

Appendix- B

AC –

Item No. –

As per NEP 2020

**SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA,
SAWANTWADI**



Title of the Programme: Science

M.Sc. (Botany)

A: PG Diploma in Botany (one year): 2023-2024

B: M.Sc. in Botany (Two year): 2024-2025

C: M.Sc (Botany) (One year) - 2027-28

Syllabus for

Sem-I and Sem-II

Reference GR dated 16th May 2023 for Credit structure of PG

**SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA,
SAWANTWADI**



(As per NEP 2020)

Sr. No.	Headings	Particulars
1	Title of the Program	Science- Botany
2	Eligibility	B.Sc. Botany
	Duration of the Programme	1- PG Diploma 2- Master Degree
	Scheme of Examination	External : 60 Internal: 40 Separate passing in External and Internal examination
	Standard of Passing	40.00%
	Program Academic Level	6.0 PG Diploma 6.0 Research Degree
	Pattern	Semester Pattern
	Status	New
	To Be Implemented from the academic year	5.0 PG Diploma 2023-2024 6.0 Master Degree 2025-2026

Preamble

Shri Pancham Khemraj Mahavidyalaya, Sawantwadi (Autonomous) believes in implementing several measures to bring equity, efficiency and excellence in higher education system in conformity to the guidelines laid down by the University Grants Commission (UGC). In order to achieve these goals, all efforts are made to ensure high standards of education by implementing several steps to enhance the teaching- learning process, examination and evaluation techniques and ensuring the all-round development of learners.

The two-year course in M.Sc. Botany has been designed to have a progressive and innovative curriculum in order to equip our learners to face the future challenges in the field of higher education.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Botany and related subjects, the Board of Studies in Botany at S. P. K. Mahavidyalaya, Sawantwadi (Autonomous) has developed the curriculum for the first semester of F.Y. M.Sc. Botany which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report and Government of Maharashtra's General Resolution dated 20th April and 16th May 2023.

A Botany Post Graduates degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Post Graduates in Botany find opportunities in various fields, including urban planning, teaching, environmental science, all plant sciences, organic farming, nursery management, entrepreneurship Mushroom cultivation, medicinal plant, floriculture, horticulture, propagation methods and plant tissue culture method and many other domains. Throughout their three-year degree program, students explore the significance of plant in life of each and every living organism on Earth. They learn tool, techniques, process which is required to set up agencies including pickles, jam, and jelly medicinal plant, fruit processing, vegetable processing, organic product, organic fertilizer and pesticides producing industries also the can earn the knowledge to produce natural remedies for varies diseases. They became expert

in discovery and development of many new therapeutic compounds which are now used in pharmaceutical herbal cosmetics and other compound based industries.

Overall, revising the Botany syllabi in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

PROGRAMME SPECIFIC OUTCOMES FOR M.Sc. (BOTANY)

AT THE END OF SEMESTER I AND II

THE STUDENTS WOULD HAVE ACQUIRED THE FOLLOWING SKILLS:

- Students will be able to identify the major groups of organisms amongst plants and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of Cryptogams and Phanerogams that differentiate them from each other and from other forms of life.
- Students will be able to explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behaviour of different forms of life.
- Students will be able to explicate the ecological interconnectedness of life on earth by studying ecological principles and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems.
- Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.
- Students will be able to carry out a thorough study of the active constituents of medicinal plants with an emphasis on the use of plant based food as medicine.
- Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for understanding the above.


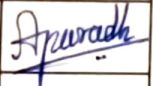
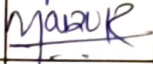

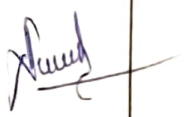





Proposed First Year Credit Structure as per NEP 2020

Department of Botany

Proposed Structure for Main/OE/RM/OJT

Semester	Paper Code	Paper Title	Type	Credits
I (Level 6.0)	PS101BOT	Plant diversity I	Theory	4
	PS102BOT	Plant Physiology and Cytogenetics	Theory	4
	PS103BOT	Molecular Biology and Recombinant DNA technology	Theory	2
	PS104BOP	Practical I & Practical II (Practicals based on	Practical	2
	PS105BOP	Course PS101BOT, PS102BOT & PS103BOT)	Practical	2
	PBOTOE01(OE) OR PBOTOE02(OE)	Industrial Application of Botany. Practicals based on PBOTOE01 OR Biotechnology Practicals based on PBOTOE02	Elective OR Elective	2+2 OR 2+2
	PBOTRM01(RM)	Research Methodology	RM Skill	4
	TOTAL			22
II (Level 6.0)	PS106BOT	Plant diversity II	Theory	4
	PS107BOT	Plant Physiology and Environmental Botany	Theory	4
	PS108BOT	Medicinal Botany	Theory	2
	PS109BOP	Practical I & Practical II (Practicals based on	Practical	2
	PS110BOP	Course PS106BOT, PS107BOT & PS108BOT)	Practical	2
	PBOTOE03(OE) OR PBOTOE04(OE)	Dietetics and Food Technology Practical's based on PBOTOE03 OR Environmental Studies Practical's based on PBOTOE04	Elective OR Elective	2+2 OR 2+2
	PBOTOJT01		OJT	4
	TOTAL			22


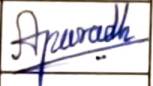
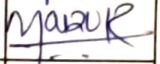

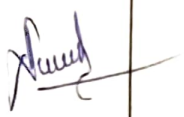





Committee for creation of Syllabus

Sr. No.	Name	College Name	Designation	Signature
1.	Prof. (Dr.) Dethu U. L	Head, P.G. Department of Botany Shri Pancham Khemraj Mahavidyalaya, Sawantwadi	Chairman, BOS	
2.	Dr. Aparadh V.T	Shri Pancham Khemraj Mahavidyalaya, Sawantwadi	Member	
3.	Dr. Pawar U.R.	Shri Pancham Khemraj Mahavidyalaya, Sawantwadi	Member	
4.	Mrs. Sawant S. S.	Shri Pancham Khemraj Mahavidyalaya, Sawantwadi	Member	
5	Dr. Pawar Nilesh .V	Assistant Professor, The New College Kolhapur Phone: 9860282394 Email: nileshsu@gmail.com	Subject experts from outside the university are to be nominated by the Academic Council	
6	Dr. Patil M.S.	Assistant Professor, S. G.M. College, Karad Phone: 9226824947 Email: manasipatil202@gmail.com	Subject experts from outside the university are to be nominated by the Academic Council	
7	Dr. Kashetti Ramesh P.	Anandibai Raorane Arts, Commerce, and Science College Vaibhavwadi Phone: 9730460853 Email: kashettiramesh@gmail.com	Expert nominated by the VC	
8	Dr. Naik Vinayak R.	Vardanjali Herbals, Goregaon (E), Mumbai Mobile: 8928207443 Email: drvinayaknaik01@gmail.com	Representative from Industry/corporate sector/allied areas nominated by the Principal	
9	Dr, Naikwade Pratap V.	Assistant professor Athalye Sapre Pitre College, Devrukh Mobile:9595821891 naikwade.pratap@gmail.com	Experts from outside the Autonomous college whenever special courses of studies are to be formulated to be nominated by the Principal	
10	Mr. Ghaware Pandurang Prabhakar	Botany Executive Shree Swami Samarth Enterprises, Thane 7588451052 pandurangghaware75@gmail.com	Post Graduate Meritorius Alumni	

Letter Grades and Grade points

Semester GPA/Program CGPA/Semester Program	Percentage of Marks	Alpha- sign / letter grade result
9.00-10.00	90.00-100	O (Outstanding)
8.00-9.00 \geq	80.0-90.0	A+ (Excellent)
7.00-8.00	70.0-80.0	A(Very Gppd)
6.00-7.00	60.0-70.0	B+(Good)
5.50-6.00	55.0-60.0	B(Above Average)
5.00-5.50	50.0-55.0	C(Average)
4.00-5.00	40.0-50.0	P(Pass)
Below 4.00	Below 40.0	F(Fail)
AB (absent)		Absent

Committee for creation of Syllabus

Sr. No.	Name	College Name	Designation	Signature
1.	Prof. (Dr.) Dethu U. L	Head, P.G. Department of Botany Shri Pancham Khemraj Mahavidyalaya, Sawantwadi	Chairman, BOS	
2.	Dr. Aparadh V.T	Shri Pancham Khemraj Mahavidyalaya, Sawantwadi	Member	
3.	Dr. Pawar U.R.	Shri Pancham Khemraj Mahavidyalaya, Sawantwadi	Member	
4.	Mrs. Sawant S. S.	Shri Pancham Khemraj Mahavidyalaya, Sawantwadi	Member	
5	Dr. Pawar Nilesh .V	Assistant Professor, The New College Kolhapur Phone: 9860282394 Email: nileshsu@gmail.com	Subject experts from outside the university are to be nominated by the Academic Council	
6	Dr. Patil M.S.	Assistant Professor, S. G.M. College, Karad Phone: 9226824947 Email: manasipatil202@gmail.com	Subject experts from outside the university are to be nominated by the Academic Council	
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8	Dr. Naik Vinayak R.	Vardanjali Herbals, Goregaon (E), Mumbai Mobile: 8928207443 Email: drvinayaknaik01@gmail.com	Representative from Industry/corporate sector/allied areas nominated by the Principal	
9	Dr, Naikwade Pratap V.	Assistant professor Athalye Sapre Pitre College, Devrukh Mobile:9595821891 naikwade.pratap@gmail.com	Experts from outside the Autonomous college whenever special courses of studies are to be formulated to be nominated by the Principal	
10	Mr. Ghaware Pandurang Prabhakar	Botany Executive Shree Swami Samarth Enterprises, Thane 7588451052 pandurangghaware75@gmail.com	Post Graduate Meritorius Alumni	

Course Code and Title: PS101BOT: PLANT DIVERSITY I

Level: 6.0	Credits: 04	Number of Lectures: 40	Semester-I
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Learning Objectives:

- Classify algae into various groups, understand the importance in various fields and will be able to collect and identify them.
- Classify fungi into various groups, understand the role of fungi in various fields and will be able to collect and identify fungi, fungal pathogens and culture them.
- Differentiate between gymnosperms and angiosperms, study their origin and nomenclature, understand evolutionary theories for origin of Angiosperms, understand characteristics of selected Angiosperm families and learn the rules governing the code of botanical nomenclature, also learn the recent developments as in molecular systematics.

Learning Outcomes:

After Completing the course, Student will be able to

- Classify algae into various groups, understand the importance in various fields and will be able to collect and identify them.
- Classify fungi into various groups, understand the role of fungi in various fields and will be able to collect and identify fungi, fungal pathogens and culture them.
- Differentiate between gymnosperms and angiosperms, study their origin and nomenclature, understand evolutionary theories for origin of Angiosperms.
- Understand characteristics of selected Angiosperm families and learn the rules governing the code of botanical nomenclature, also learn the recent developments as in molecular systematics.

Course Contents:

	Unit - I ALGAE	10 Lectures
	1.1 Life cycle of <i>Scytonema</i> , <i>Nitella</i> , <i>Padina</i> and <i>Dictyota</i> .	
	1.2 Diversity and distribution of marine algae in Maharashtra.	
	1.3 Contributions of Eminent Algologists in India: M. O.P. Iyengar and T. V. Desikachary.	
	Unit – II FUNGI	10 Lectures
	2.1 Life cycle of <i>Saprolegnia</i> , <i>Daedalea</i> , and <i>Trichoderma</i> .	
	2.2 Study of the following diseases with reference to occurrence, symptoms, causal organism, disease cycle, predisposing factors and control measures of the following diseases: <ul style="list-style-type: none"> • Red rot of Sugarcane (<i>Colletotrichum falcatum</i>) • Blast of Rice (<i>Pyricularia oryzae</i>) • Wilt of Arhar/ Tur (<i>Fusarium oxysporum</i>) • Green ear of Bajra (<i>Sclerospora graminicola</i>) 	

	2.3 Mycorrhiza: type, distribution and significance with reference to agriculture and forestry.	
Unit – III GYMNOSPERM:		10 Lectures
	3.1 Classification of Gymnosperms up to orders according to the system proposed by C. J. Chamberlain.	
	3.2 General characters; affinities and interrelationships of Cycadofilicales, Bennettitales, Cordaitales and Ginkgoales.	
	3.3 Life cycle of <i>Cupressus</i> and <i>Araucaria</i>	
Unit – IV ANGIOSPERMS::		10 Lectures
	Study of following families with reference to its systematic position, distribution, floral formula, floral diagram, affinities, morphological peculiarities, economically important plants and their uses: <ul style="list-style-type: none"> • Brassicaceae, • Portulacaceae, • Tiliaceae, • Rutaceae, • Myrtaceae, • Crassulaceae • Acanthaceae, • Chenopodiaceae. 	

References:

1	Harold C Bold, Michael J Wynne 1978. Introduction to Algae: Structure and reproduction. Prentice Hall.
2	Sambamurty A V S. 2005. A Textbook of Algae. I K International publishers Pvt Ltd.
3	Sharma O P.2011. Textbook of Algae. Tata McGraw Hill.
4	Alexopoulos C.J., Mims, C.W. & Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley& Sons Inc.
5	Ainsworth, G.C., Sparrow, K.F.& Susmann, A.S.(Eds.) 1973.The Fungi - An Advanced Treatise. Vol 1 -4. Academic Press.
6	Burnett, J.H. 1970. Fundamentals of Mycology. Edward Arnolds.
7	Agrios, G. N. 1997. Plant pathology. 4th Ed., Academic Press.
8	Gymnosperms Structure And Evolution by Chamberlain C.J.
9	A textbook of Gymnosperms by Vyas, Purohit and Garg. Ramesh book depot, Jaipur.
10	Gymnosperms, by P.C. Vashishta. 1983. VAS g. Publisher, New Delhi.
11	Charles Joseph Chamberlain and John Merle Coulter, 1910, Morphology of Gymnosperms.
12	K. R. Sporne. The morphology of gymnosperms.
13	A.K. Mondal (2005). Advanced plant taxonomy, New Central book agency (p) Ltd, London.
14	Davis, P. Hand V.H. Heywood, 1963, Principles of angiosperm taxonomy, Oliver and Boyd, Edinburgh.
15	Cole A. J. 1969, Numerical Taxonomy, Academic Press, London.
16	Cronquist A. 1981, An integrated system of classification of flowering plants, Columbia University Press, N.Y.
17	Gurucharan Singh, 2021 (4th Ed) , Plant Systematics: Integrated Approach, Oxford and IBH publishers.

Course Code and Title: PS102BOT: PLANT PHYSIOLOGY AND CYTOGENETICS

Level: 6.0	Credits: 04	Number of Lectures: 40	Semester-I
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Learning Objectives:

- Students should be able to understand how to apply the basic concepts of Plant Physiology in other fields and also to know and discuss the concept of physiological processes of plants.
- Students will be able to understand the control points in a cell cycle.

Learning Outcomes:

Students should be able to understand

- How to apply the basic concepts of Plant Physiology in other fields and also to know and discuss the concept of physiological processes of plants.
- The control points in a cell cycle, Study and apply principles of microbial genetics, understand recombinant DNA technology and study applications of the same for the improvement of crops.

Course Contents:

Unit - I	PHOTOSYNTHESIS (EUKARYOTES)	10 Lectures
	1.1 ATP synthesis in chloroplasts (chemiosmotic hypothesis)	
	1.2 Regulation of C3, C4 and CAM pathways of photosynthesis:	
	1.3 C3 plants: Role of light, regulation of RUBISCO	
	1.4 C4 plants: Role of light, regulation of PEPcase, transport of metabolites, carbonic anhydrase, NADP-MDH and PPDK	
	1.5 Regulation of CAM through transport of metabolites.	
	1.6 Pentose Phosphate Pathway and its importance, effect of glucose-6-phosphate dehydrogenase deficiency	
Unit – II	PROTEINS	10 Lectures
	2.1 Primary, secondary, tertiary and quaternary structural features and their analysis – Theoretical and experimental. .	
	2.2 Protein folding – biophysical and cellular aspects,	
	2.3 Role of chaperons in protein folding	
Unit – III	CYTOGENETICS I	10 Lectures
	3.1 Check points during cell cycle-G1 to S, progression of S phase, G2to M phase. Anaphase check points and components involved as regulators of check points.	
	Role of cyclins and CDKs, synthesis and degradation of cyclins, structural features of CDKs and cyclins, activation and inactivation of CDKs; role of E2Fs, and DP proteins,	
	3.2 P53, different types of Cyclin dependent CDKs, CDC25, CAKs, Wee1 proteins, nim-proteins, SCFs.	
	3.3 Anaphase Promoting Complexes APC (cyclosomes), replication origin and replication initiation complexes.	

Unit – IV CYTOGENETICS II :		10 Lectures
	Centrosome activation- structure, duplication of centrosomes.	
	Role of nucleophosmins, organization of mitotic apparatus, binding of tractile fibers to kinetochore complexes, molecular motors involved in movement of chromosomes to equatorial plate and in anaphase movement.	
	Cytokinesis by cleavage and phragmoplast formation- different gene products and structures involved and the mechanisms of cytokinesis	

References:

1	Cooper Geoffrey M. And Hausman Robert E. (2009) The Cell – A Molecular Approach, 5 th Edition, ASM Press and Sinauer Associates INC.
2	Daneil J.H and Lodish D. (1995). Molecular Cell Biology. Baltimore Scientific American Book
3	Eduardo Diego Patricio De Robertis, EMF De Robertis (1988), Cell and molecular. biology, International Ed. Inst. Med. Ltd.
4	Elliot and Elliot. (2001). Biochemistry and Molecular Biology. Oxford University Press.
5	Gerald Karp. (1996). Cell and Molecular Biology. John Wiley and Sons. Inc.
6	Sunders Russell PJ (2001) iGenetics: A molecular Approach, Pearson.
7	Simmons M.J. Principles of Genetics, John Wiley and Sons.
8	Slater, A., Scott, W.N. and Flower, R.M. (2008). Plant Biotechnology. 2nd edition. Oxford University Press Inc., New York.
9	Plant physiology by Lincoln Taiz and Eduardo Zeiger.
10	Introduction to plant biochemistry by T W Goodwin and E I Mercer.
11	Fundamentals of biochemistry by Donald Voet and Judith G Voet Biochemistry by Zubay.

Course Code and Title: PS103BOT: MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY.

Level: 6.0	Credits: 02	Number of Lectures: 20	Semester-I
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Learning Objectives:

- Students will be able to understand and apply principles of microbial genetics,
- Understand Recombinant DNA technology and study applications of the same for the improvement of crops.

Learning Outcomes:

- Students will be able to understand and apply principles of microbial genetics,
- Understand recombinant DNA technology
- Study applications of the same for the improvement of crops.

Course Contents:

Unit - I	MOLECULAR BIOLOGY	10 Lectures
	1.1 Microbial Genetics: Molecular basis of transformation, Transduction, Conjugation;	
	1.2 Fine structure of the gene, T4 Phage, complementation analysis, deletion mapping, cis-trans tests.	
	1.3 Tetrad analysis in <i>Neurospora</i>	
Unit – II	RECOMBINANT DNA TECHNOLOGY	10 Lectures
	2.1 Strategies to create Transgenic plants with herbicide resistance: Following strategies to be studied in detail with reference to herbicide Glyphosate resistance	
	2.1.1 Overexpression of the target protein by using a strong promoter.	
	2.1.2 Improved plant detoxification resulting in a more and faster conversion of toxic herbicide to non-toxic or less toxic compounds.	
	2.1.3 Detoxification of herbicide by using a foreign gene.	
	2.1.4 Mutation of target protein	
	2.2 Improvement of nutritional content and Quality:	
	2.2.1 Monellin	
	2.2.2 Increase in sweetness and flavor in fruits and vegetables	
	2.2.3 Gene from African plant (<i>Dioscoreophyllum cumminsii</i>)- introduction in tomato and lettuce	
	2.2.4 Increase and change in the quality oils in <i>Brassica</i> species (increase in medium chain fatty acids and converting unsaturated fatty acid to saturated fatty acids).	
	2.2.5 Increase in starch content (potato).	

References:

1	Brown Terence A. (2002) Genomes, Oxford: Wiley-Liss; John Wiley sons
2	Channarayappa (2007) Molecular Biotechnology: Principles and practice, Universities Press Pvt Ltd.
3	Gerald Karp. (1996). Cell and Molecular Biology. John Wiley and Sons. Inc.
4	Glick B. and J. Pasternak, (2003) Molecular Biotechnology: Principles and Applications of Recombinant DNA , 3rd Edition, American Society of Microbiology.
5	Watson James D. Molecular Biology of the Gene, Pearson.
6	Hyde David R, Genetics and Molecular Biology, Mcgraw Hill.

Course Code and Title: PS104BOP: PRACTICAL I

Level: 6.0	Credits: 02	Number of Lectures: 40	Semester-I
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EXTERNAL		
PS104BOP: PRACTICAL I (PLANT DIVERSITY I)		
1	Study of following type of algae with reference to their systematic position, thallus and reproductive structures: <i>Scytonema, Volvox, Scenedesmus, Ulothrix, Enteromorpha, Closterium, Padina, Gracilaria and Dictyota.</i>	
2	Extraction of algal pigments and their separation by Paper Chromatography	
3	Study of the following types of fungi with reference to their systematic position, thallus and reproductive structures: <i>Saprolegnia, Penicillium, Daedalea, Fusarium and Trichoderma.</i>	
4	Study of the following diseases with reference to occurrence, symptoms, causal organism, disease cycle, predisposing factors and control measures of the following fungal diseases: <ul style="list-style-type: none"> • Red rot of Sugarcane (<i>Colletotrichum falcatum</i>) • Green ear of Bajra (<i>Sclerospora graminicola</i>) 	
5	Study of Gymnosperms and fossil specimens <ul style="list-style-type: none"> • <i>Cupressus</i> • <i>Cycadeoidea</i> (Fossil) 	
6	A study of the angiosperm families mentioned in theory with reference to their morphological peculiarities and economic importance of its members.	
INTERNAL		
1	Culturing of <i>Spirulina</i> algae	
2	Culturing of <i>Penicillium</i> by Streak method	
3	Study of the following disease with reference to occurrence, symptoms, causal organism, disease cycle, predisposing factors and control measures of the following fungal disease: <ul style="list-style-type: none"> • Blast of Rice (<i>Pyricularia oryzae</i>) 	
4	Study of Gymnosperms and fossil specimens <ul style="list-style-type: none"> • <i>Araucaria</i> • <i>Williamsonia</i> (Fossil) 	
5	Identification of genus and species of Angiosperm families using flora (In addition to the above-mentioned families, all families studied in undergraduate classes are included)	

Course Code and Title: PS105BOP: PRACTICAL II

Level: 6.0	Credits: 02	Number of Lectures: 40	Semester-I
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EXTERNAL		
PS104BOP: PRACTICAL II		
(PLANT PHYSIOLOGY AND CYTOGENETICS, MOLECULAR BIOLOGY)		
1	Quantitative study of diurnal fluctuation in Titratable Acid Number (TAN) in a CAM plant.	
2	Determine the Chl a / Chl b ratio in C 3& C 4 plants.	
3	A study of the enzyme polyphenol oxidase from potato peels.	
4	Solvent extraction of Chlorophyll a/b, Xanthophylls and study of absorption pattern.	
5	Immobilisation of yeast cells and study of invertase activity.	
6	Squash preparation from pre-treated root tips (Colchicine/ Paradichlorobenzene/ Aesculin).	
7	Problems based on: <ul style="list-style-type: none"> • Restriction map analysis and construction of restriction maps. • Tetrad analysis in <i>Neurospora</i> – two genes and centromere. • Deletion mapping in Bacteriophage. 	
INTERNAL		
1	Determination of Km and Vmax of the enzyme amylase (purified amylase)	
2	Extraction and estimation of GOT and GPT from suitable plant material.	
3	Preparation of cytological stains, fixatives and pre-treatment agents.	
4	Smear preparation from any suitable plant material	

**Course Code and Title: PBOTOE01(OE)
INDUSTRIAL APPLICATION OF BOTANY.**

Level: 6.0	Credits: 02+02	Number of Lectures: 20+40	Semester-I
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Learning Objectives:

- At the end of the course the students will be able to understand industrial applications of Botany
- Practice the knowledge of Industrial applications of Botany.
- Apply the acquired knowledge of Industrial applications of Botany.

Learning Outcomes:

After Completing the course, Student will be able to

- Classify algae into various groups, understand the importance in various fields and will be able to collect and identify them.
- Classify fungi into various groups, understand the role of fungi in various fields and will be able to collect and identify fungi, fungal pathogens and culture them.
- Apply the acquired knowledge of Industrial applications of Botany.

Course Contents:

Unit - I ALGAE & FUNGI	10 Lectures
1.1 Algae	
1.1.1 Introduction to Industrial Applications of Algae	
1.1.2 Overview of algae as a valuable resource for various industries	
1.1.3 Industrial uses of algae in food, pharmaceuticals, biofuels, and bioremediation	
1.2 Algal Bioremediation	
1.2.1 Role of algae in wastewater treatment and nutrient removal	
1.2.2 Algae as a tool for carbon dioxide capture and utilization	
1.2.3 Algae-based bioremediation of pollutants and heavy metals	
1.3 Fungi	
1.3.1 Fungal Biotechnology and Enzyme Production	
1.3.1.1 Industrial applications of fungi in enzyme production: amylases, cellulases, proteases, and lipases	
1.3.1.2 Fungal fermentation processes for enzyme production	
1.3.1.3 Downstream processing and purification of fungal enzymes	
1.3.2 Fungi in Food and Beverage Industries	
1.3.2.1 Role of fungi in food fermentation: bread, cheese, beer, and wine production	
1.3.2.2 Fungal cultures and starter cultures in food processing	
1.3.2.3 Flavor and aroma compounds produced by fungi	

Unit – II LICHENS, GYMNOSPERMS AND ANGIOSPERMS		10 Lectures
	2.1 Lichens as Bioindicators and Environmental Monitors <ul style="list-style-type: none"> • Lichens as indicators of air pollution, heavy metal contamination, and climate change • Monitoring lichen biodiversity and ecological health • Use of lichens in biomonitoring programs and environmental assessments 	
	2.2 Lichens in Dye Production and Textile Industry <ul style="list-style-type: none"> • Natural dyes and pigments obtained from lichens • Traditional dyeing techniques and modern applications in the textile industry • Sustainability aspects of using lichen dyes 	
	2.3 Industrial Uses of Gymnosperms and Angiosperms Timber and wood products from gymnosperms: construction, furniture, and paper industries <ul style="list-style-type: none"> • Industrial crops and their applications: fibers, oils, resins, and rubber • Ornamental plants and landscaping industry 	
	2.4 Plant-based Natural Products and Cosmetics Plant-derived ingredients in cosmetics, skincare, and personal care products <ul style="list-style-type: none"> • Extraction methods and formulation techniques for plant-based cosmetics • Market trends and consumer demand for natural and botanical products 	

PRACTICALS BASED ON PBOTOE01		
EXTERNAL		
1	Study of algae used in industries.	
2	Detection of mycotoxins by paper chromatography method.	
3	Estimation of total protein content from mushroom by Lowry's method/Biuret method.	
4	Economic importance of Lichens.	
5	Analyse wood density (Angiosperms and Gymnosperms) by Buoyancy method	
6	Medicinal and Industrial uses of Angiosperms and Gymnosperms	
INTERNAL		
1	Demonstration of algal cultivation using Bioreactor.	
2	Study of antibacterial effect of <i>Parmelia</i>	
3	Preparation of any personal care product using natural ingredients	

References:

1	Alexopoulos C.J., Mims, C.W. & Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons Inc.
2	Sambamurty A V S. 2005. A Textbook of Algae. I K International publishers Pvt Ltd.
3	Sharma O P. 2011. Textbook of Algae. Tata McGraw Hill.

4	Burnett, J.H. 1970. Fundamentals of Mycology. Edward Arnolds.
5	Ainsworth, G.C., Sparrow, K.F.& Susmann, A.S.(Eds.) 1973.The Fungi - An Advanced Treatise. Vol 1 -4. Academic Press.
6	Agrios, G. N. 1997. Plant pathology. 4th Ed., Academic Press.
7	K. R. Sporne. The morphology of gymnosperms.
8	Nash, T.H. 1996. Lichen Biology. Cambridge University Press.
9	Hale Mason, E. 1983. The Biology of Lichens. 3rd Ed. Edward Arnold, London.

Course Code and Title: PBOTOE02(OE)
BIOTECHNOLOGY
PRACTICALS BASED ON PBOTOE02

Level: 6.0	Credits: 02+02	Number of Lectures: 20+40	Semester-I
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Learning Objectives:

- At the end of the course the students will be able to understand industrial applications of biotechnology.
- Students will be able to understand and apply principles of micropropagations,
- Understand Recombinant DNA technology and study tissue culture applications for the improvement of crops.
- Student should aware about current trends in botany.

Learning Outcomes:

After Completing the course, Student will be able to

- Understand the concept and applications of Genetic engineering.
- Develop skills and gain knowledge of Tissue culture techniques.
- Demonstrate clear understanding of Green synthesis of Nano technology.
- Comprehend Biosafety and Bioethics in Biotechnology.

Course Contents:

	Unit - I TISSUE CULTURE AND GENETIC ENGINEERING	10 Lectures
	1.1 Tissue culture <ul style="list-style-type: none"> • Impact of Cell and Tissue Culture on commercial applications and importance in Plant Science with special reference to Agriculture, Forestry, Horticulture, floriculture, production of ornamental plants, virus free plants; Global market; Commercial opportunities in plant tissue culture with special reference to plant tissue culture industries in India. 	
	1.2 Genetic engineering and its applications: <ul style="list-style-type: none"> • Methods of modifying the Diazotrophs (N₂ fixing bacteria) by Gene alterations in <i>Rhizobium sp.</i> • Transgenic plants with insect resistance from microbes 	
	Unit – II NANOTECHNOLOGY, BIOSAFETY AND BIOETHICS	10 Lectures
	2.1 Nanotechnology <ul style="list-style-type: none"> • Introduction, properties of nano-materials & Green synthesis of nano-materials, • Application of nano-materials in food, agriculture, environment management and medicine. 	
	2.2 Biosafety and Bioethics <ul style="list-style-type: none"> • Biosafety guidelines in India; International biosafety guidelines: OECD, FAO, WHO. • Introduction to bioethics; social and ethical issues in biotechnology: Bioethics in genetic engineering. 	

PRACTICALS BASED ON PBOTOE02		
EXTERNAL		
1	Encapsulation of Axillary Bud.	
2	Inoculation of Explant.	
3	Green Synthesis of Silver nano particles using plant extract.	
4	Identification of Biosafety Symbols.	
INTERNAL		
1	Techniques of preparing Petri plate, Slant and Butt.	
2	Fermentation of Sugarcane juice/fruit juice using Yeast (Kuhne's tube).	
3	Isolation and quantification of plant genomic DNA.	

References:

1	Altman, A (1997), Agricultural Biotechnology.
2	Ashwini Kumar and Sudhir K. Sopory (2008) Recent Advances in Plant Biotechnology and its applications Prof. Karl- Hermann Commemorative Volume, IK International Publishing House Pvt.Ltd.
3	Channarayappa (2007) Molecular Biotechnology: Principles and practice, Universities Press Pvt Ltd.
4	Clark, P.D. and Pazdernik, J.N. (2009). Biotechnology. Elsevier Academic press, London.
5	Elliot and Elliot. (2001). Biochemistry and Molecular Biology. Oxford University Press.
6	Slater, A., Scott, W.N. and Flower, R.M. (2008). Plant Biotechnology. 2nd edition. Oxford University Press Inc., New York.
7	Sunders Russell PJ (2001) iGenetics: A molecular Approach, Pearson.

Course Code and Title: PBOTRM01(RM)
RESEARCH METHODOLOGY

Level: 6.0	Credits: 04	Number of Lectures: 40	Semester-I
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Learning Objectives:

- Understand the concept of research methodology and its types.
- Develop skills of data collection through literature and scientific documentation.
- Comprehend the importance of ethics involved in research through Plagiarism..
- Familiarize students with the methods of scientific writing and reporting.

Learning Outcomes:

The students will be able to,

- Understand the concept of research and its types.
- Develop skills of data collection and scientific documentation.
- Comprehend the importance of ethics involved in research.
- Familiarize the methods of scientific writing and reporting.

Course Contents:

Unit - I INTRODUCTION TO RESEARCH METHODOLOGY		10 Lectures
	1.1 Introduction: Research Experimental design principles, Classification of Research- pure research, applied research; descriptive, experimental, historical, etc, Design of Survey, statistical methods, interpretation of results.	
	1.2 Problem Identification & Formulation – Research area – Investigation – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null & Alternative Hypothesis. Hypothesis Testing – Logic & Importance, parametric and non-parametric.	
	1.3 Review of literature:	
	1.4 Library: Concepts of a scientific library, journals, books, E books, websites and Digital library and Data bases, NCBI-Pub Med.	
Unit – II REFERENCING AND RESEARCH		10 Lectures
	2.1 Qualitative and Quantitative Research: Concept of measurement, causality, generalization, replication. Merging the two approaches.	
	2.2 Journals: Indexing journals, h-index, i -10, ISSN, ISBN, abstracting journals, research journals, review journals, e-journals, Impact factor of journals, UGC CARE Journals.	
	2.3 Reprints, Open access initiative, INFLIBNET, INSDOC, ShodhGanga, ShodhGangotri, etc. Google Scholar, Research Gate, LinkedIn, Orcid id, Scopus, Web of Science, Boolean words.	
	2.4 Preparation of index cards: Author index and subject index; Open source, bibliography management system.	

Unit-III RESEARCH SCIENTIFIC WRITING AND COMMUNICATION		10 Lectures
	3.1 Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability, Consultation in Herbaria and Library, authentication of plant material. Levels of measurement – Nominal, Ordinal, Interval, Ratio.	
	3.2 Introduction to scientific writing: Meaning of Scientific and non-scientific writing; Scientific Vocabulary and grammar. Synopsis, Dissertations, Thesis, Posters.	
	3.3 Correspondence: Formal letters and permissions (Forest department, State Biodiversity board, International authorities, Quarantine process, etc.), cover letters, drafting emails, replying to reviewers.	
	3.4 Writing a Research article/ paper: Title, Abstract, Introduction, Review of literature, Methodology, Observations, Results, Discussions, Summary, Conclusion, and Bibliography (Referencing and citation styles), IMRAD format. Research ethic: Ethical issues related to publishing, Plagiarism and Self-Plagiarism.	
Unit – IV RESEARCH DATA ANALYSIS, TOOLS AND PROJECT PROPOSAL		10 Lectures
	4.1 Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.	
	4.2 Writing for Research Proposal Grant: Funding agencies, guidelines, structure of research proposals – Setting a budget (Manpower, Consumables, Equipment, Travel, Contingencies, Overheads) with justifications, Expected outcomes, Cost benefit analysis, Work plan, and Time schedule of activities.	
	4.3 Presentations: Presenting numerical data - Graphical, Tabular, Animations, Slides, etc.	
	4.4 Data analysis –SPSS, R (statistical software) and MS Excel.	

References:

1	Anderson J, Durston B H, Poole 1970. Thesis and assignment writing. Wiley eastern.
2	Bedekar V. H.1982. How to write assignments and research papers, dissertations and thesis. Kanak publications.
3	Kothari– C.R. 2004. Research Methodology –Methods and Techniques, New Age International LTd. Publishers, New Delhi.
4	P.N. Arora and P.K. Malhan (1998). Biostatistics. Himalaya Publishing Bombay.
5	P.S.G. Kumar (2004). Research methods and statistical techniques. B.R. publishing Academy, Udaipur.
6	Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition 2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
7	G.B.N. Chainy, G. Mishra and P.K. Mohanty (2004) Basic Biostatistics. Kalyani Publisher.
8	N. Gurumani (2006). Research Methodology for Biological Sciences. MJP Publishing, Chennai.
9	Dawson, Catherina (2002). Practical Res. Methods. New Delhi. UBS Publ.
10	Kumar Ranjit (2005). Res. Methodology. A step by step Guide for Beginners. Singapore, Pearson Education.

SEM II (Level 6.0)	PS106BOT	Plant diversity II	Theory	4
	PS107BOT	Plant Physiology and Environmental Botany	Theory	4
	PS108BOT	Medicinal Botany	Theory	2
	PS109BOP	Practical I & Practical II	Practical	2
	PS110BOP	(Practicals based on Course PS106BOT, PS107BOT & PS108BOT)	Practical	2
	PBOTOE03(OE)	Dietitics and Food Technology Practicals based on PBOTOE03	Elective	2+2
	OR PBOTOE04(OE)	OR Environmental Studies Practicals based on PBOTOE04	OR Elective	OR 2+2
	PBOTOJT01		OJT	4
	TOTAL			22

**Course Code and Title: PS106BOT:
PLANT DIVERSITY II**

Level: 6.0	Credits: 04	Number of Lectures: 40	Semester-II
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Learning Objectives:

Upon successful completion of this course, the student will be able to:

- Classify Bryophytes into various groups, study their importance.
- Classify Pteridophytes into various groups, study their importance and multiplication of important ferns.
- The development of pollen, spore, fertilization and to apply palynological information to plant systematics.

Learning Outcomes:

After Completing the course, the student will be able to:

- Classify Bryophytes into various groups, study their importance.
- Classify Pteridophytes into various groups, study their importance and multiplication of important ferns.
- Understand the development of pollen, spore, fertilization and to apply palynological information to plant systematics.

Course Contents:

Unit - I BRYOPHYTA		10 Lectures
	1.1 Classification of Bryophyta, up to orders, according to the system proposed by G. M. Smith, Diversity and distribution of Indian Bryophytes	
	1.2 Life cycle and Alternation of generations in <i>Pogonatum</i>	
	1.3 Bryophytes: Applied aspects: Agriculture, medicine, Food technology and environmental aspects.	
	1.4 Contribution of Shiv Ram Kashyap and S. C. Srivastava in Bryology.	
Unit – II PTERIDOPHYTA		10 Lectures
	2.1 Classification of Pteridophyta, up to orders, according to the system proposed by G.M.Smith., Heterospory and seed habit	
	2.2 Life cycle of <i>Pteris</i> and <i>Azolla</i>	
	2.3 Cultivation and maintenance of ornamental ferns, Ethnomedicinal uses of Pteridophytes	
	2.4 A study of fossil Pteridophytes: <i>Horneophyton</i> , <i>Cladoxylon</i> , <i>Coenopteris</i>)	
Unit – III ANATOMY		10 Lectures
	3.1 Meristems: Definition type of meristems, apical cell theory, histogen theory and Tunica corpus theory.	
	3.2 Morphogenesis and organogenesis in plants: phyllotaxy; transition of flowering, floral meristems and floral development.	

	3.3 Study of Secretory Tissue System: Introduction, Glands, Digestive glands, Nectaries, Resin ducts and oils ducts, Laticiferous ducts.	
	3.4 Wood Anatomy: Coniferous and Angiosperm wood Parenchyma: Storied and non-storied wood parenchyma, Distribution of axial parenchyma, Distribution of vessels, Structure of rays.	
Unit – IV DEVELOPMENTAL BOTANY		10 Lectures
	4.1 Embryology: Male gametophyte: Pollen development and gene expression male sterility sperm dimorphism and hybrid seed production; pollen tube growth and guidance. Female gametophyte; Types of embryo sacs; structure of embryo sac cells. Endosperm-Types and importance.	
	4.2 Pollination: Evolutionary history of flowers and animals, introduction to pollinator syndrome; Floral attractants-: Olfactory, Floral scent biology. Ultrastructural and histochemical details of style and stigma, self and interspecific incompatibility, significance of pollen-pistil interaction, role of pollen wall proteins and stigma surface proteins, barriers to fertilization, in-vitro pollination.	
	4.3 Fertilization: heterospermy, syngamy and triple fusion, post-fertilization metabolic & structural changes in embryo-sac.	
	4.4 Palynology 1. Pollen Chemistry: Introduction, Chemical constituents of pollen-Major metabolites (Carbohydrates, Mineral content, Callose, Organic acids, Amino acids, Pigments, Vitamins, Hormones and steroids), Chemistry of pollen wall, 2. Utilization of pollen: Pollen as health food, Pollen as medicine, Pollen allergens for diagnosis and therapy.	

References:

1	Atherton, I. D. M., Bosanquet, S. D. S. and Llawley, M. 2010. Mosses and liverworts of Britain and Ireland: A field guide. British Bryological Society, United Kingdom. Cambridge University Press.
2	Gerson, U. 1982. Bryophytes and invertebrates. In: Smith, A. J. E. (ed.) Bryophyte ecology. Springer Netherlands. https://doi.org/10.1007/978-94-009-5891-3_9
3	Goffinet, B., Shaw, A.J. (eds.) 2009. Bryophyte Biology, 2nd edition. Cambridge University Press, Cambridge.
4	Longton, R. E. 1988. Biology of Polar Bryophytes and Lichens. Cambridge, UK. Cambridge University Press.
5	Bierhorst, D. W. 1971. Morphology of vascular plants. New York: Macmillan.
6	Eames, A. J. 1936. Morphology of vascular plants. Lower groups. New York London: MacGraw-Hill.
7	Erdtman, G. 1957. Pollen and spore morphology/plant taxonomy. Gymnospermae, Pteridophyta, Bryophyta (Illustrations). Stockholm: Almqvist and Wiksell.

8	Sporne, K. R. 1975. The morphology of pteridophytes. 4th edn. London: Hutchinson.
9	Crang, R.C.; Lyons-Sobaski, S.; Wise, R.R. (2018) Plant Anatomy: A Concept-Based Approach to the Study of Seed Plants. Springer, New York, 725 pp.
10	Eames, Arthur Johnson; MacDaniels, Laurence H. (1947). An Introduction to Plant Anatomy 2nd ed. McGraw-Hill, New York.
11	Jeffrey, E. C. (1917). The anatomy of woody plants. Chicago, The University of Chicago Press.
12	Cutler, D. F.; Gregory, M.; Rudall, P. (eds.) (1960-2014). Anatomy of the Monocotyledons. 10 vols. Oxford University Press.
13	Metcalfe, C.R.; Chalk, L. (1957). Anatomy of the Dicotyledons: Leaves, stem and wood in relation to taxonomy, with notes on economic uses. 2 vols. Oxford: Clarendon Press. 1500 pp.

Course Code and Title: PS107BOT
PLANT PHYSIOLOGY AND ENVIRONMENTAL BOTANY

Level: 6.0	Credits: 04	Number of Lectures: 40	Semester-II
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Learning Objectives:

- Distinguish key physiological processes underlying the seed germination.
- Identify the physiological factors that regulate growth and developmental processes of plants.
- Demonstrate clear understanding of crop-environment interaction and its implication on crop growth and yield.
- Integrate and apply their knowledge of crop physiology for analytical thinking and solving practical problems experienced in agricultural systems.
- Students should be able to understand how to apply the basic concepts of Plant Physiology in other fields and also to know and discuss the concept of physiological processes of plants.

Learning Outcomes:

On completion of the course students should be able to understand

- How to apply the basic concepts of Plant Physiology in other fields and also to know and discuss the concept of physiological processes of plants.
- Distinguish key physiological processes underlying the seed germination.
- Identify the physiological factors that regulate growth and developmental processes of plants.
- Demonstrate clear understanding of crop-environment interaction and its implication on crop growth and yield.
- Integrate and apply their knowledge of crop physiology for analytical thinking and solving practical problems experienced in agricultural systems.
- To understand and apply ecological principles and understand legislation and measures to solve environmental problems.

Course Contents:

Unit - I	SEED PHYSIOLOGY	10 Lectures
	1.1 Physiology and Biochemistry of seed germination.	
	1.2 Mobilization of food reserves, Germination and growth factors.	
	1.3 Seed dormancy, Control and release of seed dormancy.	
	1.4 Factors in control for the long-term storage of seeds, seed proteins.	
Unit – II	STRESS PHYSIOLOGY	10 Lectures
	2.1 Biotic and abiotic stress, Response of plants to Biotic (pathogenic and insects) stress	
	2.2 Adaptations to eliminate and tolerate the infection, Hypersensitive reaction.	
	2.3 Response of plants to abiotic stress - Drought stress, Heat stress - Heat shock proteins, Chilling, and freezing, Salinity stress	

	2.4 Signaling pathways activated during stress	
Unit – III THE ENVIRONMENT, BIOGEOGRAPHY AND POPULATION ECOLOGY: 10 Lectures		
	3.1 Environment: Components, Major components of physical environment, biotic and abiotic interactions	
	3.2 Biogeography: Major terrestrial biomes, Theory of island bio-geography	
	3.3 Bio-geographical zones of India.	
	3.4 Population Ecology: Characteristics of a population; population growth curves; population regulation.	
Unit – IV CLIMATE CHANGE 10 Lectures		
	4.1 Global warming, carbon credits, Kyoto mechanism.	
	4.2 Factors responsible for climate change, Climate change in relation to the changes in patterns of temperature, precipitation and sea level rise, Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem.	
	4.3 The Montreal Protocol, Paris Agreement, UNFCCC, IPCC.	
	4.4 Adaptation Strategy/ Mitigation Measures, Blue carbon initiative.	

References:

1	Plant physiology by Lincoln Taiz and Eduardo Zeiger.
2	Introduction to plant biochemistry by T W Goodwin and E I Mercer.
3	Fundamentals of biochemistry by Donald Voet and Judith G Voet Biochemistry by Zubay.
4	Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
5	Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
6	Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.

**Course Code and Title: PS108BOT:
MEDICINAL BOTANY**

Level: 6.0	Credits: 02	Number of Lectures: 20	Semester-II
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Learning Objectives:

- Identify medicinal plants and understand the effects of plant chemical constituents on humans.
- Be familiar with the idea of various natural resources and how they are used.
- Assess the various natural resources' management plans.
- Evaluate the management of the coastal zone critically.
- Consider how society can help preserve and maintain the environment.

Learning Outcomes:

At the end of the course the students will be able to,

- Understand the concept of different natural resources and their utilization.
- Evaluate the management strategies of different natural resources.
- Critically analyze the coastal zone management.
- Reflect upon the role of society in environmental protection and its conservation.

Course Contents:

	Unit - I Medicinal Botany I	10 Lectures
	1.1 Monograph of drugs with respect to Biological source, Geographical distribution, macro and microscopic characters, chemical constituents and therapeutic uses of the following drugs:	
	Root: <i>Withania somnifera</i> (Ashwagandha) Rhizome:.. <i>Zingiber officinale</i> (Ginger) Stem bark: <i>Holarrhena antidysenterica</i> (Kurchi) Leaf: <i>Azadirachta indica</i> (Neem) Fruit: <i>Foeniculum vulgare</i> (Fennel) Seed: <i>Plantago ovata</i> (<i>Isabgol</i>)	
UNIT-II Medicinal Botany II		10 lectures
	2.1 Introduction to Pharmacopoeia: Indian pharmacopoeia and Ayurvedic pharmacopoeia.	
	2.2 Quality control of crude drugs: <ul style="list-style-type: none"> ➤ Morphological examination – Exomorphic characters and importance ➤ Microscopical evaluation – Anatomical characters and importance ➤ Preliminary phytochemical tests: Introduction and importance 	
	2.3 Standardization parameters: Introduction, importance – Moisture content, Ash values, Solvent extraction value, bitterness value, foaming index, swelling index.	

References:

1	Ram Rastogi & B.N. Mehrotra: Indian Medicinal Plants Vol. 1 to IV & VI
2	Vaidyaratnam P.S. Variers: Indian Medicinal Plants 5 Books
3	John Lindley :Encyclopedia if useful plants of the world 3 books
4	Plants of Bhava Prakash National Academy of Ayurveda
5	S. K. Sharma, K.C. Chunekar, K. Paudel : Plants of Sharangdhara Samhita
6	Min. of H &. F.W. The Ayurvedic Pharmacopoeia of India 3 Books

Course Code and Title: PS109BOP: PRACTICAL I

Level: 6.0	Credits: 02	Number of Lectures: 40	Semester-I
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PS109BOP: PRACTICAL I (PLANT DIVERSITY II)	
1	Bryophyta Study of vegetative and reproductive structures in <i>Plagiochasma and Pogonatum</i>
2	Pteridophyta Study of vegetative and reproductive structures in: <i>Ophioglossum, Pteris, Lygodium and Azolla</i>
3	Anatomy Study of the following leaves with respect to leaf surface characters (wax, cuticle, epidermis, stomata, epidermal outgrowth): <i>Pistia, Ficus, Avicennia</i> .
4	Mounting of Glands- <ul style="list-style-type: none"> • Salt glands of halophytes- <i>Avicennia</i>, • Nectaries- Euphorbiaceae, • Resin ducts- <i>Pinus</i>, • Oils ducts- <i>Citrus, Murraya</i>, • Laticiferous ducts Asclepiadaceae. • Digestive glands- From permanent slides/photomicrograph.
5	Developmental Botany Microtomy- Processing of material, Block making, cutting, slide preparation & staining (2 slides for submission).
6	A study of types of embryo sacs with the help of permanent slides/photomicrographs
7	Palynology In vitro germination of pollen grains, effect of temperature on pollen viability and short-term storage

Course Code and Title: PS110BOP: PRACTICAL II
PLANT PHYSIOLOGY, ENVIRONMENTAL BOTANY AND MEDICINAL BOTANY

Level: 6.0	Credits: 02	Number of Lectures: 40	Semester-I
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PS110BOP: PRACTICAL II (PLANT PHYSIOLOGY, ENVIRONMENTAL BOTANY AND MEDICINAL BOTANY)		
1	Assessing seed viability by TTC method.	
2	Comparison of two populations of a species collected from two areas.	
3	Determination of primary production of an area by chlorophyll method.	
4	Effect of water and salinity stress on chlorophyll content of leaves.	
5	Effect of water and salinity stress on Proline content of leaves.	
6	Determination of Stomatal Index of leaves.	
7	Determination of LAI of different types of trees.	
8	<p>Medicinal Botany Monograph of drugs with respect to Biological source, Geographical distribution, macro and microscopic characters, chemical constituents and therapeutic uses of the following drugs:</p> <ul style="list-style-type: none"> • Root:<i>Withania somnifera</i> (Ashwagandha) • Rhizome:.....<i>Zingiber officinale</i>(Ginger) • Stem bark: <i>Cinnamom zeylanicum</i> (Cinnamon) / <i>Holarrhena antidysenterica</i> (Kurchi) • Leaf:<i>Azadirachta indica</i> (Neem) • Fruit:.....<i>Foeniculum vulgare</i> (Fennel) • Seed:<i>Plantago ovata</i> (Isabgol) 	
9	Determination of Moisture content, Ash values of the given sample.	
10	Determination of foaming index and swelling index of the given sample.	

**Course Code and Title: PBOTOE03(OE)
DIETITICS AND FOOD TECHNOLOGY;
PRACTICALS BASED ON PBOTOE03**

Level: 6.0	Credits: 02+02	Number of Lectures: 20+40	Semester-I
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Learning Objectives:

- At the end of the course the students will be able to understand nutraceutical value of food and human nutrition.
- Practice the knowledge of food technology and processing.
- Apply the acquired knowledge of food adulterants.

Learning Outcomes:

After Completing the course, Student will be able to

- Comprehend the nutraceutical value of food and human nutrition.
- Understand the concept of food technology and processing.
- Gain knowledge of food adulterants and their types.

Course Contents:

Unit - I DIETETICS		10 Lectures
	1.1 Nutraceutical: Definition and Introduction, classification (Dietary supplements, functional foods, Medicinal food, Pharmaceuticals)	
	1.2 Plant Food as medicine: Phytonutrients and its types, food source and its benefits	
	1.3 Concept of Antioxidants, their significance, Plants as a source of antioxidants	
	1.4 Plant food in the treatment of diseases – hormones, arthritis, constipation, diarrhoea, diabetes, hypertension, cancer, jaundice, memory and piles	
Unit – II FOOD TECHNOLOGY		10 Lectures
	2.1 Food Processing technology: Principle of Food processing, Processing of beverages, fruit beverage, tea, coffee, cocoa etc.	
	2.2 Food preservation: - introduction and objective, preservation by fermentation	
	2.3 Food additives and Adulteration: Food additives, colouring & flavouring substance	
	2.4 Food packaging technology: introduction, packaging material, aseptic and biodegradable methods. Advantage and disadvantage of packaging materials like metal, aluminium and plastic	

PRACTICALS BASED ON PBOTOE03(OE)

PRACTICALS BASED ON PBOTOE03(OE)		
1	Estimation of Crude fibres.	
2	Estimation of Pectin content of fruits.	
3	Monitor changes in pH and taste during yogurt fermentation.	
4	Analyse the phytochemical contents of Herbal tea.	
5	Measure pH and titratable acidity of fruit juice.	
6	Test food samples for common additives (Eg. Artificial colours,etc.) and adulterants (Eg. Starch etc.) using appropriate chemical test.	
7	Detect the presence of synthetic colours in fruit flavoured drinks.	
8	Identify and state uses of plant food in the treatment of diseases (Studied in theory)	

References:

1	Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
2	Stacy Keach (2016) Natural Resources Management. Syrawood Publishing House.
3	United States Government Accountability Office (2008) Natural Resource Management. Nova Science Publishers Inc, 10th Edition.
Selected Online Reference Sources	
1	Benders' Dictionary of Nutrition and Food Technology
2	The Concise Encyclopedia of Foods & Nutrition
3	CRC Desk Reference for Nutrition
4	Dictionary of Food Science and Nutrition
5	Encyclopaedia of Food Sciences and Nutrition
6	Encyclopedia of Human Nutrition
7	Handbook of Nutrition, Diet, and Epigenetics
8	Multicultural Handbook of Food, Nutrition, and Dietetics

Course Code and Title: PBOT0E04(OE)
ENVIRONMENTAL BOTANY;
PRACTICALS BASED ON PBOT0E04(OE)

Level: 6.0	Credits: 02+02	Number of Lectures: 20+40	Semester-I
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Learning Objectives:

- Recognize the idea of various natural resources and how they are used.
- Analyze the various natural resources' management plans.
- Examine the management of the coastal zone critically.
- Consider how society can help preserve and maintain the environment.

Learning Outcomes:

At the end of the course the students will be able to,

- Understand the concept of different natural resources and their utilization.
- Evaluate the management strategies of different natural resources.
- Critically analyze the coastal zone management.
- Reflect upon the role of society in environmental protection and its conservation.

Course Contents:

Unit - I		
NATURAL RESOURCES AND COASTAL ZONE MANAGEMENT IN INDIA		10 Lectures
	1.1 Definition, types and concept of Natural Resources. EIA, GIS, Green audit.	
	1.2 Waste management - National and international efforts in resource management and conservation.	
	1.3 Coastal Zone Management, initiatives in India, Prohibited and Regulated activities in Coastal Areas, State Coastal Zone Management Authorities.	
	1.4 Mangrove: Habitat and Characteristics, Mangrove, Plantation - Establishment and Rehabilitation of degraded mangrove formations; silvicultural systems.	
Unit – II		
ECOTOXICOLOGY, PUBLIC PARTICIPATION FOR ENVIRONMENTAL PROTECTION		10 Lectures
	2.1 Introduction to Toxicology Definitions, Classification, General Nature of Toxicants in Environment, concepts; Toxic chemicals in the environment - air, water & their effects.	No change in the Unit - II
	2.2 Toxic Mechanisms, Bioaccumulation and Biomagnification of toxic materials in food chain, detoxification, bioconcentration	
	2.3 Environmental movement and people’s participation with special references to Gandhamardan, Chilika and Narmada Bachao Andolan, Chipko and Silent valley Movement.	
	2.4 WTO and Environment, Corporate Social Responsibility, Environmental awareness and Education., Environmental Ethics.	

PRACTICALS BASED ON PBOT0E02	
ENVIRONMENTAL BOTANY	
1	Determination of mineral matter from soil by ignition method.
2	Identification of mangroves plants in Maharashtra and plotting their distribution on map of Maharashtra.
3	Calculate the carbon foot print of different activities using available data. Compare carbon foot prints of modes of transportation.
4	Identify potential environmental impact and propose mitigation measures.
5	Determination of LD-50 values for Pollutants (Cu, Pesticides, Phenols etc.) using duckweed culture.
6	Report writing of Green Audit.

Note:

- A minimum of Two field excursions (with at least one beyond the limits of Mumbai / Local Area) for habitat studies are compulsory.
- Field work of not less than eight hours duration is equivalent to one period per week for a batch of fifteen students.
- Industrial visit / Institutional visit at least One per Semester are compulsory.

References:

1	Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2	Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3	Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
4	United States Government Accountability Office (2008) Natural Resource Management. Nova Science Publishers Inc, 10th Edition.
5	Stacy Keach (2016) Natural Resources Management. Syrawood Publishing House.
6	Rathor, V.S. and Rathor B. S. (2013) Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.
7	Ågerstrand, M.; Arnold, K.; Balshine, S.; Brodin, T.; Brooks, B. W.; Maack, G.; McCallum, E. S.; Pyle, G.; Saaristo, M.; Ford, A. T. Emerging investigator series: use of behavioral endpoints in the regulation of chemicals. <i>Environ. Sci. Process. Impacts</i> 2020 , <i>22</i> , 49– 65, DOI: 10.1039/C9EM00463G
8	Evans, G. W. Projected Behavioral Impacts of Global Climate Change. <i>Annu. Rev. Psychol.</i> 2019 , <i>70</i> , 449– 474, DOI: 10.1146/annurev-psych-010418-103023
9	Peterson, E. K.; Buchwalter, D. B.; Kerby, J. L.; LeFauve, M. K.; Varian-Ramos, C. W.; Swaddle, J. P. Integrative behavioral ecotoxicology: bringing together fields to establish new insight to behavioral ecology, toxicology, and conservation. <i>Curr. Zool.</i> 2017 , <i>63</i> , 185– 194, DOI: 10.1093/cz/zox010
10	Dell’Omo, G. <i>Behavioral Ecotoxicology</i> ; John Wiley & Sons, 2002.

Evaluation Pattern:
External assessment: 50%
Internal assessment: 50%

Internal Assessment- 50% Sr. No.	Evaluation type	Total Marks
1	One Assignments/Case study	20
2	Seminar	20
3	Group Discussion / Quiz / Test	10

External examination- 50%

a) **Semester End Theory Assessment- 50%**

50 Marks

- Duration – These examinations shall be of two hours duration for each paper.

1. Theory Question Paper Pattern:

- There shall be five questions each of 10 marks.
- One question from each unit.
- Question No. 5 will be based on all 4 Units.
- All questions shall be compulsory with internal choice within the questions. Each question will be of 15 to 20 marks with options.
- Question may be subdivided into sub-questions a, b, c... and the allocation of marks depend on the weightage of the topic.

University of Mumbai
M.Sc. (BOTANY)
Semester I / Semester II EXAMINATION
Course PSBO

Maximum Marks: 50 Duration: 2.00 Hours

Question 1: Based on Unit I

Question 2: Based on Unit II

Question 3: Based on Unit III

Question 4: Based on Unit IV

Question 5: Based on Unit I to IV (Mixed Questions)

Instructions:

1. All questions are compulsory.
2. All questions carry equal marks.
3. Draw neat and labelled diagrams wherever necessary.

1. Answer any one questions from the following. (Based on Unit 1) (10 Marks)

A)

B)

C)

2. Answer any one questions from the following. (Based on Unit2). (10 Marks)

A)

B)

C)

3. Answer any one questions from the following. (Based on Unit 3). (10 Marks)

A)

B)

C)

4. Answer any one questions from the following. (Based on Unit 4). (10 Marks)

A)

B)

C)

5. Answer any Two questions from the following. (Based on all 4 units). (10 Marks)

A)

B)

C)

D)