbarium in Systematics, Floristics, Teaching, Research, Assessment and documentation of phyto diversity and Public Education, pests in herbarium and its control. Contribution of "BAMU" Herbarium.

c) **Botanic Gardens:** Definition, criteria, history and role of botanic gardens, special types of botanic gardens: Arboretum, Pineatum, Orchidarium, Bambusetum, Fernary. Important Botanic Gardens in India and World.

UNIT-VI: Comparative account on distribution, floral morphology, interrelationships of families belonging to the following order as per APG IV system of classification:

a) Nympheales b) Magnoliales c) Arecales d) Asparagales,
e) Liliales f) Poales g) Zingiberales h) Ranunculales
i) Fabales j) Rosales

Suggested Reading:

1. AHMEDULLAH, M., AND M. P. NAYAR. 1987. Endemic Plants of the Indian Region. Vol. I. Botanical Survey of India. Howrah.
2. BHOJWANI, S. S. AND BHATNAGAR, S. P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Dehli.
3. BILGRAMI, K. S. AND J. V. DOGRA. 1990. Phyto-Chemistry and Plant Taxonomy. New Delhi, CBS Publishers
4. CRONQUIST, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U. S. A.
5. DANIEL, M. 2009. Taxonomy: Evolution at work. Narosa Publishing House Pvt. Ltd. New Delhi.
6. DAVIS, P. H., AND V. H. HEYWOOD. 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi
7. DOBSON, A. P. 1996. Conservation and Biodiversity. Scientific American Library. New York, U. S. A.
8. ERDTMAN, G. 1986. Pollen Morphology and Plant Taxonomy: Angiosperms An Introduction to Palynology. Netherland, E. J. Brill, Leiden.
9. FORMAN, L. AND D. BRIDSON. 1989. The Herbarium Handbook. Royal Botanic Gardens, Kew, U. K.
10. GRAHAM, L. E. 1993. Origin of Land Plants. John Wiley & Sons. Inc. New York.
11. GREUTER, W, (Ed.) 2007. International Code of Botanical Nomenclature. (VIENNA CODE) Koeltz Vesentific Books. Germany.
12. GROOMBRIDGE, B, (Ed.) 1992. Global Biodiversity: Status of the Earth's Living Resources. Chapman and Hall. London.
13. HENRY, A. N., M. CHANDRABOSE. 1980. An Aid to International Code of Botanical Nomenclature. Today & Tomorrow's Printers and Publishers. New Delhi.
14. HEYWOOD, V. H. 1995. Global Biodiversity Assessment. Cambridge University Press, Cambridge, U. K.
15. HUTCHINSON, J. 1973. The Families of Flowering Plants. 3rd Edition. Oxford University Press. Oxford.
16. JAIN, S. K. and R. R. RAO. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.
17. JOHRI, B. M. 1994. Botany in India: History and Progress. Vol-I. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

18. JONES, S. B., AND A. E. LUCHSINGER. 1987. Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York.
19. JUDD, W. S, C. S. CAMPBELL, E. A, KELLOG, P. F. STEVENS AND N. J. DONOGHUE. 2008. Plant Systematics. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
20. LAWRENCE, G. H. M. 1951. Taxonomy of Vascular Plants. The Macmillan Company. New York.
21. MABBERLEY, D. J. 2005. The Plant-Book, A portable dictionary of the vascular plants. Cambridge University Press, United Kingdom
22. MANILAL, K. S. AND M. S. MUKTESH KUMAR [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.
23. MINELLI, A. 1993. Biological Systematics: The State of the Art. London, Chapman & Hall.
24. MONDAL, A. K. 2005. Advanced Plant Taxonomy. New Central Book. Agency Pvt. Ltd. Kolkata.
25. MOORE, R., W. D. CLARK, K. R. STERN AND D. VODOPICH. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers. London.
26. NAIK, V. N. 2000. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company Limited, New Delhi.
27. Nair, P. K. K. 1966. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.
28. NAYAR, M. P., 1996. "Hot Spots" of Endemic plants of India, Nepal and Bhutan. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, India.
29. NAYAR, M. P., AND R. K. SASTRY. 1987-1990. Red Data Book on Indian Plants. Vols. I - III. Botanical Survey of India. Howrah.
30. QUICKE, D. L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Chapman and Hall. London.
31. RADFORD, A. E., W. C. DICKISON, J. R. MASSEY, AND C. R. BELL. 1974. Vascular Plant Systematics. Harper & Row. New York.
32. RAVEN, P. H., R. F. EVERT, AND S. E. EICHHON. 1992. Biology of Plants. 5th Edition. Worth Publishers. New York.
33. SANTAPAU, H. AND H. A. HENRY. 1994. A dictionary of the flowering plants in India, CSRI, New Delhi.
34. SHARMA A. AND A. SHARMA. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.

35. SHIVANNA, K. R. AND N. S. RANGASWAMY. 1992. Pollen Biology- A Laboratory Manual. Springer-Verlag
36. SIMPSON, M. G. 2006. Plant Systematics. Elsevier Academic Press, California, USA.
37. SINGH, G. 2005. Plant Systematics – Theory and Practice. Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi.
38. SIVARAJAN, V. V. 1989. Introduction to Principles of Plant Taxonomy. Oxford and IBH Publishing Co. New Delhi.
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40. STACE, C. A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
41. STUESSY, T. F. 2002. Plant Taxonomy. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
42. SUBRAMANIAM, N. S. 1995. Modern Plant Taxonomy. Vikas Publishing House. New Delhi.
43. TAKHTAJAN, A. 1997. Diversity and Classification of Flowering Plants. Bishen Singh and Mahendra pal Singh, Dehra Dun, India.
44. TAYLOR, D. V. AND L. J. HICKEY. 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.
45. WILEY, E. O. 1981. Phylogenetics: The Theory and Practice of Phylogenetic Systematics. New York, John Wiley & Sons.
https://academic.oup.com/botlinnean/article/181/1/1/2416499
https://en.wikipedia.org/wiki/APG_IV_system#:~:text=The%20APG%20IV%20system%20of,Angiosperm%20Phylogeny%20Group%20(APG).

Course Code: BOT/DSE/UD/562

(Practical based on BOT/ DSE/UD/ 561)

Course Name: Practical - Taxonomy of Angiosperms – II

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Description of species based on many specimens to study intraspecific variation.
2. Study of morphology and general evolutionary trends in flowers, stamens and carpels of primitive families viz. Magnoliaceae, Papaveraceae, Nymphaeaceae, Lauraceae
3. Study of different types of ovules, placentation and evolutionary trends therein
4. Exercises on nomenclature problems: Author citation, principle of priority, transfer of taxa, effective and valid publication.
5. Semi-permanent pollen preparations by acetolysis method and study of different pollen morphotypes.
6. Study of plant surface attributes with the help of SEM photographs.
7. Descriptions, sketching, classification and identification of at least 30 families represented in local flora.
8. Classification and identification of at least 5 species of some of the genera like *Alysicarpus, Amaranthus, Cassia, Chlorophytum, Commelina, Cyperus, Euphorbia, Indigofera, Leucas, Sida, Solanum* etc.
9. Several One-day botanical excursions to botanically rich locations.
10. Botanical excursion of about one week to any botanically rich location preferable outside the State.

Course Code: BOT/DSE/UD/563

Course Name: Advanced Plant Physiology and Biochemistry – II

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I Photosynthesis and plant productivity C3, C4 and CAM pathways and photorespiration in relation to crop productivity, soil and water conservation methods, weed biology herbicides, biological weed control, intensive cropping, zero tillage use of plant growth regulators and bio-fertilizers in agriculture, Nitrogen use efficiency, optimum economic dose of nitrogen fertilizers green manuring.

Unit II. Biomass : The concept of Biomass, Biomass production, Utilization of biomass as a energy agricultural. Residue and their management HDEF energy forests energy crapping hydro carbon, plants biomathylation biogas, biogas plants, biogas production from soils city wastes.

Unit III.The practice of green manuring and preparation of compost NADEP and other methods, Utilization of solid wastes for composting recent trends in solid waste management and production sources.

Unit IV. Green crop fractionation: The GGF system and advantages of GCF. Mechanical fractionation, plants suitable for GCF, Machinery recommended for mechanical fractionation, products, pressed crop residue (PCR) Juice, leaf protein concentrate and deproteinized Juice (DPJ)

Unit V. Green Crop Fractionation: Use of PCR in animal nutrition preparation of silage, silage fermentation, use of leaf juice as a milk replacer, Preparation of LPC, chloroplastic and cytoplasmic LPC, Nutritive value of LPC, and its suitability in human nutrition as a sources of protein and vitamin - A, preservation of LPC, DPJ as a replacer of tissue culture media, LPC compared with algal protein SCP, the possibility of increasing protein productivity through green crop fractionation. Bidkin Process.

Suggested Readings:

1. Bajrachrys D. Experiment in Plant Physiology, Narosa Publishing House, New Delhi.
2. Bidwell R. G. S., Plant physiology: Mac Millan Publishers Co., New York.
3. Bormer, J. and Galston, A. W., Principles of plant physiology,
4. Hess, Plant physiology, Narosa Publishing House, New Delhi.
5. Datta, S. C., Plant Physiology, Willey Eastern Limited, Culcutta.
6. Devlin, R. M. and Hostan, F. H., Plant physiology, CBS Publishers and Distributors, New Delhi.

7. Fairley, J. L. and Kilgon, G. L., Essentials of Biological Chemistry, Earr west Press Pvt. Ltd., Delhi.
8. Goodwin T. W. & E. I. Mercer (2003) Introduction to Plant Biochemistry, CBS, New Delhi
9. Hess, D. Plant Physiology, Narosa Publishing House, New Delhi.
10. ICAR Handbook of Agriculture, ICAR, New Delhi.
11. Jayraman, J., Laboratory Manual in Biochemistry, New Age International Publishers, Mumbai.
12. Lehninger, A. L. Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
13. Mertz, E. T., Vakils, Elementary Biochemistry, Fetter and SimsonsPvt Ltd. Mumbai.
14. Mukharji S., A. K. Ghosh, Plant Physiology, New Central Book Agencies, Kolkatta.
15. Mukharji, S. and Ghosh, A. K. Plant Physiology. New Central Book Agencies, Kolkatta.
16. Mungikar, A. M. Bibliography of leaf protein in Marathwada University.
17. Nels R. Lersten (2014) Flowering Plant Embryology, Wiley, New Delhi
18. Noggle G. R. and Fritz, G. S., Introductory plant physiology, Prentice Hall, USA.
19. Pandey S. N. & Sinha B. K., Plant Physiology, Vikas Publishing House, New Delhi
20. Pine, N. W. (1971) Leaf protein, its preparation, quality and use, Blackwell Scientific Publ. U. K.
21. Salisbury F. N. and C. W. Ross, Plant physiology: CBS Publishers and Distributors, New Delhi.
22. Slyter, R. O. Plant Water Relationships, Academic Press, New York.
23. Telek, H. and Graham, L. T. (1983) Leaf protein concentrates, AVI, Publishing Co., USA.
24. Vaidya, V. G., Sahasrabuddhe, K. R. and Khupse, V. S. Crop production and field experimentation Continental Prakashan, Pune - 30.
25. Wilkins M. B., Advanced plant physiology, English Language Book Society, London.

Course Code: BOT/DSE/UD/564

(Practical based on BOT/DSE/UD/563)

Course Name: Practical - Advanced Plant Physiology and Biochemistry – II

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Estimation of crude protein, crude fat and crude fiber.
2. Estimation of ash acid soluble / insoluble ash, Nitrogen free extracts and total carbohydrates.
3. Estimation of cell wall constituents, ADF, NDF, cellulose, hemicellulose, lignin etc.
4. Estimation of calcium by titration method.
5. Estimation of phosphorus by Subba Rao and Fiske Method,
6. Growth analysis: AGR, RGR, NAR, LAR, LAI, CGR and LAD.
7. The process of GCF and extractability of dry matter and Nitrogen.
8. Preparation of LPC, by heat coagulation, acid coagulation and fermentation.
9. Preparation of cytoplasmic and chloroplast LPC by differential heat coagulation.
10. Preparation of TCM using DPJ and Inoculation of explant.

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