COURSE STRUCTURE – DEPARTMENT OF BOTANY

Three year B.Sc Degree Course in BOTANY

Semester	Core		Elective			
I	**BOT-I.C-1** Plant diversity	**BOT-I.C-2** Cell Biology & Biomolecules	--------	--------	--------	--------
II	**BOT-II.C-3** Plant Anatomy and Embryology	**BOT-II.C-4** Microbiology	--------	--------	--------	--------
III	**BOT-III.C-5** Physiology of Plants		**BOT-III.E-1** Ecology & Conservation	**BOT-III.E-2** Techniques and Instrumentation in Botany	**BOT-III.E-3** Enzymes and It's metabolic pathways	**BOT-III.E-4** Herbal Cosmetology
IV	**BOT-IV.C-6** Cytogenetics		**BOT-IV.E-5** Plant Breeding and Biostatistics	**BOT-IV.E-6** Systematics of Flowering plants and Phylogeny	**BOT-IV.E-7** Plant pathology	**BOT-IV.E-8** Horticulture, Floriculture & Landscaping
V	**BOT-V.C-7** Plant Molecular Biology		**BOT-V.E-9** Bioinformatics	**BOT-V.E-10** Seed Technology	**BOT-V.E-11** Pharmacognosy	**BOT-V.E-12** Organic Farming
VI	**BOT-VI.C-8** Plant Genetic Engineering		**BOT-VI.E-13** Plant tissue culture	**BOT-VI.E-14** Algal Biotechnology	**BOT-VI.E-15** Plant Drug Technology	**BOT-VI.E-16** Field Botany

Part B

i. **Important points/ recommendations of BoS that require consideration/ approval of academic council**.

1. BoS approved syllabi of Semester V and VI presented in Annexure I.
2. Change in the title of paper 'Plant Biotechnology and genetic engineering' BOT-VI. C-8 to 'Plant Genetic Engineering'
3. Focus of the teaching at UG level should be **'on the basics'** rather than mere completion of syllabus content.
4. Purchase of at least one book in respective papers by the students should be made mandatory by the course instructor.
5. Plant Drug Technology and Pharmacognosy to be merged to one paper, and considered during the next revision. Also, necessary inputs to be taken from Pharmacy Colleges in Goa.
6. Field Botany is a component of Taxonomy paper in botany and hence should not a separate elective paper in semester VI
7. Two more elective papers to be developed in relevance to Botany to replace Field Botany and Plant Drug Technology.
8. Faculty to take special training to gain expertise in papers like Bioinformatics.
9. Special invitees in relevant papers to be called during the BoS meetings and seating fee should be given to the BoS members for their inputs.

The foregoing minutes of the meeting to be circulated out by the Chairman via e-mail and the same was unanimously approved by all the members present.

The Chairman thanked the members of the Board of Studies in Botany for their valuable contributions, suggestions and participation.

The meeting was concluded on 21st October 2016 at 01:30 PM.

The following members of Board of Studies in Botany were present for the meeting

1. Dr. Sangeeta Sankhalkar - Chairman
2. Prof. Dr. P. K. Sharma - Academic Council Nominee
3. Prof. Dr. Bernard Rodrigues - Vice Chancellor nominee
4. Mr. Lalit Pandey - Industry representative
5. Mr. Niranjan Murty - Special Invitee
6. Dr. Uma Masur - Member
7. Mrs. Amisha Shirodker Pednekar - Member
8. Ms. Divyarani S. Revankar - Member Secretary
9. Ms. Nisha Kevat - Member

Dr. Usha Mukundan (Academic council Nominee) and Ms. Devika Priolkar (Alumnus) were absent for the meeting

Ms. Divyarani S. Revankar
Member Secretary
Board of Studies

Dr. Sangeeta Sankhalkar
Chairman
Board of Studies

Date: 28-10-2016

PARVATIBAI CHOWGULE COLLEGE OF ARTS & SCIENCE, MARGAO GOA
(AUTONOMOUS)
DEPARTMENT OF BOTANY

PAPER TITLE: **PLANT MOLECULAR BIOLOGY** (THEORY)
PAPER CODE: **BOT-V.C-7**
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES

To introduce the students with fundamental knowledge of molecular system in cells.

LEARNING OUTCOME

The students will be able to understand general principles of gene organization and functions.

BOT-V.C- 7 PLANT MOLECULAR BIOLOGY THEORY: 75 MARKS

Sr. No	UNITS, TOPICS AND SUB-TOPICS	Hours
UNIT-I: NATURE OF GENETIC MATERIAL		**08**
1.1	Characteristics of genetic material, physical and biological evidences to prove DNA & RNA as genetic material, Watson and Crick's model of DNA, structure , organization and polymorphism of DNA; comparison between DNA and RNA.	5
1.2	Central Dogma of molecular biology, Model organism for studying molecular biology; DNA content of the cell and C-value paradox	2
1.3	Chargoff's Law, Franklin's and Wilkin's work	1
UNIT II: REPLICATION OF DNA		**09**
2.1	General feature of DNA replication (replication eye, replication forks)	2
2.2	Types of DNA replication Molecular mechanism of DNA replication in Prokaryotes (Transduction, transformation and conjugation), & in Eukaryotes (Dispersive, Conservative and Semi- conservative)	5
2.3	Enzymes of replication –DNA Primase ; DNA polymerases I, II, III, Topoisomerases, Helicases, Binding proteins and Ligases	2
UNIT III: DNA DAMAGE AND REPAIR		**06**
3.1	Types of DNA damages and repair (direct reversal of damage, excision repair, recombination repair and SOS repair)	4
3.2	Gene mutation and its types (site directed mutational changes)	2
UNIT IV: TRANSCRIPTION		**09**

4.1	Structure and functions of mRNA, tRNA and rRNA	2
4.2	Transcription of mRNA in Prokaryotes & eukaryotes	4
4.3	Post transcriptional event, eukaryotes splicing, RNA editing and processing of mRNA.	3
UNIT V: GENE REGULATION & EXPRESSION		**07**
5.1	Units of Gene (Cistron, recon, muton, Enhancers, Split genes, overlapping genes; transposons and its role in gene structure , promoters & terminators	3
5.2	Gene regulation in prokaryotes (Lac operon concept) and eukaryotes (Britten and Davidson's model); Inducible and repressible mechanism	4
UNIT VI: TRANSLATION-PROTEIN SYNTHESIS		**06**
6.1	Secondary structure of mRNA; Ribosome structure and functions	2
6.2	Genetic code; Mechanism of Translation; RNA polymerases; Enzymes and factors	3
6.3	Post translational modifications; Protein targeting	1
		45

SEMESTER V
PAPER TITLE: PLANT MOLECULAR BIOLOGY (Practical)
PAPER CODE: BOT-V-C-7
MARKS: 25
CREDIT:1

Sr. No	TOPICS	PRACTICALS
1	Isolation of plant genomic- DNA	1
2	Phenol chloroform extraction of DNA	1
3	Ethanol precipitation of DNA	1
4	Spooling of DNA	1
5	Quantification of DNA by DPA method.	1
6	Spectrophotometric determination of Nucleic acid purity	1
7	Isolation of total RNA from plant tissue	1
8	Estimation of RNA by Orcinol method	1
9	Preparation of Agarose gel and running of DNA (demonstration)	1
10	Formaldehyde-Agarose gel Electrophoresis for RNA (denatured gel) (demonstration only)	2
11	Primer designing for PCR	2
12	PCR amplification of DNA (Demonstration)	2
	Total	**15**

Reference Books :

1. Alberts B., Bray, D Lewis, J., Raff, M., Roberts, K and Walter 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York
2. David Freifelder, 1983 Jones & Bartlett publishers. 2ed Molecular biology. Reprint 1993. Narosa Publishing House.
3. Pal J.K.and Ghaskadabi S.S. 2008 Fundamentals of Molecular Biology. Oxford.
4. James D. Watson, 2007.Molecular Biology of the Gene (6th Edition) by, Tania A. Baker, Stephen P. Bell, and Alexander Gann.
5. Kleinsmith L.J and Kish V.M 1995. Principles of Cell and Molecular Biology (Second Edition). Happer Collins College Publishers, New York,
6. Lehninger 2008. Principles of Biochemistry by David L. Nelson and Michael M.
7. Dube R.C. 2008. A Text Book of Biotechnology S. Chand pub.
8. Adams R.L., Knowler, J.T. and Leader, D.P. 1992. The Biochemistry of the Nucleic Acids.
9. Lewin B. 2000. Genes VII. Oxford University Press, New York.
10. Buchanan B.B, Gruissm W. and Jones R.L 2000. Biochemistry and Molecular biology.

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
(AUTONOMOUS)
DEPARTMENT OF BOTANY

SEMESTER-V
COURSE TITLE: BIOINFORMATICS (THEORY)
COURSE CODE: BOT-V. E-9
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES: The course will help the students to understand the fundamentals of bioinformatics and tools available.

LEARNING OUTCOMES:

It will enable the students to gain knowledge in vast data handling and analysis, and to develop skills.

BOT-V. E-9 BIOINFORMATICS THEORY -75 MARKS

Sr.No.	UNITS, TOPICS AND SUB-TOPICS	HOURS
UNIT I: INTRODUCTION TO BIOINFORMATICS		**08**
1.1	Introduction to bio-informatics, The biological sequence / structure deficit	02
1.2	Genome projects, Pattern recognition and prediction, Levels of protein structure	03
1.3	Role of Chaperons, Sequence analysis	01
1.4	Fields Related to Bioinformatics: Computational Biology, Genomics, Proteomics, Pharmacogenomics, Cheminformatics, Medical Informatics Importance of Bioinformatics	02
UNIT II: INFORMATION NETWORKS		**07**
11.	Internet and the facilities available on it, computational biology, What is World Wide Web, Web browsers and Web addresses	03
2.2	HTTP, HTML, CORBA and URLs	01

2.3	The National Centre for Biotechnology Information- NCBI The European Molecular Biology Network- EMBnet	02
2.4	Bioinformatics programme in India- BTISNet, BPI-2004	01
UNIT III : INTRODUCTION TO BIOLOGICAL DATABASE		**04**
3.1	Introduction To Biological Database : GenBank, EMBL, SwissProt, PROSITE, EC-ENZYME, PDB, GDB, OMIM, PIR-PSD,	04
UNIT IV : PROTEIN INFORMATION RESOURCES		**07**
4.1	Introduction	01
4.2	Primary Sequence Databases, Composite protein sequence databases, Secondary databases, Composite protein pattern databases	04
4.3	Structure classification databases	02
UNIT V : GENOME INFORMATION RESOURCES		**08**
5.1	Introduction	01
5.2	DNA sequence databases	02
5.3	Specialised genomic resources, ORF (Open Reading Frame Finder), TIGR Genome Resources	03
5.4	Genome comparison, Genome Annotation	01
5.5	Microarray image analysis	01
UNIT VI : HOMOLOGY, ANALOGY, ORTHOLOGY AND PARALOGY		**05**
6.1	Introduction	01
6.2	Comparision of Homology, Analogy, Orthology And Paralogy.	02
6.3.	Alignment based methods and Hybrid method	01
6.4	Comparision of Computer Prediction Algorithms	01
UNIT VII : PAIRWISE ALIGNMENT AND MULTIPLE SEQUENCE ALIGNMENTS		**06**
7.1	Introduction	01
7.2	Database interrogation, Alphabets and complexity, Comparison of sequences	02
7.3	Global alignment: The Needleman and Wunsch algorithm	02

7.4	Pairwise database searching, BLAST Databases of Multiple Alignments, Clustal W	01
	TOTAL	**45 HOURS**

COURSE TITLE: BIOINFORMATICS (PRACTICALS)
COURSE CODE: BOT-V. E-9
MARKS: 25
CREDITS: 1
ANY 10

SR. NO	TOPICS	PRACTICAL
1	Biological databases and exploring various websites- NCBI, PUBMED and Gen Bank databases	3
2	To explore EBI server and searching EMBL	2
3	Exploring and querying UniProt KB	1
4	To study the file formats- FASTA, PDB, Mol	2
5	Pairwise global alignment of protein and DNA using Needleman- Wunsh algorithm	2
6	Obtaining sequences for Pairwise alignment and to interpret the results to study the homology between the sequences	2
7	Database searching using different versions of BLAST and FASTA and Derivation of relationships of query sequences	2
8	Use of ClustalW for multiple sequence alignment	1
	TOTAL	**15**

REFERENCES:

1. Attwood, D. J., Parry Smith D.J. and Phukan, S. (2011). Introduction to Bioinformatics; Pearson education.
2. Ignacimuthu, S. (2005). Basic Bioinformatics. Narosa Publishing House
3. Khan, I. A. and Khanum, A. (2003). Fundamentals of Bioinformatics –Ukaaz publications.
4. Mani, K. and Vijayaraj, K.A. (2002). Bioinformatics for Beginners. Aparnaa Publication.
5. Murthy, C. S. V. (2004). Bioinformatics. Himalaya Publishing House.

Web Resources

1. http://genes.mit.edu/GENSCAN.html

2. http://vmoc.museophile.org Computer History
3. http://www.clcbio.com/index
4. http://www.genome.jp
5. http://www.genome.jp/dbget/ LinkDB
6. http://www.ncbi.nlm.nih.gov/Structure/CN3D/cn3d.shtml
7. http://www.softberry.com/berry
8. http://www.studentworkzone.com/
9. www.ebi.ac.uk
10. www.fgcu.edu/support/office2000
11. www.learnthenet.com Web Primer
12. www.clustawomega.org
13. www.embl.org

PARVATIBAI CHOWGULE COLLEGE OF ARTS & SCIENCE, MARGAO GOA
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DEPARTMENT OF BOTANY

SEMESTER -V
PAPER TITLE: SEED TECHNOLOGY (THEORY)
PAPER CODE: BOT-V.E-10
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES:

The course is focused in training students with knowledge of seed health, seed storage, seed certification techniques and regulation.

LEARNING OUTCOMES:

Student will have better understanding of seed physiology and vigour. The course knowledge will create trained human resource for seed industry and research organizations.

BOT-V.E-10 SEED TECHNOLOGY THEORY: 75 MARKS

Sr. No	UNITS, TOPICS AND SUB-TOPICS	Hours
UNIT-I: PRINCIPLES OF SEED TECHNOLOGY		**06**
1.1	Concepts, role & aim of seed technology	1
1.2	Seed defination and its types (nucleus seed, breeders seed, foundation seed, certified seed and truthful seed),characteristics of good seeds; seed dormancy and germination.	2 3
1.3	Difference between seed and grain, Seed development programmes and their role in Indian seed industry, National seed corporation.	
UNIT-II: ORGANIZATIONS OF SEED TESTING		**07**
2.1	International seed testing association	2
2.2	Association of official seed analysts.	2
2.3	Central and state seed testing laboratories	2
2.4	Role of ICRISAT	1

UNIT III: SEED CERTIFICATION		**07**
3.1	Objectives and concept of seed certification, Phases of seed certification	2
3.2	Procedure of seed certification: Minimum seed certification standards ; General seed certification standard and Specific crop standards	4
3.3	Seed certification agencies and its organization	1
UNIT IV: SEED TESTING		**04**
4.1	Principles and procedure of seed testing	1
4.2	Equipments for seed testing	1
4.3	Importance of seed testing, Seed heterogeneity test and tolerance value	2
UNIT V: PLANT BREEDING IN RELATION TO SEED TECHNOLOGY		**08**
5.1	Maintenance of breeders seed methods in self and cross fertilized crops	2
5.2	Development trial and release of seed variety	1
5.3	Germ plasm and its conservation, seed banks and types of seed collections	2
5.4	Hybridization methods: Heterosis & its types; uses of heterosis in crop improvement	3
UNIT VI: SEED PROTECTION		**06**
6.1	Importance of epidemic and seed borne diseases (Rice and Wheat)	2
6.2	Factors affecting seed infection	2
6.3	Seed borne pathogens and control measures	2
UNIT VII: SEED PROCESSING AND STORAGE		**07**
7.1	Seed drying- principles, its advantages and methods	2
7.2	Seed treating chemicals and equipments	1
7.3	Pest problems and their treatment during storage	2
7.4	Concept of seed marketing	1
7.5	Forecasting of seed demand and supply	1
	TOTAL	**45**

SEMESTER -V
PAPER TITLE: SEED TECHNOLOGY (Practical)
PAPER CODE: BOT-V.E-10
MARKS: 25
CREDITS: 1

Sr. No	TOPICS	Practicals
1.	Study of internal and external structure of dicot and monocot seed	2
2.	Analysis of physical properties of seed (seed weight variations in seed size)	1
3	Analysis of chemical properties of seed (carbohydrate, oil/ protein)	1
4	Microscopic examination of monocot and dicot seeds for disease symptoms	2
5	Testing of seed viability (2,3,5-triphenyl tetrazolium chloride test)	1
6	Effect of drying temperature & duration on seed germination	2
7	Estimation of moisture content in seed (oven method)	1
8	Breaking of seed dormancy methods (chemical, hormone & temperature)	3
9	Study of chalkiness in rice seeds.	1
10	Visit to seed production plant and report submission	1
	Total	**15**

REFERENCES:

1. Agrawal R.L. 2005. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Dutta A.C, 2000. A Class book of Botany, Oxford University Press, USA, 17th edition.
3. Pandey B.P 2010. A text book of Botany. S. Chand and Company Ltd., New Delhi.
4. Reddy S.R. 2008. Principles of crop production. Kalyani Publishers, New Delhi.
5. Santra S.C. and Chatterjee T.P., 2007. College Botany, New Central Book Agency (P) Ltd., Kolkata.
6. Singh B.D. 2009. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
7. Umaraniet. A.L. 2006. Experimental Seed Science and Technology, Agrobios, Jodhpur.
8. Paul Neergaard (1977).Seed pathology, Macmillan; 2nd edition.

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
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DEPARTMENT OF BOTANY

SEMESTER-V
COURSE TITLE: PHARMACOGNOSY (THEORY)
COURSE CODE: BOT-V.E-11
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES:

The course provides fundamental knowledge to understand drug discovery and development.

LEARNING OUTCOMES:

Creating human resource in the field of drug development and pharmacognosy.

BOT-V.E-11 PHARMACOGNOSY THEORY -75 MARKS

Sr. No.	**UNITS, TOPICS AND SUB-TOPICS**	Hours
UNIT I- INTRODUCTION TO PHARMACOGNOSY		**09**
1.1	History, scope and development of Pharmacognosy	04
1.2	Classification of drugs: Morphological, Taxonomical, Chemical And Pharmacological.	05
UNIT II: General Introduction, Cultivation and Collection, Description, Histology, Constituents, Substitutes of plants of Pharmacognosic importance under following categories:		**12**
2.1	**LEAVES:** Eucalyptus and Adathoda	03
2.2	**SEEDS:** Castor and Nutmeg	03
2.3	**FRUITS:** Coriander and Senna pod	03
2.4	**FLOWERS:** Clove and Rose	03
UNIT III- STARCHES AND UNORGANISED DRUGS		**05**
3.1	Rice, Potato and Curcuma starch, Modified starches.	02
3.2	Unorganised Drugs: Dried Latex, Opium, Catechu	03
UNIT IV- STUDY OF RHIZOMES AND ROOTS OF PHARMACOGNOSIC IMPORTANCE		**05**

4.1	**Source plant, Cultivation, Collection and drying, Description, Histology, Constituents and Uses of:** • Curcuma • Ginger • Colchicum	
UNIT V- STUDY OF RESINS, GUM-RESINS AND OLEO-RESINS OF PHARMACOGNOSIC IMPORTANCE:		**04**
5.1	**Source plant, Collection, Description, Constituents, Varieties, adulterants and Uses of:** • Rubber • Acacia gum • Coniferous gum • Canada Balsum	
UNIT VI- STUDY OF OILS, FATS AND WAXES OF PHARMACOGNOSIC IMPORTANCE:		**02**
6.1	**Preparation, Description, Constituents and Uses of:** • Coconut oil • Sesame oil	 01 01
UNIT VII- STUDY OF FIBRES OF PHARMACOGNOSIC IMPORTANCE:		**03**
7.1	**Source plant, Cultivation, Collection and storage, Description, Microscopy, Constituents and Uses of:** • Cotton • Jute • Hemp	 01 01 01
UNIT VIII- COMMERCE IN DRUGS		**05**
8.1	Transport and Marketing	01
8.2	Deterioration and storage	01
8.3	Adulteration and its detection	01
8.4	Drug standardisation procedures	01
8.5	Bio-safety / regulations, bio ethics.	01
	TOTAL	**45 hours**

COURSE TITLE: PHARMACOGNOSY (PRACTICAL)
COURSE CODE: BOT-V.E-11
MARKS: 25
CREDITS: 1
ANY 10

Sr. No	Experiments	Practical
1.	Chemical tests for *Rauwolfia* and *Cinchona*	02
2.	Study of Anatomy of *Nux vomica* seeds	01
3.	Powder microscopy of *Nux vomica* seeds	01
4.	Micro-chemical tests for: i. Cellulose, ii. Lignin, iii. Protein, iv. Tannins v. Starch	03
5.	Histochemical tests for Fixed Oils And Fats	01
6.	Microscopic observation and measurements of Starch grains	01
7.	Microscopic observation and measurements of fibres.	01
8.	Adulteration of crude drugs (honey)	01
9.	Borntrager test for anthraquinone derivatives in Senna leaves.	01
10.	Microchemical test of *Datura* and *Adathoda* leaves for observation of Calcium oxalate crystals.	01
11.	Microchemical test of *Nux vomica* for oil globules and strychnine.	01
12.	Staining / diagonosis/ microchemical test of clove for volatile oils.	01
	TOTAL PRACTICALS	**15**

REFERENCES:

1. Gokhale S.B and Kokate, C.K. (2009). Pharmacognosy. Nirali Prakashan.

12. Khandelwal, K. R. (2008). Practical Pharmacognosy. Nirali Prakashan.

13. Kokate, C. K. (2008). Pharmacognosy. Nirali Prakashan.

14. Qadry, J.S. (2014). A Textbook of Pharmacognosy Theory And Practicals, CBS Publishers & Distributors.

15. Trease, G.E. & Evans, W.C., (2002). Pharmacognosy. Elsevier Science Publishers.

16. Wallis, T. E. (2005). Textbook of Pharmacognosy. CBS Publishers & Distributors.

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
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DEPARTMENT OF BOTANY

SEMESTER-V
COURSE TITLE: ORGANIC FARMING (THEORY)
COURSE CODE: BOT-V.E-12
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES:

The course provides knowledge of principles and practices of organic agriculture and its role in sustainable crop production.

LEARNING OUTCOMES:

On completion of the course: the students will develop an understanding of the social, economic and environmental context for current and future organic agriculture production and management.

BOT-V.E-12 ORGANIC FARMING THEORY -75 MARKS

Sr.No.	UNITS, TOPICS AND SUB-TOPICS	Hours
	UNIT I: Concept of Organic Farming	**09**
1.1	Introduction: Farming, organic farming, concept and development of organic farming.	02
1.2	Principles of organic farming, Types of organic farming	02
1.3	Needs and benefits of organic farming.	02
1.4	Agencies and institutions related to organic agriculture	01
1.5	Farm components for an organic farm	02

UNIT II: Composts, Manures and its application		**11**
2.1	Manure application: Composted vs. uncomposted manure	03
2.2	Composting- principles, stages, types and factors	03
2.3	Composting methods, Vermicomposting Bio-fertilizers, M.I., F.I.M., Neem cake, Mulching, Elley farming, Bio-innoculation	02 03
UNIT III: Soils, Soil Fertility Management and fertilizers		**13**
3.1	Soil types, Soil profile and Soil tillage	03
3.2	Factors affecting soil fertility and productivity	02
3.3	Land preparation	01
3.4	Water management for good soil, Commercial fertilizers, composition	03
3.5	Residual effects and fertilizer use efficiency	02
3.6	Foliar application and its concept	02
UNIT IV: Organic plant protection and Seed Certification		**07**
4.1	Plant protection- cultural and mechanical methods	02
4.2	Plant protection- bio pesticide and bio control agents	02
4.3	Allelopathic methods of weed control	02
4.4	Certification of organically produces seeds.	01
UNIT V: Entrepreneurship Development		**05**
5.1	Entrepreneurship – Concept, characteristics, approaches, need for entrepreneurship in Organic farming	02
5.2	Popularization of organic farming. Marketing of organic produce. Organic farming in the rest of the world.	03
	TOTAL	**45**

COURSE TITLE: ORGANIC FARMING (PRACTICAL)
COURSE CODE: BOT-V.E-12
MARKS: 25
CREDITS: 1
ANY 10

Sr. No.	Experiments	Practical
1.	Comparative analysis of pH, EC, organic C, total N, available N, P, K and S from organic and inorganic data (obtained data).	1
2.	Survey of weeds in crop fields (Organic v/s inorganic farming)	1
3.	Study of soil types.	1
4.	Preparation of M.I.	1
5.	Study of bio pesticide (Neem cake)	1
6.	Preparation of Compost/ vermi-compost.	2
7.	Study of Mulching	1
8.	Study of nitrogen fixing bacteria in leguminous plants.	1
9.	Visit to an organic farm	2
10.	Study of recycling of farm waste	1
11.	Effect of various manures on plant growth.	3
	TOTAL 15	

REFERENCES:

1. Chakraverty, A. (1991). Post-harvest technology of cereal, pulses and oil seeds. Oxford IBH Publishing Co. Pvt Ltd.

2. Deshmukh, S.N. (2012). Organic Farming: Principles, Prospects and Problems, Agrobios Publishers (India).
3. Gehlot, D. (2010). Organic Farming: Components and Management, Agrobios Publishers (India).
4. Gupta, O.P. (2010). Modern weed management. Agrobios Publishers .
5. Israelsen, O.W. and Hansen, V.E. (2015). Irrigation Principles and Practices. John Wiley & Sons Inc.
6. Kanwar, J.S. (1978). Soil Fertility, Theory and Practice. Indian Council of Agricultural Research Publication.
7. Palaniappan, S.P. and Annadurai, K.A. (2010). Organic Farming: Theory and Practice. Indian Council of Agricultural Research, Scientific Publishers Journals Dept.
8. Rao, V.S. (2000). Principles of Weed science. Taylor & Francis Publishers.
9. Reddy, T.Y. and Sankar Reddi, G. H. (2015). Principles of Agronomy. Kalyani Publishers.
10. Sadhu, A.N. and Singh, A. (2014). Fundamentals of Agricultural Economics. Himalaya Publishing House.
11. Saraswat, V.N., Bhan, V. M. and Yaduraju, N.T. (2003). Weed management - (ICAR), Indian Council of Agricultural Research Publication.
12. Sharma, A.K. (2002). A hand book of Organic Farming. Agrobios Publishers.
13. Singh, B. D. (2006). Plant Breeding Principles and Methods. Kalyani Publishers.
14. Tisdale, S.L., Nelson, W.L., Beaton, J.D. and Havlin, J. L. (2013). Soil fertility and fertilizers. Pearson Publishers.
15. Yawalkar, K. S., Agrawal, J.P. and Bokde, S. (1962). Manures and Fertilizers. Agri-Horticulture Publishing House.

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
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PAPER TITLE: PLANT GENETIC ENGINEERING
PAPER CODE: BOT- VI.C-8
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES: This course is to develop fundamental knowledge and skills in various aspects of Genetic engineering.

LEARNING OUTCOME: Students will understand basic concepts in Plant Genetic engineering simultaneously getting trained at laboratory skills.

BOT- VI. C-8 PLANT GENETIC ENGINEERING THEORY-75 MARKS

Sr.No	UNITS, TOPICS AND SUB-TOPICS	Hours
	UNIT – I: Recombinant DNA technology: Tools	**15**
1.1	Enzymes- Exonucleases; Endonucleases; Restriction endonucleases Type I, II&III; ligases, methylases; Reverse Transcriptase, Polymerase.	05
1. 2	Prokaryotic and eukaryotic cloning vectors; General account of plasmids, cosmids, bacteriophages, Phasmids – Advantages and disadvantages; Structure of pBR 322; Artificial chromosome vectors – BAC, YAC, Shuttle vectors.	05
1.3	DNA Ligation – Linkers, adaptors, Homopolymer tailing,Transformation, selection of transformed bacteria – antibiotic selection, reporter genes - GUS,GFP.	05
	UNIT – II: Recombinant DNA technology: Techniques	**10**
2.1	Polymerase chain reaction – Principle, types of primers, Taq polymerase, Protocol, Reverse Transcriptase PCR and Real Time PCR	02
2.2	Prokaryotic expression of foreign genes; Isolation of gene of interest – Construction of cDNA library; Genomic Library	02
2.3	DNA sequencing – Maxam Gilbert's method, Sanger's method,	02

	Automated DNA sequencing	
2.4	Molecular Analysis of gene and gene products – Southern, Northern and Western blotting, ELISA, RIA	02
2.5	Molecular markers – RAPD, RFLP, AFLP, Brief account of DNA Finger printing and Bar coding of plants Brief account of: Antisense RNA technology – FLAVR SAVR Tomato; Gene Silencing; RNA interference; mtRNA	02
UNIT – III: Gene transfer methods in plants		**10**
3.1	Vector mediated gene transfer- Agrobacterium mediated gene transfer – T DNA, Ti plasmid and Ri plasmid derived vector systems*;* hairy-root culture; **Plastid/ Mitochondria transformation.**	05
3.2	Process of transfer - Bacterial colonization, Induction of virulence, generation of TDNA transfer complex, T-DNA transfer, Integration of TDNA into plant genome	03
3.3	Direct methods of gene transfer – Biolistics, Lipofection, Electroporation, microinjection – Advantages and disadvantages	02
UNIT – IV: BIOSAFETY		**05**
4.1	Intellectual Property Rights	02
4.2	Genetic engineering and Public issues	02
4.3	Biosafety regulation	01
UNIT V: Application of Genetic engineering		**05**
5.1	Agricultural: Bt cotton, Golden rice	01
5.2	Environmental: Biodiversity and conservation; Waste management and Bioremediation	02
	Industrial- Large scale production of beverages, Pharmaceuticals, hormones.	01
5.3	Molecular Taxonomy and Food – SCP, Improved food and food products.	01
		45

PAPER TITLE: PLANT GENETIC ENGINEERING
PAPER CODE: BOT- VI.C-8
MARKS: 25
CREDITS: 1

Sr. No	Topics	Practical
1	DNA isolation by CTAB method	02
2.	Estimation of DNA	02
3.	DNA electrophoresis in Agarose gels	02
4.	Restriction of DNA	02
5	Sequence reading – Sanger method/Maxam Gilbert method – problem	02
6	*Agrobacterium tumefaciens*-mediated plant transformation.	02
7	Small scale plasmid preparation from *E. coli*	02
8	Visit to a leading biotechnology institute and Report making.	01
	Total	**15**

Reference Books:

1. Brown TA (2006) Gene cloning and DNA analysis; Blackwell scientific publishers
2. Sobti RC & Pachauri SS (2009) Essentials of Biotechnology; Ane Books, New Delhi
3. Dubey RC Introduction to Plant Biotechnology; S Chand & Co
4. Purohit SS (2003) Agricultural Biotechnology, Agrobios (India)
5. Chawla HS (2000) Introduction to Plant Biotechnology
6. Dovstekel (2005) Microarray Bioinformatics; Cambridge University press
7. Ignacimuthu S (1997) Plant Biotechnology, New Hampshire Science Publishers
8. Gupta PK (1996) Elements of Biotechnology; Rastogi and Company, Meerut
9. Lewin B (2004) Genes VIII. Oxford University Press
10. Primrose SB, Twyman RM & Old RW (2001). Principles of gene manipulation: An Introduction to genetic engineering. 6th Edn. Blackwell Oxford
11. Smith JE (2005) Biotechnology; Cambridge University press, UK
12. Wilson K & Walker J (2008) Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press
13. Brown TA (2002) Genome, Black well.

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
(AUTONOMOUS)
DEPARTMENT OF BOTANY

PAPER TITLE: PLANT TISSUE CULTURE
PAPER CODE: BOT-VI-E-13
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES: To develop the plant tissue culture skills.

LEARNING OUTCOME: Students will be able to develop skills and techniques in in plant tissue culture.

BOT-VI-E- 13 PLANT TISSUE CULTURE THEORY-75 MARKS

Sr.No	UNITS, TOPICS AND SUB-TOPICS	Hours
UNIT – I: Introduction		**05**
1.1	Scope and history of plant tissue culture, Laboratory organization.	02
1.2	Culture techniques –Constituents of Various medias, Sterilization methods of glasswares, Explant preparation, sterilization	03
UNIT – II: Concept of differentiation and culture types		**15**
2.1	Cellular differentiation and totipotency; effect of growth regulators on differentiation	05
2.2	Cell culture types- callus, single cell and suspension culture	05
2.3	Organogenesis and embryogenesis; Somaclonal variation; meristem culture, anther and pollen culture, embryo culture	05
UNIT – III: Techniques in Tissue culture		**15**
3.1	Micropropagation, Germplasm conservation; Isolation and regeneration of protoplasm; Somatic hybridization, Synthetic seeds	05
3.2	Cryopreservation of cells, tissues and cell organelles, secondary metabolite production, Hairy root cultures	05
3.3	The screening of high-yielding cell lines ;Precursor feeding; Biotic	05

	and abiotic elicitors ; Metabolic engineering; Bioreactors	
UNIT –IV: Application of Plant tissue culture		**10**
4.1	Horticulture	04
4.2	Agriculture	04
4.3	Forestry	02
	Total	**45**

PAPER TITLE: PLANT TISSUE CULTURE
PAPER CODE: BOT-VI.E-13
MARKS: 25

CREDITS: 1

Sr. No	Topics	Practical
1	Preparation of MS Medium; Sterilization techniques	03
2	Embryo culture of maize	01
3	Callus induction and its morphological studies	02
4	Subculturing callus for rooting and shooting	02
5	Suspension culture	01
6	Single cell culture- Bergmann's technique	02
7	Enzymatic Isolation of plant protoplast	01
8	Synthetic seed production	01
9	Secondary metabolite in suspension culture	01
10	Visit to Plant tissue culture unit	01
	Total	**15**

Reference Books:

17. Bhojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA.
18. Kumar, U. (1999). *Methods in Plant Tissue Culture.* Jodhpur: Agrobios (India).

19. Razdan, M. K. (2002). *Introduction to Plant Tissue Culture.* New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
20. Satyanarayana U.(2013). Biotechnology. Books and allied (P) Ltd.
21. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

PARVATIBAI CHOWGULE COLLEGE OF ARTS & SCIENCE, MARGAO GOA (AUTONOMOUS)
DEPARTMENT OF BOTANY

SEMESTER -VI
PAPER TITLE: ALGAL BIOTECHNOLOGY (THEORY)
PAPER CODE: BOT-VI.E-14
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES:

Goa being a coastal state, this course will provide an understanding of alternate resources of food, fuel and environment.

LEARNING OUTCOMES:

This course will enable the students for exploring bio-resources from algae through various algal techniques for sustainable development.

BOT-VI.E-14 ALGAL BIOTECHNOLOGY (Theory) MARKS: 75

Sr. No	UNITS, TOPICS AND SUB-TOPICS	Hours
	UNIT-I: METHODS OF ALGAL ISOLATION AND CULTURE	**10**
1.1	Method of algal isolation	2
1.2	Types of algal cultures (synchronous, continuous, mass and "in vitro" culture)	3
1.3	Maintenance and growth of algal culture (freshwater and marine algae)	3
1.4	Multiplication of economically important algae (Rhodophyta, Phaeophyta, Chlorophyta, Cyanophyta)	2
	UNIT-II: PHYCOREMEDIATION	**08**
2.1	Phycoremediation	3
2.2	Sewage disposal and waste treatment, textile and effluent sugar industry	3
2.3	Single cell algal protein and phycocolloids	

		2
	UNIT III: ALGAE AND POLLUTION	**11**
3.1	Algae as indicator ofpollution, aquatic pollution by algae: causes and consequences	3 3
3.2	Eutrophication and its impact on water quality	3
3.3	Algae in environmental health, sewage treatment & treatment in industrial water quality	2
3.4	Algal Blooms and their control	
	UNIT IV: COMMERCIAL APPLICATIONS OF ALGAL TECHNOLOGY	16
4.1	Application of algae in carbon sequestration	2
4.2	Application of algae as food and fodder	2
4.3	Application of algae in pharmaceutical industries	2
4.4	Algae in biofuels	3
4.5	Algae as Biofertilzers	3
4.6	Algae as secondary metabolites	2
4.7	Applications of algae in entrepreneurship development	2
	TOTAL	**45**

SEMESTER -VI
PAPER TITLE: ALGAL BIOTECHNOLOGY (Practical)
PAPER CODE: BOT-V.E-14
MARKS: 25
CREDIT:1

Sr. No	TOPICS	Practicals
1	Survey of market products of algal material	1
2	Culture of algae (Fresh & marine water, one each)	4
3	Chromatographic separation of algal pigments (β-carotene containing algal species eg. *Synechococcus*)	2
4.	Use of algae as biofertilizer	2
5	Isolation and estimation of algal proteins and lipids	4
6	Visit to NIO and submission of report.	2
	Total	**15**

REFERENCES:

1 Becker S. W. 1994. Micro Algae Biotechnology and Microbiology. Cambridge University Press.
2. Ignacimuthu S. 1996. Basic Biotechnology. Tata McGraw Hill Publishing Limited. New Delhi.
3. Power M., Van der Meer, J., Tchelat, R. 1998. Molecular based methods can contribute to assessments of toxological risks and bioremediation strategies. J. Microbiol. Methods, 32: 107 –119.
4. Tridevi P. C. 2001. Algal Biotechnology. Point Publisher, Jaipur, India.
5. Venkatraman G. S. 1972. Algal Biofertilizers and rice cultivation. Today and Tomorrows Printers and Publishers, New Delhi.
6. Zajic J. E. 1970. Properties and Products of Algae. Plenum Press, New York.
7. Bold H.C.and Wynne ,M.J. 1976 Introduction to Algae structure and reproduction. Prentice -hall.
8. Presott G.W. 1970 How to know freshwater Algae W.C. Braun & Co. 11. Round , F.E. 1966
9. Desikachary T.V. 1972. Taxonomy and Biology of Blue Green Algae. University of Madras

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
(AUTONOMOUS)
DEPARTMENT OF BOTANY

PAPER TITLE: PLANT DRUG TECHNOLOGY
PAPER CODE: BOT-VI. E-15
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES: To enable students to learn and understand the techniques and skills used in plant drug industry.

LEARNING OUTCOME: Students will be able to understand and use of various techniques used in plant drug industry along with bioassays.

BOT-VI.E-15: PLANT DRUG TECHNOLOGY THEORY-75 MARKS

Sr.No	UNITS, TOPICS AND SUB-TOPICS	Hours
	UNIT – I: Introduction	**05**
1.1	History, present status, future scope & Development of plant drug technology	05

UNIT – II: Phytochemicals		**07**
2.1	Synthesis; Regulation ; Parameters affecting phytochemicals; Crude drugs, metabolic pathways with secondary metabolite biosynthesis	**04**
2.2	Molecular biology of plant drugs.	**03**
UNIT – III: Extraction and analysis of Phytochemicals		**08**
3.1	Extraction methods and principles. Traditional, analytical and preparative seperations of plant drugs.	04
3.2	Analysis of Pigments, Phenolics, Flavonoids and Alkaloids	04
UNIT IV: Characterization of plant drugs		**10**
4.1	Methods of characterization: NMR, MS, UV-Vis; GC-Ms, LC-MS	05
4.2	Classification of drugs. Major type and chemical nature	05
UNIT – V: Bioassays and testing drugs		**15**
5.1	Identification of marker compounds in the formulations. Fingerprint identification of plant drugs.	05
5.2	Microbial, Invitro cell based; invertebrate based; biochemical screens; Evaluation through structural interactions via NMR and MS methods	05
5.3	Toxicology, Efficacy and Biosafety	05
	Total:	**45**

PAPER TITLE: PLANT DRUG TECHNOLOGY
PAPER CODE: BOT-VI. E- 15
MARKS: 25
CREDITS: 1

Sr. No	Topics	Practical
1	Plant collection procedures	02
2	Extraction of biologically important compounds	02
3	Isolation and Estimation of total alkaloids	02
4	Test for alkaloids: Mayer'sreagent: Dragendorff's reagent; Wagner's reagent	01
5	Isolation of flavonoids	01

6	Flavonoid separation by TLC	02
7	Alkaloid separation by Paper Chromatography	01
8	Disc diffusion evaluation for antimicrobial assay	02
9	MIC evaluation for antimicrobial assay	02
	Total	**15**

Reference Books:

1. Leleand J. Cseke. 2006. Natural products from Plants. Taylor and Francis. New York.
2. Harborne J.B. 2010. Phytochemical methods. Springer International edition, New Delhi.
3. Daniel Mammen. 1991. Methods in Plant chemistry and economic botany. Kalyani Publishers New Delhi.

PARVATIBAI CHOWGULE COLLEGE OF ARTS AND SCIENCE
(AUTONOMOUS)
DEPARTMENT OF BOTANY

PAPER TITLE: FIELD BOTANY
PAPER CODE: BOT-VI.E-16
MARKS: 75
CREDITS: 3

COURSE OBJECTIVES: To make students understand and appreciate environment that aims to connect prior knowledge of plant studies with identification in the field.

LEARNING OUTCOME: Students will learn to connect classroom learning with environment. Spot-identify plant species using a herbarium collection, literature and online resources.

BOT-VI.E-16 FIELD BOTANY **THEORY: 75 MARKS**

Sr.No	UNITS, TOPICS AND SUB-TOPICS	Hours
UNIT – I: Introduction to Field Botany		**05**
1.1	Identification: Fungi, Algae, Bryophytes, Pteridophytes,	03

1.2	Gymnosperms, Angiosperms. Keys for identification	02
	UNIT – II: Techniques	**15**
2.1	Plant handling, Collection, preservation (temporary/ permanent/ herbarium, e- herbarium, Chemical), identification (use of keys, e-Keys)	05
2.2	Field Techniques: Survey, Introduction; Methods of test area; Data on habitat; Lower plant habitat mapping; Sampling techniques; Pin-frames,Transects , Forestry techniques., Soil differences among microhabitats.	10
	UNIT – III: Field analysis methods	**15**
3.1	Morphology (Vegetative features, Reproductive features); Population Analysis, Tree demography, Spatial dispersion, Species area curves ;	05
3.2	Introduction to digital cameras, Compasses, maps, GPS, Remote sensing (Working and analysing), Satellite	10
	UNIT – IV: Field work planning	**10**
4.1 4.2 4.3	General Field Procedures Standard Field Equipment Field Journaling Science Inquiry Planning Getting a Representative Sample Forest Ecology Plant Ecology (Pollination) Lichen Ecology Wetland Ecology	02 04 04
	Total	**45**

PAPER TITLE: FIELD BOTANY
PAPER CODE: BOT-VI.E-16
MARKS: 25
CREDITS: 1

Sr. No	Topics	Practical
1	Lower Plant identification using floras, books and databases (Algae, Bryophytes, Pteridophytes, Gymnosperms)	03
2	Angiosperm identifications using floras, books and online resources	02

3	Preparation of herbarium	**02**
4	Sample Preservation Techniques (Temporary/ Permanent)	**02**
5	Field analysis methods- Pin frames, Transects	**02**
6	Field Photography	**01**
7	Field observation, reference collection and making report (diagnostic characters and ecological characteristics)	**03**
	Total	**15**

Reference Books:

1. Ambrose, H.W. III and K.P. Ambrose. 2001. A Handbook of Biological Investigation. 5th Ed. Hunter Textbooks Inc. Winston-Salem, NC, U.S.A.
2. Crawley, M.J. 1996. Plant Ecology. 2nd ed. Blackwell Publishing. Malden, MA, U.S.A.
3. Gurevitch, J., S.M. Scheiner, and G.A. Fox. 2002. The Ecology of Plants. Sinauer Associates, Inc. Sunderland, MA, U.S.A.
4. Pollan, M. Botany of Desire. 2002. Random House Trade Paperbacks. NY, NY, U.S.A.
5. Subramanyam NS and Sambamurty AVSS. 2006. Ecology.2nd edition. Narosa Publishing house. New Delhi. India
6. Bendre A.and Kumar A. 2000. A text book of Practical Botany. 8th Edition. Rastogi Publications. Meerut.
7. Dahiya P. and Ahlawat M.2015. Environmental science a new approach. Narosa Publishing House. Delhi.
8. Gurucharan S. Plant systematic theory and Practice .2007.2nd Edition. Oxford and IBH publishing co-op. Pvt. Ltd. New Delhi.