KONGUNADU ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

COIMBATORE – 641 029

DEPARTMENT OF BOTANY (PG)

CURRICULUM AND SCHEME OF EXAMINATIONS

(CBCS)

(2022 – 2023 onwards)

KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
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DEPARTMENT OF BOTANY

Vision:

- Disseminate knowledge and feasible strategies for obtaining sustainable benefits from plants and their utility to the society.

Mission:

- Designing the curriculum by frequently updating the syllabi according to the need.
- Preparing the students with more aptitude, skill and leadership quality by educating them.
- Make the students as entrepreneurs in the plant based industries.
- Identification and encouragement to turn the students into eminent Scientists/ Laurels.

PROGRAMME OUTCOMES (PO)

PO 1

- This programme aids an excellent opportunities for students to develop demonstrative knowledge, understanding skills, qualities and other attributes in range of plant diversity in terms of structure, function, evolution and their environmental relationships.

PO2

- Plant diversity conservation strategies such as tissue culture techniques, in situ and ex situ methods motivate students to create interest towards nature and its protection of plant heritage.

PO3

- Contribution and importance of medicinal plants instill a sense of care and concern over the improved production of our supply on medicine, food and other plant products for the betterment of man's holistic development and welfare.

PO4

- Explore the therapeutic aspects of medicinal plants by traditional indigenous approaches and perspectives on treating ailments

PO5

- Contribution and importance of medicinal plants instill a sense of care and concern over the improved production of out supply on medicine, food and other plant products for the betterment of man's holistic development and welfare.

PO6

- Students can acquire acquainted knowledge on basic scientific phenomena, fundamental principles and applications of various mathematical tools and physical principles in relevant biological situations.

PO7

- Students will be able to understand the potentials and impact of biotechnological innovations by implementing modern appropriate techniques and practical exposures in the field of Plant Molecular Biology, Plant Biotechnology and Nanobiology.

PO8

- Demonstrate knowledge and understanding of concepts and principles in recent research approaches and to manage projects in multidisciplinary environments.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1

- Highest priority is given to morphology, taxonomy, anatomy and embryology to know each and every character of the plant, both external and internal characters for their identification and classification to involve plants further in biochemical and pharmaceutical aspects.

PSO2

- Students will be able to apply fundamental biostatistics, bioinformatics tools and biophysical principles for the analysis of relevant biological situations and for developing intellectual skills on biological data and databases.

PSO3

- Students will be able to explicate the ecological interconnections of life on earth by tracing energy and nutrient flows through the environment by the microbial and degradation of the waste. They will be able to relate the physical features of the environment to that of the structure of populations, communities and ecosystem.

PSO4

- ❖ Study on medicinal plants provide firsthand knowledge on local, rare, endangered, endemic and exotic medicinal plants in their original habitats, their therapeutic values acquired through their physiological pathways and their cultivation practices for effective conservation for future use.

PSO5

- ❖ Through microbiological core concepts the students were able to inter-relate integral and ubiquitous role of microbes with their environment. In plant pathology, students are expected to recognize plant diseases and their disease management for economically important crop plants.

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641 029

Programme Name: M.Sc., Botany

Curriculum and Scheme of Examination under CBCS

(Applicable to the students admitted during the Academic Year 2022-2023)

Semester	Subject Code	Title of the Paper	Instruction hours /cycle	Exam Marks			Duration of Exam (hours)	Credits
				CIA	ESE	Total		
I	22PBO101	C.P.1 - Plant Diversity I	7	50	50	100	3	5
	22PBO102	C.P.2 - Plant Diversity II	7	50	50	100	3	5
	22PBO103	C.P.3 - Anatomy, Embryology of Angiosperms and Microtechniques	7	50	50	100	3	5
	22PBO1E1	Major Elective I	5	50	50	100	3	5
	22PBO1CL	C.Pr.1 - Plant Diversity I & II , Anatomy, Embryology of Angiosperms and Microtechniques	4	50	50	100	4	2
		Total	**30**	-	-	**500**	-	**22**
II	22PBO204	C.P.4 – Bioinformatics	7	50	50	100	3	4
	22PBO205	C.P.5 - Cell Biology, Genetics, Plant Breeding and Biostatistics	7	50	50	100	3	5
	22PBO206	C.P.6 - Ecology, Bioenergetics and Natural Resource Management	7	50	50	100	3	5
	22PBO2E2	Major Elective II	5	50	50	100	3	5
	22PBO2CM	C. Pr. 2 – Bioinformatics, Cell Biology, Genetics, Plant Breeding, Biostatistics, Ecology, Bioenergetics and Natural Resource Management	4	50	50	100	4	2
		Total	**30**	-	-	**500**	-	**21**
III	22PBO307	C.P.7 - Taxonomy and Biosystematics	7	50	50	100	3	5
	22PBO308	C.P.8 - Microbiology and Plant Pathology	7	50	50	100	3	4
	22PBO309	C.P.9 – Plant Biotechnology	6	50	50	100	3	4
	22PBO3CN	C.Pr.3- Taxonomy, Biosystematics, Microbiology, Plant Pathology & Plant Biotechnology	4	50	50	100	4	2
	22PBO3N1	Non-Major Elective I	4	50	50	100	3	4
	-	Extra Departmental Course (EDC)	2	100	-	100	3	2
		Total	**30**	-	-	**600**	-	**21**
IV	22PBO410	C.P.10 – Biophysics and Biochemistry	7	50	50	100	3	4
	22PBO411	C.P.11 - Plant Physiology	7	50	50	100	3	5
	22PBO412	C.P.12 Bioinstrumentation and Research Methodology	6	50	50	100	3	4
	22PBO4CO	C.Pr.4– Biophysics, Biochemistry, Plant Physiology, Bioinstrumentation and Research Methodology	4	50	50	100	4	2
	22PGI4N2	Non-Major Elective - II	4	100	-	100	3	4
	22PBO4Z1	Project & Viva – Voce	2	50	50	100	-	5
	-	SWAYAM – MOOC	-	-	-	-	-	2
		Total	**30**	-	-	**600**	-	**26**
		Grand Total		-	-	**2200**	-	**90**

Note:

CBCS – Choice Based Credit System
CIA – Continuous Internal Assessment
ESE – End of Semester Examinations

Major Elective Papers

(4 papers are to be chosen from the following 8 papers)

1. **Forest Resources and Conservation**
2. **Seed Technology**
3. **Food Science and Nutrition**
4. **Horticulture**
5. **Molecular Biology**
6. **Algal Technology**
7. **Biofertilizer and Solid Waste Management**
8. **Applied Microbiology**

Non-Major Elective Papers

(2 papers are to be chosen from the following 4 papers)

1. **Herbal Medicine**
2. **Biotechnology and Nanobiology**
3. **Limnology**
4. **Information Security#**

To be offered by the department

Sub. code and title of the Extra Department Course (EDC)

22PBO3X1- EDC: APPLIED HORTICULTURE

Tally Table:

Part	Subject	No. of Subjects	Total Marks	Credits
I	Core - Theory / Practical / Project	17	1700	68
	SWAYAM – MOOC	-	-	2
	Major Elective Paper	2	200	10
	EDC Paper	1	100	2
	Non - Major Elective Paper	2	200	8
	Grand Total	**22**	**2200**	**90**

- 50 % CIA is applicable to all subjects except NME- II, EDC, JOC and SWAYAM courses.
- The students should complete **SWAYAM-MOOC** courses before the completion of 3rd semester and the course completion certificate should be submitted through the HOD to the Controller of Examinations. Two credits will be given to the candidates who have successfully completed. In case the students have completed more than one online course, the appropriate 2 extra credits shall be awarded to such candidates upon the submission of certificate through the HOD to the Controller of Examinations.
- A **Field Trip** preferably relevant to the course should be undertaken every year.

Extra Credit Courses

Semester	Subject Code	Title of the Paper	Instruction hours /cycle	Exam Marks			Duration of Exam (hours)	Credits
				CIA	ESE	Total		
II	21PBO0J1	JOC - Floriculture and Landscaping	4	-	100	**100**	3	**2**
	21PBO0J2	JOC - Food Processing and Preservation	4	-	100	**100**	3	**2**

Components of Continuous Internal Assessment

Components		Marks	Total
Theory			
CIA I	75	(75+75) converted to 30	50
CIA II	75		
Problem based Assignment**		10	
Attendance		5	
Others*		5	
Practical			
CIA Practical		(50) converted to 30	50
Observation Notebook		15	
Attendance		5	
Project			
Review		45	50
Regularity		5	

* Class Participation, Case Studies Presentation, Field Work, Field Survey, Group Discussion, Term Paper, Workshop/Conference Participation. Presentation of Papers in Conferences, Quiz, Report/Content writing etc.

**** Two Assignments to be given. (Each 5 marks)**

PBO4

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate

1. Theory Examination: CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 – K2 Q1 to 20	A (Answer all)	20 x 1 = 20	MCQ -10/Fill ups-5/One word-5	75**
K2 – K5 Q21 to 28	B (5 out of 8)	5 x 5 = 25	Short Answers	
K2 - K5 Q29 to 33	C (3 out of 5)	3 x 10 = 30	Descriptive / Detailed	

****For ESE 75 marks converted to 50 marks**

2. Practical Examination:

Knowledge Level	Section	Marks	Total
K3 ↕ K5	Experiments	45	50
	Record Work	05	

3. Project Viva Voce:

Knowledge Level	Section	Marks	Total
K3 ↕ K5	Project Report	35	50
	Viva - voce	15	

22PBO101

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper 1: PLANT DIVERSITY - I				
Batch **2022-2023**	**Semester** **I**	**Hours / Week** **7**	**Total Hours** **105**	**Credits** **5**

COURSE OBJECTIVES

- To obtain knowledge on diverse groups of Thallophytes.
- To impart insight knowledge on the diversity, structural organization and reproduction of algae, fungi and lichens.
- To acquire knowledge on the life cycle patterns of Thallophytes and their significance.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Grasp the basic concepts of lower life forms.
↑	CO2	Understand the diversity in habits, habitats and organization of various groups of lower plants.
↕	CO3	Explore knowledge on the modes of nutrition and fructifications in fungi
↓	CO4	Apply the inherit knowledge on the exploitation of useful products from lower forms for the betterment of human welfare.
K5	CO5	Evaluate the structural organization and life cycle patterns of various lichens.

SYLLABUS

UNIT I **(21 HOURS)**

Algae: History, Details of habit, habitat and distribution of algae. Systems of classification in algae, Classification of algae by Fritsch (1945). General characters - thallus organization, algal pigments, reproduction and life cycle patterns in algae. Thallus organization, reproduction and life cycles of Cyanophyceae, Chlorophyceae and Xanthophyceae.

UNIT II **(21 HOURS)**

Thallus organization, reproduction and life cycle patterns of Bacillariophyceae, Phaeophyceae and Rhodophyceae. Recent insights of algal phylogeny and evolution. Ecological and economical aspects of algae. Algae as pollution indicators*. Algal blooms. Centers of algal research in India. Contribution of Indian Phycologists.

UNIT III **(21 HOURS)**

Fungi: History, General features, occurrence and distribution, fungal taxonomy, mode of nutrition, classification of fungi by Alexopoulos and Mims (1979). Range of thallus structures, reproduction and types of fructifications in fungi and types of spores . Thallus organization, reproduction and life cycle patterns of Myxomycetes and Oomycetes.

22PBO101

UNIT IV **(21 HOURS)**

Thallus organization, reproduction and life cycle patterns of Zygomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Homothallism and heterothallism. Fungi as symbionts- recent insights of fungal phylogeny and evolution. Ecological and economic importance of fungi.

UNITV **(21 HOURS)**

Lichens: Brief history of lichens. General features, distribution, classification and structural organization of thallus. Nature of dual organisms, Interrelationships of phycobionts and mycobionts in lichen thallus organization. Structure, reproduction and life cycle patterns of Ascolichen, Basidiolichen and Deuterolichens. Ecological and economic aspects of lichens. Lichens as pollution indicators.

*** Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. F.E. Fritsch, (1965). (Rep) Structure and reproduction of the Algae. Vol I & II Cambridge University Press.
2. C.J. Alexopoulos and C.W. Mims. (1952). Introductory Mycology. East Wiley Ltd. New Delhi.
3. O.P. Sharma, (1986). Text book of Fungi. Tata McGraw - Hill publishing Co. New Delhi.
4. Gangulee, Das and Kar. (2001). College Botany Vol. I & II. New central Book agency Pvt. Ltd. Calcutta.
5. V. Singh, P.C. Pandey and D.K. Jain. (2012). A Text book of Botany. Rastogi Publication. Meerut, India.

REFERENCES

1. E.A. Bessey, (1971). Morphology and Taxonomy of Fungi. Hafner Publication Company, New York.
2. K.S. Bilgrams, and R.N. Verma, (1978). Physiology of Fungi. Vikas Publishing House.
3. J.W. Deacon, (1984). Introduction to Mycology. Blackwell Science publication, Oxford.
4. H.C. Duke, (1983). Introduction to fungi. Vikas publishing house. New Delhi.
5. A.C. Dutta, (2007) Botany, Oxford University Press, New Delhi
6. H.C. Dube, (2008). An Introduction to Fungi, Vikas Publishing Pvt. Ltd. Delhi
7. V. Venkateswarlu, (1964). A Text book of Fungi, Maruthi Book Depot Educational Publishers, Guntur.
8. B.R. Vashista, Dr. A.K.Sinha and V.P. Singh, (2013). Botany- Algae, S. Chand and Company Ltd, New Delhi

PBO7

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	S	M
CO2	S	M	H	M	H
CO3	H	S	H	S	S
CO4	H	H	M	S	M
CO5	S	S	H	M	H

S - Strong **H** - High **M** - Medium **L** - Low

22PBO102

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper 2: PLANT DIVERSITY – II				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**I**	**7**	**105**	**5**

COURSE OBJECTIVES

- To impart insight knowledge on the structural organizations and life cycle patterns of Bryophytes, Pteridophytes and Gymnosperms.
- To understand the basic concepts of evolutionary trends in Cryptogams and Phanerogams.
- To learn the preserved vestiges of various plant life forms of geological past.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Gain knowledge on ecological and phylogenetical aspects of Bryophytes.
	CO2	Understand the general distribution and characters of Pteridophytes.
	CO3	Apply knowledge on vascular organization and evolution of Pteridophytes.
	CO4	Distinguish various diagnostic features and distribution of Gymnosperms.
	CO5	Analyze the acquired knowledge on diversity of plant species and apply to the field level.

SYLLABUS

UNIT 1 **(21 HOURS)**

Bryophytes: General features and distribution. Classification of Bryophytes (Smith, 1955). General characters of Hepaticopsida, Anthoceropsida and Bryopsida. Structure and evolution of gametophyte and sporophyte. Ecological and economic importance of Byrophytes*. Fossil Bryophytes.

UNIT II **(21 HOURS)**

Pteridophytes: General features and distribution of Pteridophytes. Classification of Pteridophytes by Sporne (1966). General characters of Psilotopsida, Lycopsida, Sphenopsida and Pteropsida.

UNIT III **(21 HOURS)**

Reproduction methods in Pteridophytes. Origin and evolution. Vascular organization and stelar evolution in Pteridophytes. Heterospory and origin of seed habits. Evolution of sorus. Ecological and economic importance of Pteridophytes.

UNIT IV **(21 HOURS)**

Gymnosperms: General characters, distribution and origin of Gymnosperms. Classification of Gymnosperms by Sporne (1965). General structure and inter-relationships of Pteridospermales, Bennettitales, Pentoxylales and Ginkgoales.

22PBO102

UNIT V **(21 HOURS)**

General structure and inter-relationships of Cycadales, Coniferales and Gnetales. Angiospermic characters of Gnetales. Phylogenetic trends and affinities of various classes. Ecological and economic importance of Gymnosperms. Distribution of living Gymnosperms in India.

*** Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. Gangulee, Das & Kar. (2001. College Botany Vol I & II. New central Book agency Pvt. Ltd. Calcutta.
2. B.P. Pandey, (1990). (6th Ed.). A Textbook of Botany Vol. II. S. Chand & Co. Ltd., New Delhi.
3. P.C. Vasistha, (1971). Botany for Degree students. S. Chand & Co. Ltd., New Delhi.
4. B.P. Pandey, College Botany, Volume II. Including Pteridophytes, Gymnosperms, Paleobotany and Angiosperms. S. Chand & Co Ltd.
5. A.V.S.S. Sambamurty (2020). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. Dreamtech Press Publisher. New Delhi.

REFERENCES

1. K.R. Sporne, (1966). The morphology of Pteridophytes. Bal Bergen Boeken, London.
2. K.R. Sporne, (1967). The morphology of Gymnosperms. Bal Bergen Boeken, London.
3. C.D. Arnold, (1947). An introduction to Paleobotany. McGraw Hill Publications, New York.
4. A.C.Seward, (1991). Fossil plants. Today and Tomorrow Publishers, New Delhi.
5. Chittaranjan Mohanty (2018). Text Book of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. Kalyani Publications, New Delhi.
6. Anupama Krishna (2011). Botany for Degree Students: Bryophyta. S. Chand Publishing, New Delhi.
7. O.P. Sharma (2012). Pteridophyta. Tata McGraw-Hill Publication, Uttar Pradesh.
8. S. P. Bhatnagar, Alok Moitra (1996). Gymnosperms. New Age International, New Delhi

PBO10

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	S	H
CO2	H	S	H	H	M
CO3	S	H	M	S	S
CO4	H	M	H	H	M
CO5	S	S	H	H	M

S - Strong **H** - High **M** - Medium **L** - Low

22PBO103

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper: 3 –ANATOMY, EMBRYOLOGY OF ANGIOSPERMS AND MICROTECHNIQUES				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**I**	**7**	**105**	**5**

COURSE OBJECTIVES

- To acquire knowledge about complex vascular tissues.
- To obtain inherit knowledge on micro and mega sporangial development and their functions.
- To understand the histochemical techniques involved in permanent micro slides.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Recognize various histochemical techniques involved in anatomy and embryology.
	CO2	Understand phylogenetic relationship of vascular tissues.
	CO3	Explore the embryological features of plants
	CO4	Analyze the techniques of parthenocarpy and polyembryony for the improvement of economically important crop species..
	CO5	Determine knowledge on the principles and concepts of histochemical staining techniques

SYLLABUS

UNIT I **(21 HOURS)**

Introduction to complex tissue: Primary xylem and its components, Secondary xylem – arrangement of vessels, wood parenchyma and its types, xylem rays, Dendrochronology – Growth rings, anomalies in ring growth, cross dating and skeleton plots, Reaction wood - Compression wood and tension wood, Primary and Secondary phloem and its components, Differences and Phylogenetic trends of xylem and phloem.

UNIT II **(21 HOURS)**

Normal secondary growth in dicot stem*. Vascular cambium - origin, types - storied and non storied cambium, cork cambium, wound healing activity. Anomalous secondary growth in dicot and monocot stem in *Aristolochia*, *Boerhaavia*, *Piper* and *Draceana*. Nodes - types and evolution. Kranz anatomy - anatomical features of CAM plants and leaf abscission.

UNIT III **(21 HOURS)**

Development of anther, types of tapetum, role of tapetum in pollen wall development, pollen wall morphogenesis, Pollen sterility, pollen-stigma compatibility, megasporogenesis, female gametophyte and nutrition of embryo sac.

UNIT IV **(21 HOURS)**

Fertilization, control of fertilization, development of dicot and monocot embryo. Endosperm development, types of endosperm, haustoria of endosperm. Apomixis.Polyembryony - types and causes. Seed formation, dormancy and germination. Experimental embryology (embryo rescue and anther culture) and parthenocarpy.

22PBO103

UNIT V **(21 HOURS)**

Microtechniques: Fixing and killing of plant tissues – Chemical and physical fixative reagents, Methods of tissue processing – Dehydration, clearing and infiltration, embedding, sectioning, Microtome – Types of microtome and knives, Single and double staining, mounting, labeling and storage of slides. Histochemical staining techniques, Special techniques – Smear, Squash and Maceration.

*** Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. S.S. Bhojwani and S.P. Bhatnager, (1997). The embryology of Angiosperms. Vikas Publishers House, Chennai.
2. A. Fahn, Plant Anotamy. (1985) Pergman press, London.
3. B.P. Pandey, (2004) Plant Anatomy, S.Chand and Company Ltd., New Delhi.
4. B.P. Pandey, (1995) Embryology of Angiosperms, S.Chand and Company Ltd., New Delhi.
5. M.K. Prasad and M.Krishna Prasad (2000) Outline of Microtechnigue, EMKAY Publications

REFERENCES

1. K. Esau, (1991). Anatomy of seed plants. (7th Ed.). Wely Eastern Ha, Chennai.
2. A.J. Eames and Mac Daniels. (1976). An introduction to plant Anatomy. Tata Mac Graw Hill, New Delhi.
3. B.M.Johri, K.B. Ambegaokar and P.S. Srivastava. (1992). Vol. I. Embryology of Angiosperms. Springer - Verlac, New York.
4. P. Maheswari, P. (2006). Introduction to embryology and Angiosperms. Tata Mac Graw Hill, New Delhi.
5. S. N. Pandey and A. Chadha, (2000). Embryology, Vikas Publishing House, New Delhi.
6. J.A. Kierman, (1999). Histochemical methods. Butterworth Publishing London
7. A. Fahn. (1989) Plant Anatomy, Peragaman Press, Oxford, NewYork.
8. P. Maheswari, (1950). An Introduction to Embryology of Angiosperms. Mc Graw Hill, Newyork

PBO13

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	M	H
CO2	H	H	S	S	H
CO3	M	H	H	M	S
CO4	H	S	H	S	M
CO5	S	H	H	S	H

S - Strong **H** - High **M** - Medium **L** - Low

22PBO1CL

Programme Code: 05	**M.Sc., BOTANY**			
Core Practical 1: PLANT DIVERSITY- I & II, ANATOMY, EMBRYOLOGY OF ANGIOSPERMS AND MICROTECHNIQUES				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**I**	**4**	**60**	**2**

COURSE OBJECTIVES

- To understand the diversity and distribution of lower life forms.
- To obtain insight knowledge on variations in the internal structural organization among plants.
- To impart inherent knowledge on the basic techniques and modern concepts of microtome.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K3	CO1	Acquire and analyze inter-relationships between various lower life forms
↕	CO2	Examine variations in structural organization and reproduction of Cryptogams and Phanerogams
	CO3	Understand the primary and secondary structure of plants.
	CO4	Analyze data on the types of fossils and distribution pattern of lower life forms in various eras
K5	CO5	Monitor the sequential changes in the internal structural organization of plants by sectioning through Microtechniques

I. PLANT DIVERSITY - I

Study of morphology, anatomy, vegetative and reproductive organs using clear whole mounts / sections of the following genera.

Algae

Cyanophyceae : *Spirulina, Lyngbya, Anabaena, Nostoc* and *Scytonema.*
Chlorophyceae : *Volvox, Ulothrix, Cladophora, Pithophora, Oedogonium, Codium, Caulerpa* and *Chara.*
Xanthophyceae : *Vaucheria*
Bacillariophyceae : *Diatoms*
Phaeophyceae : *Ectocarpus, Dictyota, Padina, Sargassum* and *Turbinaria*
Rhodophyceae : *Gelidium, Amphiroa, Gracilaria* and *Polysiphonia.*

Fungi

Myxomycetes : *Plasmodiophora.*
Oomycetes : *Albugo* and *Phytophthora.*
Zygomycetes : *Rhizopus.*
Ascomycetes : *Saccharomyces, Penicillium* and *Aspergillus.*
Basidiomycetes : *Agaricus* and *Puccinia.*
Deuteromycetes : *Colletotrichum* and *Cercospora.*

Lichens

Morphology of Crustose, Foliose and Fruticose Lichens. Structure and reproduction of *Usnea.*

22PBO1CL

II. PLANT DIVERSITY - II

Study of morphology, anatomy, vegetative and reproductive organs using clear whole mounts / sections of the following genera.

Bryophytes

Marchantiales : *Marchantia, Lunularia* and *Reboulia*
Jungermanniales : *Fossombronia* and *Pellia*
Anthocerotales : *Anthoceros*
Sphagnidae : *Sphagnum*
Bryidae : *Bryum* and *Funaria*

Pteridophytes

Psilotopsida : *Psilotum*
Lycopsia : *Lycopodium, Selaginella* and *Isoetes*
Sphenopsida : *Equisetum*
Pteropsida : *Ophioglossum, Pteris, Adiantum, Marsilea* and *Azolla.*

Gymnosperms: *Cycas, Pinus, Cupressus, Podocarpus, Araucaria, Ephedra* and *Gnetum.*

Fossils: *Rhynia, Asteroxylon, Sphenophyllum, Ankyropteris, Botryopteris, Lagenostoma, Heterangium, Pentoxylon, Medullosa, Cycadeoidea* and *Cordaites*.

Field trip

Three days field visit - Observations of species habits in their natural habitats and collection of specimens.

III. ANATOMY

- Identification using permanent slides / photographs
    - Structure of tracheids and vessels
    - Types of wall thickening
    - Arrangement of vessels in secondary xylem
    - Types of wood parenchyma
    - Types of wood
    - Types of vascular cambium
    - Nodal anatomy
- Anomalous secondary thickening – Dicot – *Aristolochia, Boerhaavia, Piper betel*; Monocot – *Dracaena.*

EMBRYOLOGY OF ANGIOSPERMS

With the help of permanent slides to study

1. Stages in development of microsporangium and male gametophyte.
2. Configurations of ovules, 2, 4 nucleate embryo sac, mature embryo sac.
3. Types of endosperm.
4. Stages in embryogeny 2 or 3 celled, globular, proembryos and mature embryos of dicot and monocots. Interpretation of embryological drawings.

22PBO1CL

MICROTECHNIQUES

- observe plant cells using maceration techniques
- Free hand sectioning and preparation of semipermanent slide (Submission of 5 slides for evaluation).
- Histochemical staining for starch, protein, lipid, polyphenol, tannin, suberin, lignin etc.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	M	H
CO2	H	S	H	H	S
CO3	H	M	S	H	M
CO4	S		M	H	S
CO5	S	H	S	S	H

S - Strong **H** - High **M** - Medium **L** - Low

22PBO1CL

KONGUNADU ARTS AND SCIENCE COLLEGE (Autonomous)
COIMBATORE - 641 029
PG MODEL QUESTION PAPER (PRACTICALS)
End of Semester Examination Question Paper Pattern
(For the candidates admitted from the academic year 2022-2023 onwards)

Time: 4 Hours **Max. Marks: 50 Marks**

BREAK UP OF MARKS

Core Practical 1: PLANT DIVERSITY- I & II, ANATOMY, EMBRYOLOGY OF ANGIOSPERMS AND MICROTECHNIQUES

I.	Algal mixture (3 × 2)	06 Marks
II.	Micro preparation (5 × 3)	15 Marks
III.	Maceration technique (2 × 2)	04 Marks
IV.	Histochemical staining (1 × 2)	02 Marks
V.	Embryo mounting (2 × 1½)	03 Marks
VI.	Spot at sight (5 × 2)	10 Marks
VII.	Submission of permanent slides	05 Marks
	Record	05 Marks
		50 Marks

22PBO204

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper 4: BIOINFORMATICS				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**II**	**7**	**105**	**4**

COURSE OBJECTIVES

- To understand the concepts of bioinformatics and its application in various fields of plant science
- To understand the structure of biological databases and their utilities.
- To impart knowledge on various tools of biological databases.

COURSE OUTCOME

On successful completion of the course, the students will be able to

K1	CO1	Grasp knowledge on various biological databases.
↑	CO2	Impart knowledge on gene and its expression both in prokaryotes and eukaryotes.
↕	CO3	Obtain knowledge on the sequences of amino acids in protein molecules.
↕	CO4	Acquire knowledge on appropriate algorithms and to identify the similarities and dissimilarities existing between the genes of various organisms.
K5 ↓	CO5	Evaluate evolutionary relationships between organisms and biomolecular visualization tools.

SYLLABUS

UNIT I **(21 HOURS)**

Introduction to Bioinformatics, Phytoinformatics, Central dogma of molecular biology. Gene structure and information content. Promoter sequences. Genetic code, open reading frames, introns and exons. Gene finding methods, tools and problems in gene finding.

UNIT II **(21 HOURS)**

Regulation of gene expression in prokaryotes and eukaryotes. Transcription factors. Classification of Biological Databases: Sequence, Structural databases, Specialized and Literature databases.

UNIT III **(21 HOURS)**

Protein structures: primary, secondary, tertiary and quaternary structures, domain, motifs and protein families. Protein prediction.

UNIT IV **(21 HOURS)**

Sequence alignment - definition, Types and Methods – Pairwise (Local and Global) and Multiple Sequence Alignment. Methods for Scoring Matrices - PAM, BLOSUM and Gap Penalty. Sequence similarity search using BLAST and FASTA.

22PBO204

UNIT V **(21 HOURS)**

Recent trends in Bioinformatics. Biomolecular visualization, phylogenetic analysis and computer aided drug designing. Concepts of molecular modeling. Applications of Bioinformatics in various fields*.

*** Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. K. Mani and N. Vijayaraj. (2002). Bioinformatics for beginners. Kalaikathir Achakam, Coimbatore.
2. E. Dan, Krane and Michael L. Raymer. (2006). Fundamental concepts of bioinformatics. Dorling Kindersley (India) Pvt Ltd.
3. D. Mount, (2004). Bioinformatics: Sequence and Genome analysis. Cold Spcing Harbor Laboratory Press. New York
4. A.M. Lesk, (2005). Introduction to Bioinformatics, Oxford University Press
5. U. Kumarasan and R. Sundaralingam, (2020). Bioinformatics, Saras Publication

REFERENCES

1. Cold Spring Harbor. (2004). Bioinformatics - Sequence and Genome Analysis. (2nd Ed.) Laboratory Press,
2. Arthur M. Lesk. (2002). Introduction to Bioinformatics. Oxford University Press, UK.
3. David W. Mount. (2001). Bioinformatics-Sequence and Genome analysis. Cold Spring Harbor Laboratory Press.
4. D.R. Westhead, J.H. Parish and R.M. Twyman. (2003). Instant Notes in Bioinformatics.

PBO20

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	S	H
CO2	S	S	M	H	H
CO3	H	H	H	S	M
CO4	S	M	H	H	S
CO5	H	S	M	L	H

S - Strong **H** - High **M** - Medium **L** - Low

22PBO205

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper 5: CELL BIOLOGY, GENETICS, PLANT BREEDING AND BIOSTATISTICS				
Batch **2022-2023**	**Semester** **II**	**Hours / Week** **7**	**Total Hours** **105**	**Credits** **5**

COURSE OBJECTIVES

- To learn the concept of genes and gene interactions.
- To study about the principles of Mendelian's and non-Mendelian's inheritance
- To assess the methods of plant breeding and crop improvement
- To learn the experimental designs using biostatistical tools

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Acquire knowledge on various fields of genetics
	CO2	Identify the sex linked disease among the population
	CO3	Implement knowledge on the concepts of mutation for the development of new plant varieties
	CO4	Describe various molecular breeding techniques for genetic improvement of crops
	CO5	Evaluate appropriate biostatistical tools for designing any biological experiments

SYLLABUS

UNIT I **(21 HOURS)**

Structure and functions of cell organelles and nucleus. Chromosome - Structure, Molecular organization of chromosome, Special type of chromosome - Lamp brush chromosome, Polytene chromosome and Super numerary chromosome, Chromosomal aberration - Numerical and Structural variations. Genes - Features of gene concept, molecular structure of gene, gene function. Genetic code - Salient features & Wobble hypothesis. Cell Cycle and Cell Division.

UNIT II **(21 HOURS)**

Mendelism - Basic principles, Gene Interaction, Quantitative inheritance, Sex determination: Mechanism (Genetical, Metabolical, Hormonal and Environmental sex determination), Sex linked inheritance - X linked, Y linked and XY linked, Sex influenced and sex limited characters, Cytoplasmic inheritance: Plastid inheritance, Cytoplasmic male sterility, Mitochondrial inheritance and Inheritance in haploid organisms.

UNIT III **(21 HOURS)**

Mutation : Detection of mutation - Lethal mutation and Visible mutation. Molecular basis of mutation, Physical and chemical mutagens. Biochemical genetics: Biochemical mutation in Bacteria and *Neurospora*. Population genetics: Gene pool, gene frequencies, Hardy-Weinburg law, factors affecting gene frequencies. Chromosome mapping – Two point and three point test cross, Interference and Coincidence.

22PBO205

UNIT IV **(21 HOURS)**

Plant Breeding –Introduction, History, Major objectives- Principles - important achievements of plant breeding, self and cross pollinated crops - pure line selection and mass selection methods; Line breeding, pedigree, clonal selection. Incompatibility - male sterility. Mutation breeding - methods, limitation and crop improvement. Modern trends in plant breeding*.

UNIT V **(21 HOURS)**

Biostatistics - Measures of central tendencies - Mean (only arithmetic), median and mode. Measures of deviation - mean deviation, variance, standard deviation, standard error and co-efficient of variation. Probability of distribution - Binomial, Poison and Normal distribution. Linear regression and correlation (Simple and multiple). Tests of statistical significance - Chi-square test and student t-test. Analysis of variance (ANOVA) - one way and two ways. Recent advances and applications of biostatistics.

*** Self study**

Teaching Methods

Smart Class Room/PowerPoint Presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. P.S. Verma and V.K. Agarwal,(1998). Cytology. (1st Ed.). S. Chand & Pvt.Ltd., New Delhi.
2. Veerbala Rastogi. (2004). A Text book of Genetics. Kedarnach & Ramnath, Meerut.
3. B.D. Singh,(2014). Plant Breeding Principles and Methods. (Reprtd.) Kalyani Publisher, New Delhi.
4. S.P. Gupta, (2001). Statistical Methods. Sultan Chand & Sons, Educational Publishers, New Delhi.
5. Jerrold H. Zar (2006). Biostatistical Analysis,Dorling Kindersely (India) Pvt. Ltd., New Delhi

REFERENCES

1. De Robertis. (1975). Cell Biology. (6^{th} Ed.) Saunders Philadelphia
2. E.J. Gardener, Peter Suns tad, D. (1975). (5^{th} Ed.). Principles of Genetics. John Wiley & Sons Inc.
3. M.W. Strick Berger, (1997). Genetics. (2^{nd} Ed.) MacMillan, New York.
4. P.K. Gupta, (1985 - 91). Genetics. (2^{nd} Ed.). Rastogi Publications.
5. R.W. Allard, (1960). Principles of Plant Breeding. John Wiley & Sons Inc.
6. R.S. Shukla and P. S. Chandel. (1996). Cytogenetics - Evolution and Plant Breeding. S. Chand & Pvt. Ltd. New Delhi.
7. I.D. Khan and A. Khanum. (1994). Fundamentals of Biostatistics. Mc Graw Hill, New Delhi.
8. Vasantha Pattabhi and N. Gautham. (2004). Bistatistics. Narosa Publishing House, Chennai.

PBO23

22PBO205

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	S	M
CO2	S	M	H	H	S
CO3	H	S	H	M	H
CO4	H	H	S	S	H
CO5	M	S	S	H	M

S - Strong **H** - High **M** - Medium **L** - Low

22PBO206

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper 6: ECOLOGY, BIOENERGETICS AND NATURAL RESOURCE MANAGEMENT				
Batch 2022-2023	**Semester II**	**Hours / Week 7**	**Total Hours 105**	**Credits 5**

COURSE OBJECTIVES

- To understand the structural and functional organization of the ecosystems.
- To know the causes of environmental deterioration and possible measures for their rejuvenation.
- To understand the natural calamities and disaster management.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Gain knowledge on community concepts and their ecological niches
↕	CO2	Understand the principles and process of biogeochemical cycling between organisms and the environment
	CO3	Apply concepts of energy flow and dispersion in various ecosystems
	CO4	Monitor environmental hazards and their control measures
K5	CO5	Evaluate the changes in biodiversity and their management approaches through remote sensing techniques

SYLLABUS

UNIT I **(21 HOURS)**

Population and Community Ecology - Ecology - concepts and applications, biotic community concepts, characteristics and structure of population, ecological variants, and methods of studying plant communities. Ecological niches, edge effect and ecotone.

UNIT II **(21 HOURS)**

Ecosystem Ecology - Structural and functional characteristics of ecosystem, major ecosystems of world, biogeochemical cycle - cycling and reservoir pool, gaseous (nitrogen and carbon) and sedimentary pattern (sulphur and phosphorous) of cycling. Nutrient cycling and agricultural patterns in tropical and temperate regions. Plant indicators of conditions, uses and processes.

UNIT III **(21 HOURS)**

Bioenergetics - Energy dispersion, law of thermodynamics, concept and energy flow models, productivity concept, turn over - primary production processes in C_4 and CAM plants, adaptations in C_4 plants for efficient primary production. Productivity in different ecosystems, measurement of primary production.

UNIT IV **(21 HOURS)**

Environmental Pollution and Education - Air, water, soil, noise and radiation pollution - causes and possible control measures*. Climate change. Global warming, green house effect, ozone depletion, Acid rain. Environmental education-principles, Environmental education programmes in India. Environmental organizations and agencies, Man and Biosphere (MAB) and National and International organizations.

22PBO206

UNIT V **(21 HOURS)**

Natural Resource Conservation and Management - Biodiversity - International and National scenarios, importance. Ecological principles and applications in conservation of biodiversity. *ex situ* and *in situ* conservation of species. Biosphere reserves, sanctuaries, national parks, world hot spots. Remote sensing- principle, tools, concepts and applications-mapping of forest cover. Soil conservation - erosion and control. Water standards, quality and management. Surface water and ground water development - BOD and COD - Water conservation and waste water reuse. Afforestation, deforestation and social forestry. Disaster Management - Bhopal tragedy, Tsunami, land Slide, Cyclone, Flood and Earth quake.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. P.D. Sharma, (2000). Ecology and Environment. Rastogi Publications, Meerut.
2. H.D. Kumar, (1994). General Ecology. Vikas Publishing Co. New Delhi.
3. P.S. Verma and Agarwal (2000). Environmental Biology (Principles of Ecology). S. Chand & Company, New Delhi
4. R.S. Ambashat and N.K. Ambashat, (2017). A Text Book of Plant Ecology, CBS Publishers and Distributors, India
5. Rafad S. Oliveria (2019). Plant Physiological Ecology, Springer Publication

REFERENCES

1. E.P. Odum, (1971). Fundamentals of Ecology. N.B.Saunders Co. Ltd. Philadelphia.
2. Krebs, (1985). Ecology. C.J, Haper & Row, New York.
3. R.S. Ambasht, (1988). Text book of plant ecology. Lanka Publishers, Varanasi.
4. K.C. Misra, (1980). Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.
5. Alan Wellburm. (1988). Air pollution and acid rain - the biological impact. Longman Scientific and technical, Singapore.
6. C.K. Varshney, (1989). Water pollution and Management. S.P. Printers, Noida.
7. Weaver and Clements. (1929). Plant Ecology. Tata McGraw Hill Publishing Co. New Delhi.
8. R.K. Sinha and Dalbir Singh. (1997). Global Biodiversity. INA Shree Publishers, Jaipur.
9. Mason, C.F. Longman, (1981). Biology of Fresh Water. London.

PBO26

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	S	H
CO2	H	S	H	H	M
CO3	H	S	M	H	S
CO4	S	M	H	S	H
CO5	M	S	M	S	H

S - Strong **H** - High **M** - Medium **L** - Low

22PBO2CM

Programme Code: 05	**M.Sc., BOTANY**			
Core Practical 2: BIOINFORMATICS, CELL BIOLOGY, GENETICS, PLANT BREEDING, BIOSTATISTICS, ECOLOGY, BIOENERGETICS AND NATURAL RESOURCE MANAGEMENT				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**II**	**4**	**60**	**2**

COURSE OBJECTIVES

- To acquire and realize evolutionary relationships existing between the organisms
- To understand genetic analysis at gene, genome and population level
- To learn the experimental designs using biostatistical tools.
- To find out the dominant species in the particular environment.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K3	CO1	Evaluate various techniques, algorithms and tools used for phylogenetic analysis
↕	CO2	Examine different stages of mitosis and meiosis cell division in plant cell
	CO3	Design experimental methods using statistical knowledge.
	CO4	Analyze the physico-chemical nature of the soil.
K5	CO5	Determine the distribution of vegetation using quantitative ecological characters.

I. BIOINFORMATICS

1. Biological data retrieval from Nucleic acid databases - NCBI,EMBL & DDBJ.
2. Data retrieval from Protein database - PDB.
3. Use of literature database - PubMed.
4. Similarity search using BLASTs and FASTA.
5. 3-D Molecular visualization using RASMOL.
6. Multiple sequence alignment using Clustal Sigma.
7. Phylogenetic analysis using Clustal-X.
8. Prediction of locations of exon and intron structures using Genscan.
9. Protein secondary structure prediction using GOR IV.
10. Protein secondary structure prediction using SOPMA.

II. CELL BIOLOGY, GENETICS AND PLANT BREEDING

1. Ultra structure of cell organelles, nucleus, chromosome and its special types (Electron Microscopic Photographs).
2. Preparation of cytological stains, fixatives and pretreatment agents.
3. Study of mitosis and meiosis with different materials.
4. Chromosome counts in Root tips/Flower bud

5. Squash preparation from pre-treated root tips/Flower bud (Colchicine /Paradichlorobenzene/Aesculin) for study of aberrations
6. Simple problem in genetics- Gene interaction, Polygenic inheritance, Sex determination, Sex linked inheritance, Sex limited genes, Sex influenced genes.
7. Construction of chromosome maps using three-point test cross data.
8. Training in hybridization techniques using potted plants.

III . BIOSTATISTICS

1. Analysis of data to find the mean, median and mode.
2. Analysis of a given data for mean deviation variances, standard deviation and standard error.
3. Analysis of a set of data for correlation / regression.
4. Test the significance of a given data using Chi-square test, t-test and ANOVA.

III. ECOLOGY, BIOENERGETICS AND NATURAL RESOURCE MANAGEMENT

1. To determine the quantitative characters in the community by using quadrat methods.
   a) Frequency b) Abundance c) Density d) Basal cover e) IVI.
2. Synthetic characters: Similarity index, FICC, dominance index, diversity index.
3. Raunkiaer's life form classes and percentage distribution of species in vegetation.
4. Stratification, Zonation.
5. Soil analysis - Physical - bulk density, water-holding capacity, soil moisture. Chemical - nitrate and carbonate.
6. Mapping of tree species in vegetations.
7. Field visit - Report preparation on vegetation types, conservation measures undertaken in biosphere reserves/ national parks/ sanctuaries etc.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	S	H
CO2	H	S	M	H	S
CO3	H	M	S	H	M
CO4	S	H	S	S	H
CO5	H	S	H	H	S

S - Strong **H** - High **M** - Medium **L** - Low

22PBO2CM

KONGUNADU ARTS AND SCIENCE COLLEGE (Autonomous)
COIMBATORE - 641 029
PG MODEL QUESTION PAPER (PRACTICALS)
End of Semester Examination Question Paper Pattern
(For the candidates admitted from the academic year 2022-2023 onwards)

Time: 4 Hours **Max. Marks: 50 Marks**

BREAK UP OF MARKS

Core Practical: 2 – BIOINFORMATICS, CELL BIOLOGY, GENETICS, PLANT BREEDING, BIOSTATISTICS, ECOLOGY, BIOENERGETICS AND NATURAL RESOURCES MANAGEMENT

I.	Bioinformatics Experiments	2 × 5	**10 Marks**
II	Any two stages of Mitosis/Meiosis	2 × 2	**04 Marks**
III	Genetics Problem	2 × 3	**06Marks**
IV	Biostatistics Problem	2½ ×2	**05 Marks**
V	Ecology Experiment	1× 10	**10 Marks**
VI	Spot at Sight	5 × 2	**10 Marks**
	Record		**05 Marks**
	Total		**50 Marks**

22PBO307

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper 7: TAXONOMY AND BIOSYSTEMATICS				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**III**	**7**	**105**	**5**

COURSE OBJECTIVES

- To study about the classification and nomenclature of Angiosperms.
- To understand the theory and practices involved in plant systematics.
- To learn the striking affinities of different plant families.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Acquire knowledge on principles and objectives of ICN and APG
	CO2	Differentiate various systems of classifications based on natural and phylogenetic characters of flowering plants
	CO3	Explore proficiency skills using keys for identification of any unknown plant species
	CO4	Able to apply basics of biosystematics in various fields of plant sciences
	CO5	Evaluate modern advances of taxonomical tools for plant identification

SYLLABUS

UNIT I **(21 HOURS)**

Historical account of the classification of angiosperms up to the present day. Systems of classification- Detailed study of Bentham and Hooker (1862-1883), Bessey (1915), Hutchinson (1954-1960), Cronquist (1981) and APG IV (2016) - merits and demerits. ICN- history, principles, typification, principles of priority and their limitations, effective and valid publication, author citation, retention, choice and rejection of names, names of hybrids. Herbarium and its potential role in teaching and research

UNIT II **(21 HOURS)**

Taxonomic databases (TROPICOS, IPNI and POWO). Taxonomic tools - flora, monograph, revisions, icons and journals. Keys - dichotomous keys and their uses. Botanic gardens. Sources of taxonomic information- embryology, cytology, chemotaxonomy. RET species-India, Tamil Nadu and IUCN criteria, 2012.

UNIT III **(21 HOURS)**

Description and economic importance of the following families - Menispermaceae, Polygalaceae, Portulacaceae, Oxalidaceae, Tiliaceae, Zygophyllaceae, Meliaceae, Vitaceae, Rhamnaceae, Sapindaceae, Rosaceae, Combretaceae, Lythraceae, Passifloraceae and Aizoaceae.

22PBO307

UNIT IV **(21 HOURS)**

Description and economic importance of the following families - Oleaceae, Asclepiadaceae, Convolvulaceae, Boraginaceae, Bignoniaceae, Pedaliaceae, Nyctaginaceae, Aristolochiaceae, Chloranthaceae, Moraceae, Orchidaceae, Dioscoreaceae, Commelinaceae, Araceae and Cyperaceae.

UNIT V **(21 HOURS)**

Biosystematics- aim and scope. Biosystematics categories. Phenotypic plasticity. Turreson's work. Population concept, speciation. Species and genus concept. Numerical taxonomy, molecular taxonomy (RFLP, RAPD and DNA Bar coding). Evolutionary relationship among Angiospermic taxa*.

*** Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. O.P. Sharma, (1986). Plant taxonomy -Rastogi Publications, New Delhi.
2. V.V. Sivarajan, (1986). Introduction to principles of plant taxonomy. Oxford & IBH Pvt. Company.
3. N.S. Subramaniam, (1997). Modern plant taxonomy. Vikas Publishing House, New Delhi.
4. B.K. Verma, (2010). Introduction to Taxonomy of Angiosperms, Prentice-Hall of India Pvt. Ltd., Delhi
5. O.P. Sharma, (2017). Plant Taxonomy. Mc Graw Hill Education, New York.
6. N.B. Saxena and Shamindra Saxena (2019). Pragati Prakashan, Meerut

REFERENCES

1. H.M. Lawrence, (1951). Taxonomy of vascular plants. Macmillan & Co.
2. S.K. Jain and R.R. Rao. (1977). A hand book of field and herbarium methods. Today & Tomorrow Pvt. Ltd.
3. H.N. Henry and Chandra Bose. (1982). An aid to the International code of Botanical nomenclature. BSI, Calcutta.
4. V.N. Naik,(1984). Taxonomy of Angiosperms. TATA Mc Graw Hill, New Delhi.
5. S.S.R. Bennet, (1986). An introduction to plant nomenclature. International Book Distribution India.
6. B.P. Pandey, B.P. (1997). Taxonomy of angiosperms. Chand & Co. Ltd., New Delhi.
7. R.Vasudevan Nair, (1997). Taxonomy ofangiosperms. APH Publishing Corporation, New Delhi.
8. Gurcharan Singh. (2004). Plant systematic - theory and practices. Oxford and IBH Publishers, New Delhi.

PBO32

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	S	S
CO2	H	S	H	M	S
CO3	S	S	M	H	H
CO4	S	H	H	H	M
CO5	S	H	M	H	S

S - Strong **H** - High **M** - Medium **L** - Low

22PBO308

Programme Code: 05	**M.Sc., BOTANY**			
Core Paper 8: MICROBIOLOGY AND PLANT PATHOLOGY				
Batch **2022-2023**	**Semester** **III**	**Hours / Week** **7**	**Total Hours** **105**	**Credits** **4**

COURSE OBJECTIVES

- To disseminate knowledge on pathogenic group of organisms.
- To gain knowledge on disease management.
- To analyze the quality of water.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Recognize evolutionary relationships of microorganisms through various classifications.
	CO2	Understand the techniques of isolation and culture of microorganisms.
	CO3	Apply recent technologies and methods for the cultivation of microorganisms.
	CO4	Acquire knowledge on various plant diseases and their control measures
	CO5	Implement the plant disease management techniques in the fields.

SYLLABUS

UNIT I **(21 HOURS)**

Introduction to microbiology: Historical account, Scope of microbiology, major groups and classification - five kingdom concept and three domain system. Prokaryotic and Eukaryotic organisms. Bacteria: morphology, classification (Bergey's manual), ultrastructure, chemical composition of cell wall. Bacterial reproduction - conjugation, transformation and transduction. Culture methods - pour plate, spread plate, streak plate and stab inoculation. Bacterial growth curve.

UNIT II **(21 HOURS)**

Classification of plant viruses (outline only). General morphology and symmetrical structures of viruses. Morphology of Bacteriophages (T - types). Ultrastructure of TMV and HIV. Viral replication - lytic and lysogenic cycles in T- even phages. Isolation and purification of viruses.

UNIT III **(21 HOURS)**

Fermentation: Aerobic and Anaerobic fermentation*. Industrial production of Antibiotics - penicillin; Enzyme - amylase, Organic acid - lactic acid, Biofuel - ethanol. Biopolymer - PHB; Microbial cell - Baker's yeast. Waste water treatment, detection of coliform bacteria - membrane filtration technique, multiple tube fermentation test. Milk microbiology - chemical composition of milk, microbes in milk.

22PBO308

UNIT IV **(21 HOURS)**

Plant Pathology: History of Plant Pathology - Physiological functions. Effect of pathogens on plants Classification and factors responsible for plant diseases, concepts in epidemiology - Koch's postulates - host parasite interactions, genetic basis of disease resistance and pathogenicity - structural, physiological and biochemical defense mechanism in hosts, dissemination of diseases - integrated disease management.

UNIT V **(21 HOURS)**

Common plant diseases of India - symptoms, causal organisms and control measures of Red rust of Tea, Red Rot of Sugarcane, Late blight of Potato, Powdery mildew of Grapes, Black rust of Wheat, Bacterial Blight disease of Paddy, Bunchy top of Banana - general principles of plant quarantine - sanitary and phytosanitary issues - Protection of Plant Varieties (PPV) - genetically modified varieties.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. J. Michael, Pelczar, E.C.S. Chan and Noel R. Krieg (2008). 'Microbiology' 5th edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
2. R.C. Dubey and D.K. Maheshari (2005). A Text Book of Microbiology' S. Chand and Company Limited, New Delhi.
3. L.M. Prescott, J.P. Harley and D.A. Klien, (1996). Microbiology (3rd ed.), Brown W.C. Publishers, Boston, USA.
4. K.S. Bilgrami and H.C. Dube, (1990). A text book of modern plant pathology, Vikas Publishing House Pvt. Ltd., New Delhi.
5. R.S. Mehrota, (1994). Plant Pathology, Tata Mc. Graw Hill Publishing Co. Ltd., New Delhi.
6. K.R. Aneja, Pranzy Jain and Raman Areja (2018). A text Book of Basic and Applied Microbiology. New Age International Publishers, New Delhi.
7. Alexander N. Glazer and Hiroshi Nikzido. (2007).Microbial Biotechnology, Second Edition. Cambridge University Press, UK.

REFERENCES

1. S.B. Sullia and S. Shantharam, (1998). General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. J.M. Jay, (1983). Modern Food Microbiology, CBS Publishers, New Delhi.
3. G. Reed, (1983). Prescott & Dunn's Industrial Microbiology (4th ed.), AVI publishing Co., Connecticut, USA.
4. H.B.Schegel, (1986). General Microbiology (6th ed.), Cambridge University Press, UK.
5. R.S. Singh, (1990). Plant diseases (6th ed.) Oxford and IBH, New Delhi.
6. P.C. Trivedi, Sonali Pandey, Seema Bhadauria (2010). Text book of microbiology. Azuhker publishers, Distributers, Jaipur, India.

PBO35

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	L	S	H
CO2	H	H	S	M	S
CO3	H	M	H	H	M
CO4	S	H	M	H	H
CO5	H	M	S	H	H

S - Strong **H** - High **M** - Medium **L** - Low

22PBO309

Programme Code: 05	**M.Sc., BOTANY**			
Core Paper 9: PLANT BIOTECHNOLOGY				
Batch **2022-2023**	**Semester** **III**	**Hours / Week** **6**	**Total Hours** **90**	**Credits** **4**

COURSE OBJECTIVES

- To study the basic of plant genome and tissue culture techniques
- To equip students with theoretical knowledge regarding the techniques and applications of Plant Biotechnology and Genetic Engineering
- To help students to get a career in Industry/R&D/Academic

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Describe the genome organizations in plants
↑	CO2	Work on plant cell and tissue culture systems
↕	CO3	Explain the genetic transformation techniques in plants
↕	CO4	Utilize the applications of genetic transformation techniques in plants
K5	CO5	Analyze and evaluate the importance of metabolic engineering and molecular farming technology in plants

SYLLABUS

UNIT I **(18 HOURS)**

Introduction to plant biotechnology- Scope and importance, **Genome organization:** Nucleus, Chloroplast and Mitochondria. Molecular Markers: RFLP, RAPD, AFLP and Microsatellites (SSR/STR). Model Plant: *Arabidopsis* and Tobacco

UNIT II **(18 HOURS)**

Plant cell and tissue culture: Tissue culture media- MS, B5, Knudson C and Whites (composition and preparation), Plant growth regulators, Micropropagation, Callus culture (Organogenesis), Cell culture - single cell and suspension culture, Somatic embryogenesis and Artificial seeds, Protoplast culture - isolation, somatic hybridization, Haploid production: anther and pollen culture, Somaclonal variation.

UNIT III **(18 HOURS)**

Genetic transformation and vectors: *Agrobacterium* characteristics; Ti and Ri plasmids and mechanism of T-DNA transfer, Physical and chemical methods of gene transfer, Binary and cointegrate vector systems. CaMV and Gemini viruses, Marker genes and Gene silencing. Chloroplast transformation.

UNIT IV **(18 HOURS)**

Application of plant transformation: Nutraceuticals-Golden Rice and Flavr Savr, herbicide resistance- EPSP and Glyphosate , Biotic stress resistance-bacteria, virus, fungi and insect. Abiotic stress resistance- drought, cold and salt. Terminator technology and Marker free transgenics.

22PBO309

UNIT V (18 HOURS)

Plant molecular farming and metabolic engineering: Plantibodies, Biodegradable plastics and edible vaccines. Metabolic engineering for plant secondary metabolites - introduction, alkaloid, terpenoid and flavonoid biosynthesis.

***Self study**

Teaching Methods

PowerPoint presentation/Quiz/Discussion/Assignment

TEXTBOOKS

1. H.S. Chawla, (2002). Introduction to Plant Biotechnology. 2nd Edition, Science Publishers, Inc., Enfield, NH, USA.
2. M.K. Razdan, (2003). Introduction to Plant Tissue Culture. 2nd Edition, Science Publishers, Inc., Enfield, NH, USA.
3. Kalyan Kumar De. (2004). An Introduction to Plant Tissue Culture.2008. New Central Book Agency, Kolkata.
4. R.C. Dubey, (2013). A text book of Biotechnology (Revised Edition), S. Chand & Company Ltd. New Delhi

REFERENCES

1. Buchanan, Gruissem and Jones.2000. Biochemistry and Molecular Biology of Plants. John Wiley & Sons, UK.
2. H.S. Chawla, (2000). Introduction to Plant Biotechnology, Science Publishers.
3. Kirsi-Marja Oksman-Caldentey, (2002). Plant Biotechnology and Transgenic Plants. 1st Edition. CRC Press.
4. Paul Christou, Harry Klee, (2004). Handbook of Plant Biotechnology. John Wiley and Sons.
5. S.B. Primrose and R. Twyman, (2006). Principles of Gene Manipulation and Genomics. 7th Edition, Blackwell Publishing, Malden, MA, USA.
6. Slater, Scott and Fowler, (2008). Plant Biotechnology, 2nd Edition, Oxford University Press.
7. Neal Stewart, (2016). Plant Biotechnology and Genetics: Principles, Techniques, and Applications, 2nd Edition. Wiley Publications.
8. S. Umesha, (2019). Plant Biotechnology.CRC Press.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	M	H	S
CO2	S	S	H	S	M
CO3	H	M	S	H	H
CO4	H	H	S	M	S
CO5	H	S	S	S	M

S - Strong **H** - High **M** - Medium **L** - Low

22PBO3CN

Programme Code: 05		**M.Sc., BOTANY**		
Core Practical 3: TAXONOMY, BIOSYSTEMATICS, MICROBIOLOGY, PLANT PATHOLOGYAND PLANTBIOTECHNOLOGY				
Batch 2022-2023	**Semester III**	**Hours / Week 4**	**Total Hours 60**	**Credits 2**

COURSE OBJECTIVES

- To identify selected taxa using taxonomic keys.
- To understand the pathogenic organisms causing various diseases.
- To learn the basic techniques of plant biotechnology

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K3 ↕ K5	CO1	Acquire knowledge on identification of flowering plants using taxonomic keys and learn about the methods and preparation of herbarium
	CO2	Analyze techniques used for cultivation of microorganisms
	CO3	Explore knowledge on disease causing microorganisms and their control measures
	CO4	Gain the hands-on exposure on plant cell and tissue culture and molecular techniques
	CO5	Work on various aspects of plant biotechnology

I. TAXONOMY AND BIOSYSTEMATICS

1. Identification of plant specimens with reference to their families prescribed in the syllabus following Bentham & Hookers system of classification
2. Identification of economically important products with reference to their plant name and family
3. Technical description of plant parts, including floral parts L.S. of flower, floral diagram and floral formula with reference to the families mentioned in the theory
4. Preparation of dichotomous keys
5. Field visit to nearby floristic regions for the study of flora
6. Submission of 50 herbarium sheets (relevant to syllabi) with field notes for internal and external valuation

II. MICROBIOLOGY AND PLANT PATHOLOGY

1. Culture of microbes using serial dilution and pure culture techniques.
2. Isolation of microbes by pour plate, spread plate and streak plate methods.
3. Hydrogen sulphide test.
4. Methylene blue reductase test for milk.
5. Mobility by Hanging drop method.
6. Isolation of Acetobacter from soil.
7. Lab level production of wine.
8. Differential staining of bacteria using Gram stain.
9. Antimicrobial assay - disc - diffusion / agar well method.
10. Book photographs/diagrams: morphology - bacteria, viruses, media, serial dilution methods and any tools used in microbiology.
11. Books / Photographs/ diagrams of plant diseases mentioned in theory

22PBO3CN

III. PLANT BIOTECHNOLOGY

1. Preparation of MS medium and sterilization
2. Micropropagation-Nodal culture
3. Callus culture
4. Artificial seed preparation and culture
5. Isolation of plant genomic DNA
6. Polymerase Chain Reaction
7. Genetic Transformation

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	M	H
CO2	H	S	M	H	H
CO3	S	M	H	H	M
CO4	S	H	S	H	S
CO5	S	H	M	S	M

S - Strong **H** - High **M** - Medium **L** – Low

22PBO3CN

KONGUNADU ARTS AND SCIENCE COLLEGE (Autonomous)
COIMBATORE - 641 029

PG MODEL QUESTION PAPER (PRACTICALS)
End of Semester Examination Question Paper Pattern
(For the candidates admitted from the academic year 2022-2023 onwards)

Time: 4 Hours **Max. Marks: 50 Marks**

BREAK UP OF MARKS

Core Practical: 3 – TAXONOMY, BIOSYSTEMATICS, MICROBIOLOGY, PLANT PATHOLOGY AND PLANT BIOTECHNOLOGY

I.	Specimen identification (2 × 3)	06 Marks
II.	Identification of the family (4 × 2)	08 Marks
III.	Key preparation	04 Marks
IV.	Microbiology Experiment	06 Marks
V.	Biotechnology Experiment	06 Marks
VI.	Spotters (5 ×2)	10 Marks
VII.	Herbarium	05 Marks
	Record	05 Marks
	Total	**50 Marks**

22PBO410

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper: 10 – BIOPHYSICS AND BIOCHEMISTRY				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2021-2022	**IV**	**7**	**105**	**4**

COURSE OBJECTIVES

- To understand the role of electrons in absorption of light and to impart knowledge on bioenergetics of living organisms
- To know the biological importance of the macromolecules
- To learn about the hormones and vitamins and their roles

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Acquire knowledge on electromagnetic spectrum.
↕	CO2	Able to learn on energy production in cell
↕	CO3	Impart knowledge on types and functions of carbohydrates and lipids
↕	CO4	Provide knowledge on key macro molecules and carry instructions for the functioning of the cell
K5	CO5	Understand the importance of enzymes and their mode of action

SYLLABUS

UNIT I **(21 HOURS)**

Electromagnetic radiation - Nature, absorption, absorption spectrum and action spectrum, law of absorption, interaction with matter, role of electrons in absorption of light, electron multiplicity. Excitation, de-excitation and path of de-excited electrons. Bioluminescence, Fluorescence and Phosphorescence.

UNIT II **(21 HOURS)**

Bioenergetics - Energy and work, laws of Thermodynamics. Energy transductions in biological systems - Redox couple, redox potential, ATP bioenergetics, NADP/NAPH redox couple, mitochondrial bioenergetics and chloroplast bioenergetics.

UNIT III **(21 HOURS)**

Carbohydrates: Introduction to carbohydrates – classification and properties - monosaccharides, oligosaccharides and polysaccharides. Linear/ open chain and ring forms of monosaccharides. Isomerism, structural and functional polysaccharides. Biosynthesis of carbohydrate and their regulation. **Lipids:** Classification and properties - simple, complex and derived lipids - fatty acids - types - nomenclature - isomerism - Biosynthesis of fatty acids, fatty acid oxidation (α and β - oxidation)

UNIT IV **(21 HOURS)**

Aminoacids: General structure - optical isomerism - classification (based on side chain and polarity) - properties - nonprotein aminoacids- Biosynthesis of aminoacids. **Proteins:** Introduction - structure and configuration of proteins - different bonding systems - classification of proteins based on chemical nature and solubility - properties - denaturation. **Nucleic acids**: Nitrogenous bases- purine and pyrimidine biosynthesis, DNA and RNA-structure and types. Biosynthesis of nucleotides

22PBO410

UNIT V **(21 HOURS)**

Enzymes: Introduction to enzymes – classification, chemical nature and properties, theories of enzyme action, enzyme inhibitors and factors affecting enzyme activity, Michael - Menton's constant, coenzyme - FAD, NAD **Vitamins:** Classification - chemical structure and biochemical properties of vitamins A, D, E and K and B complex.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. M. Daniel, (1989). Basic Biophysics for Biologists, Agro-Botanical Publishers, Bikaner, India.
2. H.S. Srivastava, (1999). Elements of Biochemistry. Rastogi publications, Meerut.
3. P. Asokan, (2002). Analytical Biochemistry (Biochemical Techniques). Chinna Publications, Chennai.
4. S. Palanisamy, (2008). Principles of biophysics, Palani Paramount Publications
5. S. Thiraviyaraj, (2009). Biophysics. Saras Publications, Nagercoil, Tamilnadu.
6. K.L. Janin, Sunjay Jain and Nitin Jain, (2009). Fundamentals of Biochemistry, S.Chand and Company Ltd, New Delhi.
7. L. Veerakumari, (2015). Bioinstrumentation. MJP Publishers,Chennai-600005, Tamilnadu, India

REFERENCES

1. L. Albert, Lehninger (1984). Principles of Biochemistry. ICAR, Delhi.
2. J.H.Weel, (1990). General Biochemistry. Wiley Eastern Ltd.
3. Zubay, (1995). Biochemistry, Brown Publishers.
4. Voet and Voet, (2000). Fundamentals of Biochemistry, John Wiley, New York.
5. K. Wilson and J. Walker, (2000). Principles and Techniques of Practical Biochemistry, 5th edition, Cambridge University Press, Cambridge.
6. L. Stryer, (2002). Biochemistry,W.H. Freeman.
7. V. Satyanarayana, (2005). Essentials of Biochemistry. Arunabha Sen & Allied Pvt., Ltd
8. P. Narayanan, (2007). Essentials of Biophysics. Second Edition. New Age International Publishers

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	S	M
CO2	L	H	M	H	H
CO3	S	H	S	M	S
CO4	S	M	M	S	L
CO5	S	H	M	S	H

S - Strong **H** - High **M** - Medium **L** – Low

22PBO411

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper 11: PLANT PHYSIOLOGY				
Batch **2022-2023**	**Semester** **IV**	**Hours / Week** **7**	**Total Hours** **105**	**Credits** **5**

COURSE OBJECTIVES

- To study the basic physiological functions of plants.
- To learn about the metabolic pathways in plants.
- To understand the importance of phytohormones in the growth of plants.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Acquire knowledge on plant - water relations in a plant cell
	CO2	Understand the significance of metabolic pathways in plants.
	CO3	Acquire knowledge in terms of pathways of photosynthesis, respiration and nitrogen metabolism in higher plants
	CO4	Assess stress resistance mechanism for the better yield of crops.
	CO5	Apply acquired knowledge on phytohormones and their applications in fruit ripening process.

SYLLABUS

UNIT I **(21 HOURS)**

Water relations - Structure and properties of water. Water transport - diffusion, osmosis and imbibition, water potential. Absorption of water, active and passive absorption. Water relations of plants – Structure and Physicochemical properties of water, soil and plant atmosphere, stomatal physiology and regulation.

UNIT II **(21 HOURS)**

Transpiration - types, mechanism and factors affecting transpiration. Ascent of sap* - theories, mechanism and factors influencing on ascent of sap. Mineral salt absorption - mechanism and types. Translocation of organic solutes - mechanism, phloem loading and unloading and factors affecting translocation.

UNIT III **(21 HOURS)**

Mechanism of photosynthesis - Light reaction, Carbon fixation in C_3 & C_4 plants. Outline of CAM pathway. Photorespiration, Respiration, Glycolysis, Krebs cycle & Pentose phosphate pathway, ATPase and Mechanism of ATP synthesis. Biological Nitrogen Fixation - Symbiotic & Non-Symbiotic.

UNIT IV **(21 HOURS)**

Stress physiology - Classification of stress - abiotic and biotic stress factors. Stress effects - morphological, biochemical, physiological changes, associated with stress due to heat, water, salinity and metal. Stress resistance and mechanism.

22PBO411

UNIT V **(21 HOURS)**

Phytohormones - Fruit ripening - Introduction, Climacteric and non-climacteric fruits, Role of ethylene in fruit ripening, symptoms of fruit ripening. Environmental control of fruit ripening. Circadian rhythms-Biological clock. Plant movements-nastic and Tropic movements, Photomorphogenesis - Phytochrome and Cryptochrome response in plants.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. V. K. Jain. (1999). Fundamentals of Plant Physiology. S. Chand and Company Ltd, New Delhi.
2. V. Verma, (2001). Plant physiology. Emkay Publication, New Delhi.
3. S.N. Pandey and BK. Sinha. (2011). Plant Physiology. Vikas Publishing House Pvt Ltd., New Delhi
4. S.K. Sinha, (2004). Modern Plant Physiology, Narosa Publishing House, New Delhi, Chennai
5. S. Mukeuji S and AK. Ghosn, (1996). Plant Physiology. Tata McGraw – Hill Publishing Company Ltd., New Delhi

REFERENCES

1. R.E. Devlein, (1986). Plant Physiology. CBS Publishers and Distributors, New Delhi.
2. H.S. Srivastava, & N. Shankar. (2005). Plant physiology & Biochemistry. Rastogi publications, Meerut.
3. G. Ray Noggle and George J. Fritz. (2002). Introductory plant Physiology. Prentice Hall of India, Pvt., Ltd., New Delhi.
4. D. Hess, (1975). Plant Physiology. Narosa Publishing house, New Delhi.
5. E.J. Hewilt and C.V. Cutting, (1979). Nitrogen Metabolism in Plants. Academic Press London.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	S	M	L
CO2	H	M	H	H	H
CO3	S	M	H	S	S
CO4	S	S	S	H	M
CO5	S	S	M	H	M

S - Strong **H** - High **M** - Medium **L** – Low

22PBO412

Programme Code: 05		**M.Sc., BOTANY**		
Core Paper 12: BIOINSTRUMENTATION AND RESEARCH METHODOLOGY				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**IV**	**6**	**90**	**4**

COURSE OBJECTIVES

- To seed the basic knowledge about instruments
- To make students understand the applications of instruments in Botany
- To train the students handle and maintain instruments
- To understand basic concepts of research and its methodologies
- To identify appropriate research topics

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Inculcate the working principles of biological instruments
	CO2	Acquire knowledge on separation and identification of compounds based on chromatographic techniques
	CO3	To know basic principle for the separation of DNA, RNA and protein molecules
	CO4	Demonstrate knowledge of Research Processes and Perform literature reviews using print and online databases
	CO5	Identify, Explain, compare and prepare key elements of a research proposal/report

SYLLABUS

UNIT I **(18 HOURS)**

Principle, working mechanism, types and applications: pH meter, Microscopy - light and electron, Centrifugation, Autoclave and Laminar air flow chamber. Principle, working mechanism and applications: Colorimetry*, UV-visible spectrophotometry, Flourimetry and Flame photometry. Biophotometer and microplate reader.

UNIT II **(18 HOURS)**

Principle, working mechanism and applications: Paper chromatography*, Thin layer chromatography (TLC), Column chromatography, Ion exchange chromatography, Molecular exclusion chromatography, Affinity chromatography, High performance liquid chromatography (HPLC) and Gas chromatography (GC). Lyophilization.

UNIT III **(18 HOURS)**

Distillation and its types, Soxhlet apparatus, Clevenger apparatus, Sonicator, Rotary vacuum evaporator and Magnetic stirrer. Principle, working mechanism and applications: Agarose gel electrophoresis (AGE), Polyacrylamide gel electrophoresis (PAGE), Immunoelectrophoresis, Capillary electrophoresis. PCR and its types and Gel documentation system.

22PBO412

UNIT IV **(18 HOURS)**

Introduction to Research methodology Definition and Objectives of Research, Research Methodology – Process of research and its criteria, Elements of Research and Importance of Research methodology. Types of Research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Concept of applied and Basic research process, Criteria of good research.

UNIT V **(18 HOURS)**

Literature collection and Database – Structure and Preparation of thesis, Bibliography, Reference management Software, Scientific paper writing, Manuscript types, Preparation, Submission and Proof correction –Presentation of research findings in conferences - Ethical issues in publications - Plagiarism and Self-Plagiarism, Software for detection of Plagiarism, Journal Impact Factor and Paper Citation Index, UGC CARE list journals, Preparation of grant proposals – Major research funding agencies in India

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. K.R. Sharma, (2002). Research methodology .National publishing house, Jaipur and NewDelhi.
2. B.K. Sharma, (2005). Instrumental Methods of Chemical analysis. 24th Revised Edition, Goel Publishing House, Meerut.
3. John. G. Webster. (2007). Bioinstrumentation. Wiley Student Edition, India
4. L. Veerakumari, (2009). Bioinstrumentation. MJP Publishers, New Delhi, India
5. M.H. Fulekar and Bhawana Pandey. (2013). Bioinstrumentation. International Publishing House Pvt Ltd.
6. R. Kumar, (2014). Research Methodology: A step by step guide for Beginners. SAGE Publications India Pvt. Ltd., New Delhi.
7. N. Arumugam and V. Kumaresan (2015). Biophysics and Bioinstrumentation.Saras Publication.
8. C.R. Kothari, and G. Garg, (2018). Research methodology – methods and techniques. New Age International Publishers, Kochi

REFERENCES

1. Clifford D Ferris.(1978). Introduction to Bioinstrumentation. Humana Press.
2. Connor and Peter wood ford. (1979). Writing scientific papers in English. Pitman Medical Publishing Company, London.
3. Richard Normann. (1988). Principles of Bioinstrumentation. Wiley Publications.
4. Skoog and Leary. (1992). Principles of Instrumental analysis, 4th Edition. Saunder's College Publishing, New York.
5. R.A. Day,(1994). How to write and publish a scientific paper. Cambridge University Press, London.

6. Holme and Peck. (1998). Analytical Biochemistry, 3rd Edition, Pearson Education Ltd, Essex, England
7. K. Wilson and J. Walker (2000). Principles and Techniques of Practical Biochemistry, 5th edition, Cambridge University Press, Cambridge.
8. John Denis Enderle. (2006). Bioinstrumentation. Morgan & Claypool Publishers.
9. John G. Webster.(2008). Bioinstrumentation. Wiley India Edition. India
10. M.J. Reilly, (2018). Bioinstrumentation. CBS Publishers and Distributors Pvt Ltd, India.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	S	M	L
CO2	H	M	H	H	H
CO3	S	M	H	S	S
CO4	S	S	S	H	M
CO5	S	S	M	H	M

S - Strong **H** - High **M** - Medium **L** – Low

22PBO4CO

Programme Code: 05	**M.Sc., BOTANY**			
Core Practical 4 - BIOPHYSICS, BIOCHEMISTRY, PLANT PHYSIOLOGY, BIOINSTRUMENTATION AND RESEARCH METHODOLOGY				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**IV**	**4**	**60**	**2**

COURSE OBJECTIVES

- To learn the significance of EMR and spectrum
- To quantify the biochemical contents present in a given plant sample.
- To obtain knowledge on physiological functions of the plants.
- To utilize the applications of instruments for biochemical studies

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K3 ↕ K5	CO1	Provide knowledge on the concepts and principles of radioactive emissions
	CO2	Apply principles and procedures for the estimation of macromolecules in plant samples.
	CO3	Study the physiological process of plants
	CO4	Handle instruments for biophysics and biochemical practical's
	CO5	Able to utilize protocols for research process

LIST OF PRACTICALS

I. BIOPHYSICS

1. Nature of EMR and Spectrum (Demo)
2. Path of de-excitation - Fluorescence, Phosphorescence (Demo)

II. BIOCHEMISTRY

1. Preparation of phosphate & citrate buffers
2. Estimation of carbohydrates, proteins, amino acids & lipids
3. Preparation of molal, molar, normal and percentage solutions
4. Estimation of Vitamin C
5. Estimation of DNA and RNA
6. Total RNA isolation

III. PLANT PHYSIOLOGY

1. Measurement of stomatal index and frequency.
2. Measurement of membrane permeability as affected by pH, chemicals and temperature.
3. Separation of photosynthetic pigments by TLC.

4. Estimation of chlorophyll pigments.
5. Measurement of Hill reaction in the chloroplast suspension.
6. Measurement of the rate of photosynthesis under varying condition of CO_2 concentration.
7. Rate of respiration in flower buds/germinated seeds using simple respiroscope.
8. Determine the rate of transpiration using Ganong's potometer.
9. Determination of water absorption and transpiration ratio.
10. Nitrogen fixation through nodule formation in leguminous plants.
11. Solution culture.

IV. BIOINSTRUMENTATION

1. Haemocytometer
2. pH meter
3. UV - visible spectrophotometer
4. Centrifuge
5. Lyophilizer (Demo)
6. HPLC (Demo)

V. RESEARCH METHODOLOGY

1. Prepare the structure of manuscripts
2. Reference management tool – Mendeley
3. Plagiarism management tool - Dupli Checker and Plagiarism Checker
4. Prepare the proposal format of UGC, DST-SERB and DBT schemes
5. Indexing and Abstracting of the Journals

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	S	M	S
CO2	S	M	H	S	H
CO3	H	H	M	H	H
CO4	H	S	S	M	S
CO5	S	H	M	S	S

S - Strong **H** - High **M** - Medium **L** - Low

22PBO4CO

KONGUNADU ARTS AND SCIENCE COLLEGE (Autonomous)
COIMBATORE - 641 029

PG MODEL QUESTION PAPER (PRACTICALS)
End of Semester Examination Question Paper Pattern
(For the candidates admitted from the academic year 2022-2023 onwards)

Time: 4 Hours **Max. Marks: 50 Marks**

BREAK UP OF MARKS

Core Practical: 4 - BIOPHYSICS, BIOCHEMISTRY, PLANT PHYSIOLOGY BIOINSTRUMENTATION AND RESEARCH METHODOLOGY

I. Explain the principle of Biophysics - A	**- 05 Marks**
II. Biochemistry Experiment- B	**- 08 Marks**
III. Plant Physiology Experiment- C	**- 08 Marks**
IV. Bioinstrumentation Experiment – D	**- 08 Marks**
V. Research Methodology Experiment - E	**- 06 Marks**
VI. Spotters F, G, H , I & J (5 × 2)	**- 10 Marks**
Record	**- 05 Marks**
TOTAL	**50 Marks**

PBO51

22PBO4Z1

Programme Code: 05		**M.Sc., BOTANY**		
PROJECT & VIVA – VOCE				
Batch **2022-2023**	**Semester** **IV**	**Hours / Week** **2**	**Total Hours** **30**	**Credits** **5**

COURSE OBJECTIVES

- To acquire inherent knowledge and exposures on relevant practical problems in various fields.
- To execute appropriate analytical skills and skills sets on selected problems.
- To impart insight knowledge on problem solving skills and their proper execution

COURSE OUTCOME

On successful completion of the project work, the students will be able to

K3 ↕ K5	CO1	Applying theoretical knowledge in the real field of research
	CO2	Analyzing the importance of tasks in collecting the datas
	CO3	Evaluating relationships existing between theories and experiments
	CO4	Provide problem solving skills on selected problems in any disciplines of plant sciences
	CO5	Executing appropriate statistical tools and interpretation of appropriate results

Individual project work will be allotted to individual students under the supervision and guidance of the Faculty members during IV Semester. Project works will be given based on the various fields of specialization of the supervisors under whom the students are allotted. They are allotted based on the lot system. The fields of specialization are Systematic Botany, Microbiology and Plant Pathology, Medicobotany & Ecology and Conservation Biology. The students shall do their projects under their supervisors and submit their dissertations at the end of IV Semester. Both the Internal and External Examiners shall jointly evaluate the project reports submitted by the students and marks will be awarded on the basis as mentioned below.

Guidelines for the Distribution of Marks:

CIA	Project Review	45	**50**
	Regularity	05	
ESE	Project Report Present	35	**50**
	Viva – Voce	15	
	Grand Total		**100**

MAPPING

PSO / CO	**PSO1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	H	S	M	S
CO2	S	M	H	S	H
CO3	H	H	M	H	H
CO4	S	H	S	S	H
CO5	S	H	S	H	H

S - Strong **H** - High **M** - Medium **L** - Low

MAJOR ELECTIVE PAPERS

PBO53

Programme Code: 05	M.Sc., BOTANY		
	Major Elective 1: FOREST RESOURCES AND CONSERVATION		
Batch 2022-2023	**Hours / Week** 5	**Total Hours** 75	**Credits** 5

COURSE OBJECTIVES

- To understand the importance and value of trees.
- To learn the revenue sources of forests.
- To grasp various products derived from forests for the betterment of human beings.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Recognize the forest cover in India and their deterioration.
K2	CO2	Understand the significance of forest and climate change for the enhancement of environmental quality.
K3	CO3	Apply inherit knowledge on major and minor forest produce for the betterment of human welfare.
K4	CO4	Analyze forest based products and their varied applications.
K5	CO5	Implement acquired knowledge on conservation of bioresources.

SYLLABUS

UNIT I **(15 HOURS)**

Forest cover and national status. Factors for the deterioration of forest cover. Major forest types in India-Nature and Manmade (Miyawaki), Forest and climate, forest as carbon sink, forest and water, forest and soil, forest and air.

UNIT II **(15 HOURS)**

Major forest products- Timber, charcoal. Minor forest products resource of fibers and flosses, bamboos and canes, essential oils, including those from grasses, Tannins and dyes, gums , resins and oleo resins, drugs, spices, poisons and insecticides, edible products , minerals and miscellaneous products.

UNIT III **(15 HOURS)**

Forest industries- composite wood industries, match industry, Pulp and paper industry, furniture and other timber utilizing industries. Industries utilizing forest products resins.

UNIT IV **(15 HOURS)**

Conservation and plantation forestry - reserve forests, commercial forestry, social forestry, Joint forest management and tribology: agro forestry and energy plantations. Biomass conversion - technologies - pyrolysis* and gasification for thermal and electric applications.

UNIT V **(15 HOURS)**

Protection of Forest and Forest Law in India**:** Community based conservation approach, The Indian forest Act, 1927, The Forest (Conservation) Act, 1980 and The Forest (Conservation) Rules, 1981,2003, Laws Concerning Forest :Forest Right Act, 2006; International Laws and Policies Concerning Biodiversity; Gaps in Present Laws and Polices with respect to Biodiversity Conservation.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. V.B. Sharma, (1998). Trees and Environment. APH Publishing Corporation, New Delhi.
2. K.P. Sagreiya,(1994). Forests and Forestry. National book Trust, India, New Delhi.
3. S.S Negi, (2002). Forest products and their utilization. International book distributiors, 9/3 Rajpur road, Dehradun.
4. Tribhawan Mehta, (1981). A hand book of Forest Utilization. Periodical Expert Book Agency. New Delhi.
5. P.K.R. Mair (1993). An Introduction to Agroforestry, Kluwar Academic Publishers, London

REFERENCES

1. N.S. Subrahmanyam and A.V.S.S. Sambamurty. (2004). Ecology. Narosa Publishing House. New Delhi.
2. P.D. Sharma (2004). Ecology and Environment. Rastogi Publications, Meerut.
3. Arvind Kumar. (2004). Biodiversity and Environment. APH Publishing Corporation, New Delhi.
4. M.P. Singh and Vinita Vishwakarma. (1997). Forest Environment and Biodiversity. Daya Publishing House, New Delhi.
5. L. Devereburton (2013). Introduction to Forestry Science. Delmar cengage Learning
6. Fergus L. Sinclair. (1995). Agroforestry: Science, Policy and Practice. Kluwar Academic Publishers, London
7. P.K.R. Nair, M.R. Rao and Buck, L.E (2004). Advances in Agroforestry. Kluwar Academic Publishers, London
8. L.G. Donald, P. Bettinger and S. Jacek (2012). Introduction to forestry and Natural Resources. Academic Press, Cambridge.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	H	M
CO2	S	H	H	M	H
CO3	H	M	S	M	S
CO4	S	S	H	H	M
CO5	H	M	S	M	S

S - Strong **H** - High **M** - Medium **L** - Low

PBO55

Programme Code: 05	M.Sc., BOTANY		
	Major Elective: 2 - SEED TECHNOLOGY		
Batch 2022-2023	Hours / Week 5	Total Hours 75	Credits 5

COURSE OBJECTIVES

- To understand the principles of agronomy of seeds.
- To learn the methodology of seed germination, seed drying and seed treatments.
- To know the seed dormancy and their significance

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Recognize seed borne diseases due to genetic constitution and storage of seeds.
↕	CO2	To acquaint the students with principles and practices of seed health testing and management of seed borne diseases
	CO3	To impact knowledge on principles and techniques of seed processing for quality upgradation and storage for maintenance of seed quality.
K5	CO4	Assess various feasible seed treatment and marketing strategies for various crop plants.
	CO5	Evaluate various methods of breaking seed dormancy.

SYLLABUS

UNIT I **(15 HOURS)**

Seed- Characteristics, importance, Differences between seed, grain and their production. Seed technology- Definition, objectives, Scope and importance. Indian Seed industry. Principles of seed production - Genetic principles – Deterioration of crop varieties and their control, Maintenance of genetic purity during seed production. Agronomic principles.

UNIT II **(15 HOURS)**

Seed germination test using paper, sand and soil seed viability - Tetrazolium test, Embryo excision method - Seed vigour Test - concept - direct and indirect vigour test. Seed health testing - objectives - Methods of seed health test for fungi, virus and insects.

UNIT III **(15 HOURS)**

Seed Production: Principles of seed production. Seed production in self and cross pollinated crops, methods of hybrid seed development, Seed production in India. Seed processing: Introduction, importance and principles of seed processing, Processing equipments', Methods of seed drying and storage. Determination of seed moisture methods, methods of maintaining safe seed moisture content. Seed quality enhancement techniques – importance- Seed fortification, Seed priming, seed coating and seed pelleting.

UNIT IV **(15 HOURS)**

Seed treatment - significance, - packaging, - certification, - storage and marketing- demand forecast, marketing structure, marketing organization, storage of seed, factors affecting seed marketing*

UNIT V **(15 HOURS)**

Seed dormancy - primary and secondary dormancies - significance - factors involved - methods to break dormancy.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. Agrawal, R.L. (1997). Seed Technology. Oxford & IBH Publishing Co. Pvt. Ltd. Calcutta
2. Copeland LO and McDonald MB (2001). Principles of Seed Science and Technology, Champman & Hall
3. McDonald MB Jr and Copland Lo. (1997). Seed Production: principles and Practice, Chapman & Hall
4. Justice OL and Bass L.N. (1978). Principles and Practices of Seed Storage. Castle House Publ. Ltd.,
5. Dahiya, B.S & Rai K.N (1998). Seed Technology. Kalyani publishers. Calcutta

REFERENCES

1. Dhirendra khara & Mohan S.Bhale. (2000). Seed technology, Scientific Publishers Jothpur, India
2. Lawrence O.copeland, Miller B. McDonald (1936). Principles of seed science and Technology IV Edition Springer Pvt Ltd , New Delhi.
3. Agarwal P.K, M.Dadlani (1980). Techniques in seed science and Technology, South Asian publishers, Ned Delhi.
4. Nema NP. (1986). Principles seed certification and Testing. Allied Publication
5. Tunwar NS and Singh SN. 1988. Indian Minimum Seed Certification Standards, CSCB, Ministry of Agriculture, New Delhi

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	S	S
CO2	H	S	H	M	H
CO3	S	H	H	H	M
CO4	S	H	M	H	S
CO5	S	S	M	H	H

S - Strong **H** - High **M** - Medium **L** - Low

PBO57

Programme Code: 05	M.Sc., BOTANY		
	Major Elective 3 - FOOD SCIENCE AND NUTRITION		
Batch 2022-2023	Hours / Week 5	Total Hours 75	Credits 5

COURSE OBJECTIVES

- To learn the importance of different kinds of foods.
- To acquire knowledge on nutritive values of food.
- To create awareness about food adulterations

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Recognize various nutritive composition of cereals and cereal products.
↑	CO2	Understand processing practices of various foods based on their nutrients composition.
↕	CO3	Apply acquired knowledge on food processing technology in vegetables and fruits.
↓	CO4	Assess nutritive evaluation of spices and sugar based products.
K5	CO5	Evaluate the technologies employed for the processing of beverages.

SYLLABUS

UNIT I **(15 HOURS)**

Introduction of food science - classification according to function, food groups (ICMR) - Classification); Cereals and cereal products - composition, nutritive value and processing of Rice, Wheat, Maize; Fermented products- Bread- ingredients; Unfermented products - Cakes - Classes and ingredients.

UNIT II **(15 HOURS)**

Pulses- Nutrient values and processing and products of Black gram, Soya bean- Medicinal values of pulses. Nuts and Oilseeds- Coconut, Groundnut-Nutritive values, processing and products, role of nuts and oil & seed in cooking.

UNIT III **(15 HOURS)**

Vegetables- classification*-composition and nutritive values**,** - storage; Fungi as food- Mushroom - Algae - *Spirulina*. Role of vegetables in cookery. Fruits- classification, composition and nutritive values - storage of fruits- Enzymatic browning- Prevention - Non-enzymatic browning.

UNIT IV **(15 HOURS)**

Sugar - nutritive values, - properties, - sugar related products. - Role of sugar in cookery. Spices - General function of spices - Asafoetida, Clove, Garlic, Turmeric - role of spices in cookery

UNIT V **(15 HOURS)**

Beverages - classification - Coffee, Tea, Cocoa - processing, - adulterants; Fruit beverages - types. Food adulteration - types of adulterants. Food preservation - principles and methods.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. Swaminathan, M. (2006). Handbook of food and nutrients. The Bangalore printing & Publishing Co Ltd, India.
2. Sunetra Roday.2018. Food Science and Nutrition. 3rd Edition. Oxford Publication.
3. Srilakshmi, B. 2017. Nutrition Science.6th Edition. New Age International Publishers.
4. Srilakshmi, B. 2003. Food Science . New Age International Publishers.
5. Michael EJ Lean. 2006. Food Science, Nutrition & Health.CRC Press

REFERENCES

1. Sumati R Mudambi (2001). Fundamentals of foods and nutritions , New age International publishers, New Delhi.
2. Mahtab s. Bamji, N. Pralhad Rao and Vinodini Reddy (2003). Text book of Human nutrition Second Edition, Oxford &IBH Publishing Co.Pvt, New Delhi.
3. Shubhangini A. Joshi. 2017. Nutrition and Dietetics. 4th Edition. Tata Mc Graw Hill Education Privated Limited.
4. Srilakshmi, B. (2003). Food Science . New Age International Publishers.
5. Michael EJ Lean. (2006). Food Science, Nutrition & Health.CRC Press.
6. Srilakshmi, B. (2017). Nutrition Science.6th Edition. New Age International Publishers.
7. Shubhangini A. Joshi. (2017). Nutrition and Dietetics. 4th Edition. Tata Mc Graw Hill Education Privated Limited.
8. Sunetra Roday(2018). Food Science and Nutrition. 3rd Edition. Oxford Publication.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	M	H	M
CO2	H	S	H	S	M
CO3	S	H	M	H	H
CO4	H	H	S	M	S
CO5	H	H	S	M	M

S - Strong **H** - High **M** - Medium **L** - Low

PBO59

Programme Code: 05	M.Sc., BOTANY		
	Major Elective 4: HORTICULTURE		
Batch 2022-2023	Hours / Week 5	Total Hours 75	Credits 5

COURSE OBJECTIVES

- To learn about the propagation methods of horticultural crops.
- To study about gardening, landscaping and their maintenance.
- To acquire knowledge about commercial floriculture and cut flower arrangements.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Gain knowledge on solutions for a wide spectrum of plant health issues.
↕	CO2	Understand the components and adornments of gardening.
	CO3	Apply inherent knowledge on various plant propagation techniques.
	CO4	Explore knowledge on cultivation practices of fruits and vegetables.
K5	CO5	Demonstrate the aesthetic value of gardening .

SYLLABUS

UNIT I (15 HOURS)

Scope and importance - divisions of horticulture - classification of horticultural crops - climate, soil and nutritional needs - Irrigation. Organic horticulture - definition, synonyms, principles, methods, merits and demerits.

UNIT II (15 HOURS)

Gardening and landscaping - importance and scope of gardening - Gardens in India* - types - layout of a garden - Garden components and adornments - Special types of garden - principles and design - Water garden, bog garden, terrace garden, rockery garden, vertical garden, clock garden, colour wheels and temple garden. Terrarium and Bonsai techniques.

UNIT III (15 HOURS)

Asexual propagation - Advantages and disadvantages - Cuttings:- types, factors influencing rooting of cuttings - use of growth regulators in relation to horticulture - layering - types - Grafting and Budding - methods - factors for successful graft union - Stock scion relationship - Factors influencing the healing of graft union.

UNIT IV (15 HOURS)

Pomology - Establishment of orchard***** - cultivation of Banana, Citrus - Fruit carving - Olericulture - cultural aspects of vegetables - types of vegetable growing - Kitchen garden, Market garden, vegetable garden - Preservation of fruits and vegetables - ornamental floriculture - Cultivation of Jasmine and Rose - Extraction of jasmine concrete.

UNIT V (15 HOURS)

Bio-aesthetic planning, eco-tourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping and hardscaping.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. Kumar, N.(1999). An introduction to horticulture.Rajalakshmi Publication, Nagarcoil.
2. Chaha, K.L. (2001). Handbook of horticulture. ICAR, New Delhi.
3. Prasad, S., U.Kumar. (2013). A handbook of Floriculture. Agrobios, Jodhpur.
4. Peter KV. Basics of Horticulture, 2nd Revised edition, New Delhi Publishing Agency.
5. Manibhushan Rao. Text Book of Horticulture, Lakshmi Publications & Pvt. Ltd.,

REFERENCES

1. Bose, T.K., J. Kabir, P. Das and P.P. Joy. (2001). Tropical Horticulture. Naya Prakash Publications, Calcutta.
2. George Acquaach. (2003). Horticulture - Principles and practices.
3. Edwin Biles. (2003). The complete book of gardening. Biotech book, New Delhi.
4. Singh, S.P. (1999). Advances in Horticulture and Forestry - Scientific Publishers, Jodhpur.
5. Sharma, V.K. (2004). Advances in Horticulture: Strategies, Production, Plant Protection and Value Addition - Deep and Deep Publications, New Delhi.
6. Bhattacharjee, S.K. (2006).Advances in Ornamental Horticulture -Pointer Publications, Jaipur.
7. Desh Beer Singh and Poonam Wazir. (2002). Bonsai-An Art. Scientific Publishers, Jodhpur.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	M	S
CO2	S	H	M	H	H
CO3	H	S	H	M	H
CO4	S	M	S	H	S
CO5	H	S	H	M	H

S - Strong **H** - High **M** - Medium **L** – Low

PBO61

Programme Code: 05	M.Sc., BOTANY		
	Major Elective 5: MOLECULAR BIOLOGY		
Batch 2022-2023	Hours / Week 5	Total Hours 75	Credits 5

COURSE OBJECTIVES

- To understand the basic knowledge and organization of genome
- To learn the historical development of molecular biology
- To know and acquire fundamental knowledge on molecular mechanism of gene expression and protein synthesis

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Gain fundamental knowledge on molecular biology
	CO2	Understand and acquire knowledge on nucleic acid and genome organization
	CO3	Gain impact knowledge on molecular mechanism of gene expression and various molecular process at RNA level
	CO4	Apply knowledge on machinery and molecular mechanism of protein synthesis
	CO5	Evaluate the acquired knowledge on molecular biological tools in to the future research

SYLLABUS

UNIT I (15 HOURS)

Historical developments of Molecular Biology, Nucleic acid – Physical and chemical structure of DNA, Types of DNA, Watson and Crick model of DNA, Viral DNA, Bacterial DNA, Mitochondrial and Chloroplast DNA, DNA as genetic material, DNA synthesis and replication, termination of replication, Enzymes of DNA replication, Methylation of DNA, DNA damage-types and repair Mechanisms, Recombination.

UNIT II (15 HOURS)

Brief overview of genome organization, gene structure and expression in Prokaryotic and Eukaryotic organization; Extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast*.

UNIT III (15 HOURS)

Synthesis of RNA, Different types of RNA, DNA dependent RNA polymerase, Molecular events of transcription and RNA processing - Initiation of transcription, Post transcriptional changes in RNA, Transcription process in prokaryotes; Promoters; RNA polymerase; RNA processing; Splicing; Reverse transcriptase; RNA editing; Eukaryotic transcription; eukaryotic promoters and enhancers. Nuclear export of mRNA-mRNA stability and degradation, RNA editing.

UNIT IV (15 HOURS)

Translation: Machinery and mechanism (tRNA charging, initiation in prokaryotes and eukaryotes, elongation and termination); Regulation of gene expression: Regulation at the levels of chromatin organization, DNA amplification, initiation of transcription, attenuation, anti-sense RNA, alternate promoters, RNA processing, mRNA degradation and translation

UNIT V (15 HOURS)

Genetic Code - Basic features of genetic code. Deciphering of genetic code. Wobble hypothesis. Protein biosynthesis- activation of amino acids, initiation, elongation and termination of translation in prokaryotes. Post translational modifications. Inhibitors of translation. Regulation of gene expression in prokaryotes, Operon concept – Positive and negative regulation of lac operon.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. P.S. Verma, V.K. Agarwal (2010) Molecular Biology. S Chand publication, New Delhi.
2. P.S. Verma, V.K. Agarwal (2016) Cell Biology ((Cytology, Biomolecules and Molecular Biology). S Chand publication, New Delhi.
3. K.G. Ramawat, Goyal Shaily (2010) Molecular Biology and Biotechnology (For Undergraduate Courses). S Chand publication, New Delhi.
4. Walker J.M. and Rapley R. (2002). Molecular Biology and Biotechnology. Panima, New Delhi.
5. N. Vidyavathi, D.M. Chetan (2009) Molecular Biology. I K International Publishing House, Bengaluru, Karnataka
6. G. Jeyanthi (2019) Molecular Biology. MJP Publishers, Chennai, Tamil Nadu

REFERENCES

1. The Biochemistry of the Nucleic Acids by R.L. Adams, J.T. Knowler, and D.P. Leader (Paperback May 31, 1992)
2. Lehninger (2008) Principles of Biochemistry by David L. Nelson and Michael M. Cox (Hardcover - Feb 1, 2008)
3. Watson, J. D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2014). Molecular biology of the gene. 7th edition. Pearson.
4. Freifelder, D. (2001). Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
5. Brown, T. A. (2006). Essential Molecular Biology: Practical approach Vol I & II. Oxford.
6. Malacinski, G. M. (2002). Essentials of Molecular Biology. Fourth Edition. Jones & Bartlett Publishers.
7. Walker J.M. and Rapley R. (2002). Molecular Biology and Biotechnology. Panima, New Delhi.
8. Molecular Biology of the Gene (6th Edition) by James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann (Hardcover - Dec 15, 2007)

PBO63

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	M	S	S
CO2	S	S	H	M	H
CO3	S	H	H	H	M
CO4	S	H	M	H	S
CO5	S	H	M	H	H

S - Strong **H** - High **M** - Medium **L** – Low

PBO64

Programme Code: 05	M.Sc., BOTANY		
	Major Elective 6: ALGAL TECHNOLOGY		
Batch 2022-2023	Hours / Week 5	Total Hours 75	Credits 5

COURSE OBJECTIVES

- To study the laboratory culture protocol for algae
- To know the morphological characters and nutrient requirement of algae
- To learn seaweed farming and harvesting methods

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Provide knowledge on commercial importance of algae
↕	CO2	Prepare and optimize the medium for culturing algae
	CO3	Work on seaweeds and utilize the benefits
	CO4	Learn various culture techniques for mass cultivation of seaweeds
K5	CO5	Start a small scale unit for marketing of cultivated algae

SYLLABUS

UNIT I **(15 HOURS)**

Brief description and taxonomic identification of micro and macroalgae of fresh water and marine habitats. General principles of culturing algae in laboratory and growth measurement. Isolation and culture of algae of different forms (single cell, colonial, filamentous and thallus forms). Chemical composition of culture media for fresh water and marine algae.

UNIT II **(15 HOURS)**

Photobioreactor technology for microalgae cultivation and their components – light system, optical transmission system, air handling and gas exchange systems, mixing system, nutrient system, instrumentation system and electrical system. Cultivation of micro algae: algae for biodiesel, process, strains and sources of contamination. Bio-pond – production in open ponds, Harvesting and Oil Extraction: principles and methods.

UNIT III **(15 HOURS)**

Seaweeds: Morphology and classification, light, carbon metabolism, translocation, polysaccharides of seaweeds, chemical constituents of seaweeds, morphogenesis and growth regulators, sexuality and sex attraction, nutrients, individual populations and communities, morphology and environment.

UNIT IV **(15 HOURS)**

Seaweeds farming: Objectives, site selection, installation of test plants, Kinds of test planting, introduction of test plants. Preparation of the farm site and other culture activities –construction of farm – Line method, Rope and Raft methods, Net method, Floating bamboo method, Mangrove stakes and nets method. Management – Seed selection and preparation, tying of seedlings, Planting, Harvesting, Pre-harvest activities, harvesting procedures, drying, maintenance of the farm and Marketing of seaweeds

UNIT V **(15 HOURS)**

Generalized uses of seaweeds, Human food, Seaweed Baths, Cosmetics, Seaweed as agricultural fertilizers, Liquid seaweed extracts, Seaweed industrial gums: Alginates, Agars, Carrageenan, other polysaccharides and their medicinal Uses.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. Stein, H. (1973) Handbook of Phycological methods. Culture methods and growth measurements, Cambridge University Press.
2. Christopher S. Lobban and Michael James Wynne (1981) The Biology of seaweeds, University of California Press.
3. Hilson, C.J. (1990). Seaweeds: A Color-Coded, Illustrated Guide to Common Marine Plants of the East Coast of the United States. Penn State University Press.
4. Bhavanath Jha, C. R. K. Reddy, Mukund C. Thakur andM. Umamaheswara Rao. (2009). Seaweeds of India. Springer Publications

REFERENCES

1. Valentine Chapman.(1980). Seaweeds and their uses. 3rd Edition, Springer Publications
2. Gavino C. Trono, Jr.(1988). Manual on seaweed culture, FAO Manual
3. Klaus Lüning (1990). Seaweeds: their environment, biogeography and ecophysiology, Wiley-IEEE.
4. Clinton J. Dawes (1998). Marine Botany, 2nd ed, John Wiley and Sons, Inc.
5. Jha**,** B., Reddy**,** C.R.K., Thakur**,** M.C., Rao **(**2009). Seaweeds of India: The Diversity and Distribution of Seaweeds of Gujarat Coast Series: Developments in Applied Phycology. Vol. 3. Springer Publications.
6. David Sieg (2012). Making algae biodiesel at Home. Information Specialists, Corporation.
7. Ole G. Mouritsen (2013). Seaweeds: Edible, Available and Sustainable. University of Chicago Press.
8. Leonel Pereira. (2016). Edible Seaweeds of the World. CRC Press

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	M	S	S
CO2	S	S	H	M	H
CO3	S	H	H	H	M
CO4	S	H	M	H	S
CO5	S	H	M	H	H

S - Strong **H** - High **M** - Medium **L** – Low

PBO66

Programme Code: 05	M.Sc., BOTANY		
	Major Elective 7: BIOFERTILIZERS AND SOLID WASTE MANAGEMENT		
Batch 2022-2023	**Hours / Week 5**	**Total Hours 75**	**Credits 5**

COURSE OBJECTIVES

- To study the basic knowledge on biofertilizers
- To understand the impact of solid waste on environment, human and plant health
- To acquire knowledge about reuse, recycle and recovery of solid waste by biological processing methods

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Apply knowledge on implementations of biofertilizers in agriculture
	CO2	Know about microbial based fertilizers
	CO3	Acquire knowledge on solid waste management.
	CO4	Inculcate the method in maintenance of sanitary landfills
	CO5	Awareness on the various policies of solid waste management

SYLLABUS

UNIT I **(15 HOURS)**

General account about the microbes used as biofertilizers, Rhizobium – isolation, identification, mass cultivation, carrier based inoculants, symbiosis and *Azospirillum* –isolation, mass cultivation, carrier based inoculants, *Azotobacter* – classification, characteristics, crop response to *Azotobacter* inoculum, maintenance and mass cultivation.

UNIT II **(15 HOURS)**

Cyanobacteria (blue green algae), *Anabaena Azolla* association, nitrogen fixation, factors affecting growth, VA-Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM- influence on growth and yield of crop plants. Organic farming – Green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and Industrial wastes of Biocomposting – methods, types and method of vermin composting and its field application.

UNIT III **(15 HOURS)**

Effect of solid waste disposal on environment: Sources and generation of solid waste - classification and chemical composition; characterization of municipal solid waste; hazardous waste and biomedical waste. Impact of solid waste on environment, human and plant health; water quality and aquatic life; mining waste and land degradation; effect of land fill leachate on soil characteristics and ground water pollution.

UNIT IV **(15 HOURS)**

Solid waste Management: Different techniques used in collection, storage, transportation and disposal of solid waste (municipal, hazardous and biomedical waste); landfill (traditional and sanitary landfill design); thermal treatment (pyrolysis and incineration) of waste material; drawbacks in waste management techniques; Concept of Integrated waste management

UNIT V **(15 HOURS)**

Resource Recovery and Policies for solid waste management**:** 4R - reduce, reuse, recycle and recover; biological processing - composting, anaerobic digestion, aerobic treatment; reductive dehalogenation; mechanical biological treatment; green techniques for waste treatment. Municipal Solid Wastes (Management and Handling) Rules 2000; Hazardous Wastes Management and Handling Rules 1989; Bio-Medical Waste (Management and Handling) Rules 1998; Plastic Waste (Management and Handling) Rules, 2011; E-Waste (Management) Rules, 2016.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. Gaston, KJ. & Spicer, J.I. 1998. *Biodiversity: An Introduction*. Blackwell Science, London,
2. K.V. Krishnamurthy, (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
3. Gupta PK. 2004. Methods in Environmental analysis - water, soil and air. Agrobios
4. (India), Jodhpur
5. Judith, P. 1999. Handbook of Environmental Impact Assessment. Blackwell Science.
6. Marriott, B. 1997. Environmental Impact Assessment: A Practical Guide. McGraw-Hill

REFERENCES

1. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
2. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
3. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
4. Rittman, B.E. & McCarty, P.L. 2001. Environmental Biotechnology. Principles and
5. Applications. McGraw-Hill, New York.
6. Scagg, A.H. 2005. Environmental Biotechnology. Oxford University Press.
7. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
8. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
9. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.

PBO68

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	M	S	S
CO2	S	S	H	M	H
CO3	S	H	H	H	M
CO4	S	H	M	H	S
CO5	S	H	M	H	H

S - Strong **H** - High **M** - Medium **L** – Low

PBO69

Programme Code: 05	M.Sc., BOTANY		
	Major Elective 8: APPLIED MICROBIOLOGY		
Batch 2022-2023	Hours / Week 5	Total Hours 75	Credits 5

COURSE OBJECTIVES

- To provide basic knowledge on the various applications of microorganisms
- To introduce the techniques involved in microbiology
- To assess the role of microorganisms in human welfare

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Acquire knowledge on the fundamental aspects of microbiology.
	CO2	Understand the use of microbes in industries for the welfare of mankind.
	CO3	Apply knowledge on preservation of food and vegetables using suitable techniques and their commercial applications
	CO4	Grasp the knowledge on distribution of microbes in the environment and prevent their harmful effects.
	CO5	Predict the pathogenesis and control of disease causing microbes.

SYLLABUS

UNIT I **(15 HOURS)**

Fundamentals of Microbiology: Scope of microbiology - Culture of bacteria: Pure culture techniques - Culture media and preparation: solid and liquid - Preservation of cultures - Sterilization: principles, methods of sterilization-physical method and chemical method.

UNIT II **(15 HOURS)**

Industrial Microbiology: Fermentation - aerobic and anaerobic fermentation - production of microbial products - alcohol - lactic acid- penicillin - L-lysine- L-protease and riboflavin.

UNIT III **(15 HOURS)**

Food Microbiology: Microbial flora of fresh food – Botulism – Mycotoxins – food preservation methods – microbiology of milk and milk products (yoghurt and cheese) – fermented fruits and vegetables – single cell protein (*Spirulina* and *Chlorella*).

UNIT IV **(15 HOURS)**

Environmental Microbiology: Microbes in water, air and soil environment - interactions between microbes and plants: rhizosphere, phyllosphere, mycorrhizae– biodegradation of pesticides and pollutants in soil- role of microorganisms in sewage treatment

UNIT V **(15 HOURS)**

Medical Microbiology: Distribution and significance of normal human microbial flora. Infections- source of infections - Epidemiology of infectious diseases - microbial pathogens: Bacterial –*Salmonella typhii, Mycobacterium tuberculosis*; Viral - Dengue, SARS Virus-COVID-19; Fungal-*Candida, Aspergillus*

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. Michael J. Pelczar, E.C.S. Chan and Noel R. Krieg (2008), 'Microbiology' 5th edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
2. Dubey, R.C. and D.K. Maheshari (2005), A Text Book of Microbiology' S. Chand and Company Limited, New Delhi.
3. Prescott, L.M., Harley, J.P. and Klien, D.A. 1996. Microbiology (3rd ed.), Brown W.C. Publishers, Boston, USA.

REFERENCES

1. Sullia, S.B. and Shantharam, S. 1998. General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Nduka Okafor, Benedict C. Okeke. 2017. Modern Industrial Microbiology and Biotechnology, CRC Press, New Delhi.
3. Apurba S. Sastry and Sandhya Bhat, 2019. Essentials of Medical Microbiolgy. Jaypee Brothers Medical Publishers (P) Ltd. New Delhi.
4. Sanjai Saxena. 2015. Applied Microbiology, Springer, New Delhi.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	M	S	S
CO2	S	S	H	M	H
CO3	S	H	H	H	M
CO4	S	H	M	H	S
CO5	S	H	M	H	H

S - Strong **H** - High **M** - Medium **L** – Low

NON-MAJOR ELECTIVE PAPERS

PBO72

Programme Code: 05	M.Sc., BOTANY		
	Non-Major Elective1: Herbal Medicine		
Batch 2022-2023	Hours / Week 4	Total Hours 60	Credits 4

COURSE OBJECTIVES

- To impart inherent knowledge on traditional system of herbal medicine
- To understand the history, scope and therapeutic aspects of medicinal plants
- To apply the gained knowledge and advice the community on issues concerning the cultivation, harvesting and processing of medicinal plants and their products.
- To classify crude drugs based on their morphological, taxonomical, chemical or pharmacological characters

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Recollect indigenous knowledge on Indian systems of traditional medicine
↕	CO2	Provide therapeutic and pharmaceutical aspects of traditionally used medicinal plants
	CO3	Apply various methods of plant analysis for the exploitation of phytochemical constituents from plant sources
	CO4	Analyze cultivation and marketing strategies of medicinal plants
K5	CO5	Assess the potential applications of natural plant based drugs in pharmaceutical, nutraceutical and cosmeceutical industries

SYLLABUS

UNIT I **(12 HOURS)**

Medicinal Plants: History of medicinal plants – some important terms used in herbal medicine, Medico-ethnobotanical sources in India – Vrikshayurveda - Indian medicinal system - AYUSH (Ayurveda, Unani, Siddha and Homeopathy) and modern medicines (Chinese and Tibetan Medicines) - principles and diagnostic methods.

UNIT II **(12 HOURS)**

Cultivation of Medicinal Plants: Medicinal plants in trade-cultivation practices and therapeutic and pharmaceutical uses of the following drugs; *Cinchona officinalis, Cymbopogon martinii, Rauwolfia serpentina, Gloriosa superba, Withania somnifera and Zingiber officinale*. Factors influencing the cultivation of medicnal plants. Herbal remedies for heart, respiratory, skin, cancer, immune and liver diseases - Nutraceuticals and cosmeceuticals.

UNIT III **(12 HOURS)**

Pharmacognosy: History, definition, scope and future. Source and classification of Natural drugs. Analytical Phamacognosy – methods of drug evaluation, biological testing of herbal drugs. Adulteration of drugs of natural origin. Plant drug quality control – significance, status and challenges. Potential plant derived drugs in market - Taxol, Camptothecin, Vincristine - source, morphology and properties

UNIT IV **(12 HOURS)**

Major plant primary and Secondary metabolites: Nature, classification, distribution, biosynthesis and functions of carbohydrates, lipids, volatile oils, Resins, Alkaloids, Flavonoids, Phenolics, terpenoids and Steroids. Factors influencing production of secondary metabolites.

UNIT V **(12 HOURS)**

Herbal Wealth: Intellectual Property Rights (IPR): Choice of IPR, Patents, Trade secrets, Trade mark, copyrights, GATT (General Agreement on Trariff and Trade) and its relevance to international trade, TRIPS (Trade Related Intellectual Property Rights) and PGR (Plant Genetic Resource). WTO- Herbal industry – Prospects and constraints, export and import status in Indian scenario.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. Trease G.E. and W. C Evans (1983) Pharmocognosy, ELBS, Britain.
2. Biren Shah and Avinash Seth (2013).Textbook of Pharmacognosy and Phytochemistry. Elsevier India.
3. Suresh Narayana P, Varalakshmi D and Pullaiah T (2016). A Textbook of Pharmacognosy, CBS Publishers & Distributors Pvt Ltd, India.
4. Biren Shah and AK Seth. (2016). Textbook of Pharmacognosy and Phytochemistry , CBS Publishers & Distributors.
5. Purohit and Vyas. (2005). Medicinal plant cultivation- A scientific approach, Agrobios, Jodhpur.
6. John Jothi Prakash, E. (2004).Medicinal Botany and Pharmacognosy. JPR Publication, Vallioor

REFERENCE

1. Hocking, G.M. (1955). A dictionary of terms used in Pharmacognosy, Spring Field.
2. Kokate C.K., A.P. Purohit, Gokhale S.B. (2008). Pharmacognosy, Nirali.
3. Handa, S S and V.K.Kapoor. (2014). Pharmacognosy, Vallabh Prakashan
4. Evans, WC (2019), Trease and Evans of Pharmacognosy
5. Kuntal Das, (2019). Pharmacognosy and Phytochemistry – I, Nirali Prakashan
6. Neeraj Kumar Sharma, Mona Kejariwal and Md. Rageeb Md. Usman. 2021. PV Publication,Jalandhar

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	S	S	S
CO2	H	S	S	H	S
CO3	S	S	S	S	S
CO4	H	H	H	S	H
CO5	H	H	M	H	M

S - Strong **H** - High **M** - Medium **L** - Low

PBO74

Programme Code: 05	M.Sc., BOTANY		
	Non-Major Elective 2: Limnology		
Batch	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**4**	**60**	**4**

COURSE OBJECTIVES

- To study morphological and anatomical characters of aquatic flora.
- To understand the significance of the diffused light for the planktons.
- To find the gross and net productivity in fresh water life forms.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↑	CO1	Acquire knowledge on structural and functional aspects of freshwater ecosystem
	CO2	Understand the factors responsible for lotic and lentic ecosystems
	CO3	Implement knowledge on methods of conservation of fresh water bodies
	CO4	Apply inherent knowledge on various kinds of planktonic communities and their adaptations
↓ K5	CO5	Compare various aspects of biomass efficiency and their productivity

SYLLABUS

UNIT I **(12 HOURS)**

Definition, facts of limnology - scope and importance of limnology, structure of freshwater aquatic system - lentic, lakes, - their distribution, origin and forms, morphology, physical, chemical and biological structure, watershed. Ponds - swamps and estuaries. Lotic - stream, springs and rivers - discharge, temperature, nutrient, biotic categories and drift.

UNIT II **(12 HOURS)**

Physical factors influencing lotic and lentic type of vegetation - light, heat, water movements. Chemical factors - O_2 and CO_2, Nitrogen, Phosphorus, other nutrients, alkalinity and pH.

UNIT III **(12 HOURS)**

Water pollution and eutrophication* - effluent water, - nature, treatment, and uses. Freshwater formation in India. Conservation and management of freshwater bodies.

UNIT IV **(12 HOURS)**

Planktonic communities - phyto and zoo planktons. Littoral communities - algae and zoo planktons, large plants, benthos formation organisms - knowledge of adaptations of the above mentioned formations.

UNIT V **(12 HOURS)**

Freshwater ecosystem - energy and production, community concept, diversity, community succession, food chains and bio-geochemical aspects of ecosystems, energy flow in ecosystem and community metabolism. Productivity - primary, biomass and efficiency of primary production, secondary production. Biomass and efficiency- gross and net productivity.

***Self study**

Teaching Methods

PowerPoint presentation/Quiz/Discussion/Assignment

TEXT BOOKS

1. The text book of limnology. Cole. The C.V. Morby Company
2. Gerald A. Cole (1994). Textbook of Limnology. G.A. Publisher Waveland Press
3. Gerald A. Cole and Paul E. Weihe. Textbook of limnology. G.A. Publisher Waveland Press
4. Gerald A. Cole (2015). Text book of Limnology. CBS publisher
5. Simon Oakenfold. Textbook of Aquatic Ecology. Syrawood Publishing House
6. Rajiv Tyagi. Textbook of Hydrobiology. Discovery Publishing Pvt.Ltd.,

REFERENCES

1. Ruttner Franz. (1954). Fundaamentals of Limnology. University of Toronto Press.
2. Ruttner Franz. (1963). Fundaamentals of Limnology. University of Toronto Press.
3. Charles R. Goldmen, Alexander, Jorne. (1994). Limnology.. International students
4. Edition.
5. Wezel. Sauders. Limnology College Publishing Co
6. Jayashree Datta Munshi and Jyotiswwarup Datta Munshi. (2015). Fundamentals of Limnology
7. Shaarad Srivastava. Understanding Limnology. Discovery Publishing Pvt. Ltd
8. Robert G. Wetzel aand Gene E. Likens. (2000). Limnological Analysis.
9. Barnes R.S.K and K.H. Mann. Fundamentals of Aquatic Ecology. Backwell Science Ltd

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	S	M	S
CO2	H	M	H	S	H
CO3	H	H	M	H	H
CO4	S	H	S	M	M
CO5	S	S	H	M	M

S - Strong **H** - High **M** - Medium **L** - Low

PBO76

Programme Code: 05	M.Sc., BOTANY		
	Non-Major Elective 3: Biotechnology and Nanobiology		
Batch 2022-2023	Hours / Week 4	Total Hours 60	Credits 4

COURSE OBJECTIVES

- To know the principles and applications of plant tissue culture
- To learn and familiarize plant genetic transformation and its applications
- To learn the basic knowledge of Nanobiology

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Acquire knowledge on various developments and potential applications of biotechnology
	CO2	Understand the basic techniques of gene manipulation and their rapid applications in the field of plant tissue culture and genetic engineering
	CO3	Exploit nanotechnological tools to create new biomedical research tools, diagnostic tests and drug delivery systems
	CO4	Apply the concept of nanotechnology for achieving major task using nanoparticles
	CO5	Evaluate the applications of both biotechnology and nanobiology

SYLLABUS

UNIT-I **(12 HOURS)**

Introduction to classical and modern biotechnology - scope and importance. Genetic engineering : Enzymes used in gene cloning – Restriction endonuclease, Ligase, Topo Isomerase, DNA polymerase, Alkaline phosphatase, gyrase. Gene cloning, isolation of genes, sequencing of genes, synthesis of genes

UNIT-II **(12 HOURS)**

Reporter genes-β-glucuronidase (GUS) and Green fluorescent protein (GFP), Selectable marker genes- *NPT*II, *HPT*, *BAR*. Binary vector system and construction. Gene transfer methods in plants - *Agrobacterium* mediated and Biolistic gun method, Ethical and societal issues in biotechnology - GM food and bioterrorism.

UNIT-III **(12 HOURS)**

Molecular probing - radiolabelled probes and non-radioactive probes, Western blotting and ELISA techniques. Monoclonal antibodies, Biotechnology in paper industry, biohydro-metallurgy, biomineralization and bioinoculants.

UNIT-IV **(12 HOURS)**

Definition - Historical aspects, classification of nanomaterials, General properties of nanoparticles, types of nanoparticles - metallic, semiconductors and polymeric types, carbon nanotubes, bucky balls, methods of synthesis of nanoparticles-top down and bottom up approach, Nanoparticle size analyzer-Dynamic light scattering (DLS), Principle, working mechanism and applications –TEM, SEM, AFM and X-ray diffraction (XRD).

UNIT-V **(12 HOURS)**

Application of nanoscience and nanotechnology in agriculture, nanofoods, nanotherapeutics, environmental applications, fuel energy resources. Biosensors and biochips.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. Gupta, P.K. (1998). Biotechnology and Genetics. Rastogi Publications, Meerut.
2. Gregory, L. Timp. (1998). Nanotechnology (1st Ed.). American Institute of Physics.
3. Bharat Bhusan. (2006). Hand Book of Nanotechnology. (1st Ed.).Springer.
4. Madhuri Sharon (2011). Bio-Nanotechnology: Concepts and Applications. CRC Press. Taylor & Francis Group
5. Subbaiah Balaji (2013). Nanobiotechnology. MjP Publishers, India.
6. Dubey. R.C. (2014). A Text book of Biotechnology. S Chand & Company P. Ltd, New Delhi.
7. Kumaresan, V. (2015). Biotechnology. Saras Publication, Nagercoil, Tamil Nadu.
8. Kalyan Kumae De (2020). Plant Tissue Culture. New Central Book Agency (NCBA), Kolkata, West Bengal

REFERENCES

1. Kartha, K.K. (1985). Cryopreservation of plant cells and organs. CRC Press Boca Raton, Florida, USA.
2. Ignachimuthu, S. (1995). Basic Biotechnology. Tata Mc Graw-Hill Publishing Company Ltd., Madras.
3. Callow, J.A., Ford Lloyd, B.V. and Newbury, H.J. (1997). Biotechnology and Plant Genetics Resources: Conservation and Use. CAB International, Oxon, UK.
4. Gupta, P.K. (1998). Elements of Biotechnology. Rastogi Publications.
5. Santharam, S. and J.F. Montgomery (1999). Biotechnology, Biosafety and Biodiversity. Oxford and IBH Publishing Co. New Delhi.
6. Meyyan, R.P. and V. Kumaresan. (2004). Genetics and Biotechnology. Saras Publication, Nagercoil.
7. S.B. Primrose and R.M. Twyman (2006). Principles of Gene Manipulation and Genomics. Blackwell Publishing, New Jersey, USA
8. Nirmala, B., Chandra Karthik, and Rajalakshmi, G. 2019. Plant Biotechnology. MJP Publishers.

PBO78

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	S	M	H
CO2	H	M	H	H	H
CO3	S	M	H	S	S
CO4	S	S	S	H	M
CO5	S	S	S	H	H

S - Strong **H** - High **M** - Medium **L** – Low

PBO79

22PGI4N2

Programme Code: 05		M.Sc., BOTANY		
		Non-Major Elective 4: Information Security		
Batch 2022-2023	**Semester** IV	**Hours / Week** 4	**Total Hours** 60	**Credits** 4

COURSE OBJECTIVES

- Students will identify the core concepts of Information security.
- To examine the concepts of Information Security.
- To design and implement the security features for IT and Industrial sectors

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	To Learn the principles and fundamentals of information security.
↕	CO2	To Demonstrate the knowledge of Information security concepts
	CO3	To Understand about Information Security Architecture.
	CO4	To Analyze the various streams of security in IT and Industrial sector.
K5	CO5	To know about cyber laws and regulations.

SYLLABUS

UNIT I **(12 Hours)**

Information Security basics: Definition of Information Security - History of Information Security - Characteristics of Information Security - Components of Information Security - Security System Development Life Cycle (SDLC).Information Security for technical administrators: Server Security – Network security- Social Media Security.

UNIT II **(12Hours)**

Cryptography: Basic concepts - plain text - Cipher text - Encryption Principles - CRYPT Analysis - Cryptographic Algorithms - Cryptographic Tools – Authentication -Biometrics* - passwords - Access Control Devices - Physical Security - Security and Personnel. Language-based Security: Analysis of code for security errors, Safe language and sandboxing techniques.

UNIT III **(12 Hours)**

Firewalls, Viruses & Worms & Digital Rights Management : Viruses and Worms-Worms - Digital Rights Management – Firewalls - Application and Circuit Proxies - Stateful Inspection - Design Principles of Firewalls. Logical Design: Access Control Devices- Physical Security-Security and Personnel - NIST Models-VISA International Security Model- Design of Security Architecture-Planning for Continuity.

22PGI4N2

UNIT IV **(12 Hours)**

Hacking : Introduction – Hacker Hierarchy – Password cracking – Phishing - Network Hacking -Wireless Hacking - Windows Hacking - Web Hacking*- Ethical Hacking. Security Investigation: Need for Security- Business Needs-Threats- Attacks- IP Addressing and Routing - Social Media

UNIT V **(12 Hours)**

Cyber Laws : What is Cyber Law? - Need for Cyber laws - Common Cyber Crimes Applicable Legal Provisions: A Snapshot - Cyber Law (IT Law) in India – The Information Technology Act of India 2000 - Cyber Law and Punishments in India - Cyber Crime Prevention guide to users – Regulatory Authorities.

***Self study questions for examination may be taken from the self-study portions also.**

Teaching Methods:

Chalk and Talk, Power point presentation, Seminar, Brainstorming, Assignment, Google Classroom.

TEXT BOOK:

1. Information Security –Textbook is prepared by KONGUNADU ARTS AND SCIENCE COLLEGE, Coimbatore -29, 2022.

REFERENCE BOOKS:

1 Charles P Pfleeger and Shai Lawrence Pfleeger, **"Security in Computing",** Fourth & Third Edition, Prentice Hall, 2007 & 2011.

2 Ross J. Anderson and Ross Anderson, "Security Engineering: A guide to building Dependable Distributed System", Wiley,2009.

3 Thomas R. Peltier, Justin Peltier and John Bleckley, "Information Security Fundamentals",2nd Edition, Prentice Hall 1996.

4 Gettier, Urs E. Information Security: Strategies for Understanding and Reducing Risks John Wiley & Sons, 2011.

5 "Principles of information security". Michael Whiteman and Herbert J. Mattord,2012.

6 Information security -Marie wright and John kakalik,2007.

7 Information security Fundamentals- Thomas R. Peltier, Justin Peltier and John Blackley-2005.

8 Information Security theory and practical PHI publication, Dhiren R. Patel-2008.

9 Debby Russell and Sr.G.T. Gangemi," computer Security Basics,2nd edition, O'Reilly Media,2006.

PBO81

MAPPING

PSO/ CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	S	S
CO2	M	H	H	S	H
CO3	H	S	S	M	S
CO4	H	M	H	S	H
CO5	H	S	H	S	H

S–Strong **H** –High **M**– Medium **L**–Low

EXTRA DEPARTMENTAL COURSE (EDC)

PBO83

22PBO3X1

Programme Code: 05		**For PG STUDENTS**		
Extra Departmental Course (EDC) - APPLIED HORTICULTURE				
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2022-2023	**III**	**2**	**30**	**2**

COURSE OBJECTIVES

- To learn about the propagation methods of horticultural crops.
- To study about gardening, landscaping and their maintenance.
- To acquire knowledge on commercial floriculture and cut flower arrangements.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1	CO1	Demonstrate solutions for a wide spectrum of plant health issues
↕	CO2	Understand the components and adornments of gardening
	CO3	Develop employability skills in the field of gardening and landscaping
	CO4	Analyze inherent knowledge on various nursery practices and their management systems
K5	CO5	Evaluate the concepts and principles of floriculture

SYLLABUS

UNIT I **(6 HOURS)**

Landscaping: Importance and scope of Landscape Architecture. Functional uses of plants for landscape and pollution control. Landscaping for specific areas (home garden, public parks, educational institutes).

UNIT II **(6 HOURS)**

Principles of Garden Designs: Styles of gardens - English, Italian, French, Persian, Mughal, Japanese gardens and its layout. Some Famous gardens of India.

UNIT III **(6 HOURS)**

Gardening: Definition, objectives and scope - different types of gardening - Special types of gardens (rock, water, terrace, vertical and terrarium).

UNIT IV **(6 HOURS)**

Nursery Management and Routine Garden Operations: Definition of a nursery. Different types of nursery beds – (flat beds, raised beds and sunken beds), their merits and demerits. Different nursery techniques and their management. Propagation Methods: Advantages and disadvantages.

22PBO3X1

UNIT V **(6 HOURS)**

Cut flowers - Identification and selection of flowers and plant parts, value addition in cut flowers, flower arrangement, styles, Ikebana, morebana, free style, bouquets, flower baskets, garlands. Selection of containers and accessories for floral products and decorations. Dry flowers - Designing and arrangement

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXTBOOKS

1. Kumar, N.(1999). An introduction to horticulture. Rajalakshmi Publication, Nagarcoil.
2. Chaha, K.L. (2001). Handbook of horticulture. ICAR, New Delhi.
3. Prasad, S., U.Kumar. (2013). A handbook of Floriculture. Agrobios, Jodhpur.
4. Bhattacharjee, S.K. (2006).Advances in Ornamental Horticulture -Pointer Publications, Jaipur.
5. Desh Beer Singh and Poonam Wazir. (2002). Bonsai-An Art. Scientific Publishers, Jodhpur

REFERENCES

1. Bose, T.K., J. Kabir, P. Das and P.P. Joy. (2001). Tropical Horticulture. Naya Prakash Publications, Calcutta.
2. George Acquaach. (2003). Horticulture - Principles and practices.
3. Edwin Biles. (2003). The complete book of gardening. Biotech book, New Delhi.
4. Singh, S.P. (1999). Advances in Horticulture and Forestry - Scientific Publishers, Jodhpur.
5. Sharma, V.K. (2004). Advances in Horticulture: Strategies, Production, Plant Protection and Value Addition - Deep and Deep Publications, New Delhi.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	M	S
CO2	S	H	M	H	H
CO3	H	S	H	M	H
CO4	S	M	S	H	S
CO5	H	S	H	M	S

S - Strong **H** - High **M** - Medium **L** - Low

JOB ORIENTED COURSE PAPERS

22PBO0J1

Programme Code: 05	**M.Sc., BOTANY**	
JOC 1: Floriculture and Landscaping		
Batch 2022-2023	**Hours / Week 4**	**Credits 2**

COURSE OBJECTIVES

- To know the latest development in the field of floriculture.
- To develop skills on arena of floriculture and landscaping.
- To create knowledge on self employment through entrepreneur skills

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Acquire knowledge on cultivation of economic flowers.
	CO2	Understand the techniques involved in flower arrangement and decoration.
	CO3	Apply knowledge on green house cultivation practices.
	CO4	Implement acquired knowledge on commercial applications of plants in landscape gardening.
	CO5	Demonstrate strategic plans for designing various types of gardens

SYLLABUS

UNIT I **(12 Hours)**

Floriculture - Global floriculture - Floriculture in India - Economic flowers - Rose, Jasmine, Crossandra, Chrysanthemum - Cultivation and uses.

UNIT II **(12 Hours)**

Cut flowers - Significance of cut flower industry in India* - Export - Flower arrangement and decoration - dehydrated flowers, foliage and floral craft.

UNIT III **(12 Hours)**

Green house cultivation of cut flowers -Green house technology - advantages - Green house cultivation of Orchids - Anthurium - Gerbera - Dahlia - Tuberosa - Gladioli.

UNIT IV **(12 Hours)**

Landscape gardening - important principles in layout a garden - Aboriculture - Shrubs and climbers - annual, biennial herbaceous perennials - Ornamental palms - Succulents and Cacti.

UNIT V **(12 Hours)**

Water garden, Rock garden, Roof garden, Vertical garden, Hydrophonics, Lawn, Bonsai - Horticultural shows.

22PBO0J1

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. Kumar, N. (1999). An introduction to horticulture. Rajalakshmi Publication, Nagarcoil.
2. T.K. Bose, R.G. Maity, R.S. Dhua and P.Das, (1999). Floriculture and Landscaping, Naya Prokash, Calcutta.
3. S.Prasad and U.Kumar. (2013). A handbook of Floriculture Agrobios (India).
4. Pooja. (2012). Handbook of Floriculture. Discovery Publishing Pvt.Ltd.
5. Alka Singh.(2015). A Colour Handbook: Landscape Gardening. New India Publishing Agency

REFERENCES

1. Doesh Beer Singh and Poonam Wazir, (2002). Bonsai - An art. Scientific Publishers, Jodhpur.
2. Roy Edwin Biles, (2003). The complete Book of Gardening. Biotech Books, Delhi
3. Bhattacharjee, S.K. (2006). Advances in Ornamental Horticulture. Pointer Publication, Jaipur.
4. P. Ranchana, M Kannan, S Vinodh. (2017). An Illustrated Dictionary of Floriculture and Landscaping. New India Publishing Agency.
5. Sachin Tyagi and Sanjay Sahay.(2019). Protected Cultivation of Flowers. New India Publishing Agency.
6. Anil K Singh, (2020).Textbook of floriculture and landscaping. New India Publishing Agency.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	M	H
CO2	S	M	H	H	M
CO3	H	S	M	H	H
CO4	S	H	M	S	M
CO5	S	S	H	H	M

S - Strong **H** - High **M** - Medium **L** - Low

22PBO0J2

Programme Code: 05	**M.Sc., BOTANY**	
JOC 2 : Food Processing and Preservation		
Batch	**Hours / Week**	**Credits**
2022-2023	**4**	**2**

COURSE OBJECTIVES

- To know the recent technologies developed in the field of food science
- To develop skills in the aspects of Food processing and preservation
- To get employment opportunities in food processing industries

COURSE OUTCOMES

On successful completion of the course, the students will be able to

K1 ↕ K5	CO1	Recognize about preliminary preparation of food through various processes
	CO2	Understand the nutritive values and significance of cereals
	CO3	Apply knowledge on pulses and nuts and their nutritive perspectives
	CO4	Implement food preservation techniques applicable for day to day life
	CO5	Evaluate strategies for the preservation of food products and their quality enhancement

SYLLABUS

UNIT I **(12 Hours)**

Food groups - Basic groups **:** basic Four, Five and Seven, food in relation to health. Preliminary preparation of food - cleaning, peeling, stinging, cutting and grafting, soaking, marinating, sprouting, fermenting, grinding, drying and filtering - their advantages and disadvantages.

UNIT II **(12 Hours)**

Cereals and cereal products, structure composition and nutritive value of cereals - wheat and wheat products, rice and its products; fermented and unfermented products.

UNIT III **(12 Hours)**

Pulses composition and nutritive value, toxic constituents, trypsin inhibitor, hemagglutinins, cyanogenic glucoside, saponins and tannins. Nutritive values of nuts and oil seeds, toxins - aflatoxins and gossypol. Fruits and Vegetables - classification, composition and nutritive values.

UNIT IV **(12 Hours)**

Milk and milk products, nutritive value of milk, processing - clarification, pasteurization and homogenization. Milk products - fermented milk products - butter, cheese and curd. Preparation of cheese. Non-fermented products - skimmed milk, dry milk, ice cream. Flesh foods - meat, fish and poultry - composition and nutritive values.

21PBO0J2

UNIT V **(12 Hours)**

Food preservation by high and low temperatures (outline). Preservation by high osmotic pressure, high concentration of sugar, jam and jelly preparation, high concentration of salts. Principles and preparation of pickles - preservation by dehydration*. Principles and methods of drying - freeze drying, sun drying, mechanical driers - spray drying and foam mat drying and by smoking.

***Self study**

Teaching Methods

Smart Class Room/PowerPoint presentation/Seminar/Quiz/Discussion

TEXT BOOKS

1. Srilakshmi. B. (2003). Food Science, New Age International Publishers, New Delhi.
2. Frazier W.C. and Westhoff. D.C. (1978). Food Microbiology, Tata McGraw-Hill, Chennai.

REFERENCES

1. Subbulakshmi, G. (2006). Food processing and preservation, New Age International Pvt Ltd Publishers.
2. Adams M.R. and Moss M.O. (2008). Food Microbiology, The Royal Society of Chemistry, Cambridge.
3. Swaminathan M.S. (1985). Essentials of food and nutrition, Bappco Publisher, Bangalore.

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	H	S
CO2	H	H	S	H	H
CO3	S	M	H	M	H
CO4	S	M	S	H	M
CO5	H	H	M	S	M

S - Strong **H** - High **M** - Medium **L** - Low