M. Sc. BOTANY

SYLLABUS - 2014

SCHOOLS OF EXCELLENCE
with
CHOICE BASED CREDIT SYSTEM (CBCS)

SCHOOL OF BIOLOGICAL SCIENCES
St. JOSEPH'S COLLEGE (Autonomous)
Accredited at 'A' Grade (3rd Cycle) by NAAC
College with Potential for Excellence by UGC
TIRUCHIRAPPALLI - 620 002, INDIA

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)

POST GRADUATE COURSES

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to work towards the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from this academic year 2014 – 15, to standup to the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system allows the enhanced academic mobility and enriched employability of the students. At the same time this system preserves the identity, autonomy and uniqueness of every department and reinforces their efforts to be student centric in curriculum designing and skill imparting. These five schools will work concertedly to achieve and accomplish the following objectives.

- Optimal utilization of resources both human and material for the academic flexibility leading to excellence.
- Students experience or enjoy their choice of courses and credits for their horizontal mobility.
- The existing curricular structure as specified by TANSCHE and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice based credit system.
- Human excellence in specialized areas
- Thrust in internship and / or projects as a lead towards research and
- The **multi-discipline** nature of the newly evolved structure (School System) caters to the needs of stake-holders, especially the employers.

What is Credit system?

Weightage to a course is given in relation to the hours assigned for the course. Generally one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The following Table shows the correlation between credits and hours.

However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For PG courses a student must earn a minimum of 110 credits. The total number of courses offered by a department is given above. However within their working hours few departments / School can offer extra credit courses.

SUMMARY OF HOURS AND CREDITS PG COURSES - BOTANY

Part	Semester	Specification	No. of Courses	Hours	Credits	Total Credits
1	I-IV	**Core Courses** Theory Courses Laboratory Courses	 10 7	 56 26	 49 21	
	II	**Self Paced Learning**	1	-	2	
	IV	**Comprehensive Examination**	1	-	2	**81**
	IV	**Project Dissertation & Viva Voce**	1	14	7	
2	III-IV	**Core Electives**	3	12	12	**12**
3	I-III	**IDC (WS)** **IDC (Common)** **IDC (BS)**	1 1 1	4 4 4	4 4 4	**12**
4	I-IV	**Additional Core Courses**				
5	IV	SHEPHERD & Gender Studies	1	-	5	**5**
		TOTAL		**120**		**110**

IDC – Inter Departmental Courses
BS – Between School
WS – Within School

Total Hours : **120**
Total Credits : **110**

However, there could be some flexibility because of practicals, field visits, tutorials and nature of project work. For PG courses a student must earn a minimum of 110 credits. The total number of courses offered by a department is given above. However within their working hours few departments / School can offer extra credit courses.

Course Pattern

The Post Graduate degree course consists of five vital components. They are cores courses, core electives, additional core courses, IDC's and SHEPHERD. Additional Core courses are purely optional on the part of the student. SHEPHERD, the extension components are mandatory.

CORE COURSE

A core course is the course offered by the parent department related to the major subjects, components like theories, practicals, self paced learning, common core, comprehensive examinations, dissertations & viva voce, field visits, library record form part of the core courses.

CORE ELECTIVE

The core elective course is also offered by the parent department. The objective is to provide choice and flexibility within the School. There are three core electives. It is offered in different semester according to the choice of the school.

ADDITIONAL CORE COURSES (If any)

In order to facilitate the students gaining extra credit, the additional core courses are given. The students are encouraged to avail this option of enriching with the extra credits.

INTER DEPARTMENTAL COURSES (IDC)

IDC is an interdepartmental course offered by a department / School for the students belonging to other departments / school. The objective is to provide mobility and flexibility outside the parent department / School. This is introduced to make every course multi-disciplinary in nature. It is to be chosen from a list of courses offered by various departments.

There are three IDC's. Among three, one is the Soft-Skill course offered by the JASS in the II Semester for the students of all the Departments. The other one is offered "With-in the school" (WS) and the third one is offered "Between the school" (BS). The IDC's are of application oriented and inter disciplinary in nature.

Subject Code Fixation

The following code system (9 characters) is adopted for Post Graduate courses:

14	PXX	X	X	XX
↓	↓	↓	↓	↓
Year of Revision	PG Code of the Dept	Semester of the Part	Specification of Part	Running number in the part
14	**PBO**	**1**	**1**	**01**

For Example :

I M.Sc. Botany, first semester, Plant Diversity-I
The code of the paper is 14PBO1101.
Thus, the subject code is fixed for other subjects.

Specification of the Part

1. Core Courses: (Theory, Practical, Self paced Learning, Common Core, Comprehensive Examination, Dissertation and Viva-voce)
2. Core Electives
3. Additional Core Courses (if any)
4. Inter Departmental Courses (WS, Soft Skill & BS)
5. SHEPHERD & Gender Studies

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	**100**

MID-SEM & END – SEM TEST

Centralised – Conducted by the office of COE

1. Mid-Sem Test & End-Sem Test: (2 Hours each); will have Objective + Descriptive elements; with the existing question pattern PART-A; PART-B; and PART-C
2. CIA Component III for UG & PG will be of 15 marks and compulsorily objective multiple choice question type.
3. The CIA Component III must be conducted by the department / faculty concerned at a suitable computer centres.
4. The 10 marks of PART-A of Mid-Sem and End-Sem Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS; TRUE / FALSE; and FILL-IN BLANKS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.

SEMESTER EXAMINATION

Testing with Objective and Descriptive questions

Part-A: 30 Marks

Objective MCQs only

Answers are to be marked on OMR score-sheet. The OMR score-sheets will be supplied along with the Main Answer Book. 40 minutes after the start of the examination the OMR score-sheets will be collected.

Part-B + C = 70 Marks

Descriptive

Part-B: 5 x 5 = 25 marks; inbuilt choice;

Part-C: 3 x 15 = 45 marks; 3 out of 5 questions, open choice.

The Accounts Paper of Commerce will have

Part-A: Objective = 25

Part-B: 25 x 3 = 75 marks.

Duration of Examination must be rational; proportional to teaching hours 90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

EVALUATION

Percentage Marks, Grades & Grade Points

UG (Passing minimum 40 Marks)

Qualitative Assessment	Grade Points	Grade	Mark Range %)
Exemplary	10	S	90 & above
Outstanding	9	A+	85-89.99
Excellent	8	A	80-84.99
Very Good	7	B	70-79.99
Good	6	C	60-69.99
Pass (PG)	5	D	50-59.99
RA (PG)	0	RA	< 50

CGPA - Calculation

Grade Point Average for a semester is calculated as indicated here under:

$$\frac{\text{Sum total of weighted Grade Points}}{\text{Sum of Gredits}}$$

Weighted Grade Points is ***Grade point x Course Credits.*** The final CGPA will only include: Core, Core Electives & IDCs.

A Pass in SHEPHERD will continue to be mandatory although the marks will not count for the calculation of the CGPA.

POSTGRADUATE		
CLASS	Mark Range (%)	
	ARTS	SCIENCES
Distinction	75 & above, first attempt	80 & above, first attempt
First	60 - 74.99	60 - 79.99
Second	50 - 59.99	50 - 59.99

Declaration of Result:

Mr./Ms. _____ has successfully completed the Post Graduate in _____ programme. The candidate's Cumulative Grade Point Average (CGPA) is _____ and the class secured _____ by completing the minimum of 110 credits.

The candidate has also acquired _____ (if any) additional credits from courses offered by the parent department.

_____

M. Sc. Botany

Course Pattern - 2014 Set

Sem.	Code	COURSE	Hours	Credits
I	14PBO1101	Plant Diversity-I (Thallophytes and Bryophytes)	6	5
	14PBO1102	Laboratory Course 1	4	3
	14PBO1103	Plant Diversity-II (Pteridophytes, Gymnosperms and Paleobotany)	6	5
	14PBO1104	Plant Anatomy, Embryology and Morphogenesis	6	5
	14PBO1105	Laboratory Course 2	4	3
	14PBO1201A	Cell and Molecular Biology OR	4	4
	14PBO1201B	Forestry and Wood Science		
		Total for Semester I	***30***	***25***
II	14PBO2106	Plant Physiology	5	5
	14PBO2107	Laboratory Course 3	3	3
	14PBO2108	Ecology and Phytogeography	5	4
	14PBO2109	Research Methodology	5	5
	14PBO2110	Laboratory Course 4	4	3
	14PBO2202A	Biophysics and Instrumentation OR	4	4
	14PBO2202B	Plant Pathology		
	14PSS2401	IDC: Soft Skills	4	4
		Total for Semester II	***30***	***28***
III	14PBO3111	Plant Systematics	6	5
	14PBO3112	Laboratory Course 5	4	3
	14PBO3113	Biochemistry	5	5
	14PBO3114	Laboratory Course 6	3	3
	14PBO3203A	Genetics OR	4	4
	14PBO3203B	Pharmacognosy		
	14PBO3402	IDC (WS): Bioprocess Technology	4	4
	14PBO3403	IDC (BS): Horticulture and Landscaping	4	4
		Total for Semester III	***30***	***28***
IV	14PBO4115	Microbiology and Immunology	6	5
	14PBO4116	Genetic Engineering and Biotechnology	6	5
	14PBO4117	Laboratory Course 7	4	3
	14PBO4118	Comprehensive Examination	--	2
	14PBO4119	*Self-paced Learning:* Plant Breeding and Evolution	--	2
	14PBO4120	Dissertation & *Viva Voce*	14	7
I-IV	14PCW4501	SHEPHERD & Gender Studies		5
		Total for Semester IV	*30*	*24*
		Total for all Semesters	**120**	**110**

WS – IDC within School BS – IDC between Schools

Sem. I **Hours/Week: 6**
14PBO1101 **Credits: 5**

PLANT DIVERSITY - I
(Thallophytes and Bryophytes)

Objectives

1. To understand the major groups of cryptogramic plants and their characteristics.
2. To trace their interrelationships and study their evolutionary trends.

Unit I

Algae: Introduction and history of phycology. Algology in India (Contributions of eminent Indian algologists). Criteria used in algal classification (Fritsch & De Silva) - Life cycles and mass culture of algae - General characteristics, thallus variations, reproduction, distribution and economic importance of major groups of algae. Cyanophyta: *Oscillatoria, Nostoc* and *Scytonema.*

Unit II

Chlorophyta: *Chlamydomonas, Volvox, Chlorella, Pediastrum, Scenedesmus, Cladophora, Coleochaete, Ulva, Caulerpa, Oedogonium, Zygnema, Spirogyra.* Phaeophyta: *Ectocarpus, Sphacelaria, Dictyota, Padina, Sargassum.* Rhodophyta: *Porphyra, Batrachospermum, Gelidium, Gracillaria, Polysiphonia. Centric and Pinnate Diatoms, Vaucheria, Euglena.*

Unit III

Fungi - general features, occurrence and distribution; Classification of fungi (Ainsworth, 1973; Alexopoulos and Mims, 1983), recent trends in the classification of fungal cell ultrastructure; General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Thallus organization; cell wall composition; ecology of fungi, mode of nutrition (saprobic, biotropic and symbiotic); reproduction (vegetative, asexual and sexual), Spore dispersal mechanisms.

Unit IV

Heterothallism; heterokaryosis; parasexuality; sex hormones in fungi; degeneration of sex. Economic importance of fungi. Fossil fungi. Phylogeny and interrelationship of Myxomycetes, Oomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes.

Lichens: Classification of Lichens (Hale, 1969). Occurrence and interrelationship of phycobionts and mycobionts, structure and reproduction

in Ascolichens, Basiodiolichens and Deuterolichens. Lichens as indicators of Pollution. Economic importance of lichens.

Unit V

Bryophyta - classification, general and reproductive characters of major classes - distribution of bryophytes - comparative study of gametophytes and sporophytes of major classes. Hepaticopsida: *Marchantia, Targionia, Porella, Cyathodium*. Anthocerotopsida: *Anthoceros, Notothyllus*. Bryopsida: *Sphagnum, Polytrichum* and *Bryum*. Spore dispersal mechanisms and economic importance.

Books

1. Singh, Pande and Jain. 1998.A text book of Botany, Rastogi Publication, Meerut.
2. Venkataraman, *et al*., 1974, Algae-Form & Function. Today and Tomorrow, Pub. Co.
3. Prem Puri, 1973. Bryophytes - a broad perspective. Atma Ram & Sons, New Delhi.

Reference

1. Delevoryas, T., 1977, Plant Diversification. Holt, Rinehart & Wintson, New York.
2. Chapman, V.J. & Chapman,D.J. The Algae. ELBS & MacMillan, London
3. Srivastava, H.N., 1999, Fungi. Pradeep Publications, Jalandhar
4. Hale, Jr. M.E., 1983, Biology of Lichens. Edward Arnold, Mayland.
5. Alexopoulus, C. J. and Mims, C. W. (1979). Introductory Mycology. Wiley Eastern Ltd., NY
6. Bessey, E. A. 1979. Morphology and Taxonomy of Fungi. Vikas Pub, New Delhi.
7. Bold, H. C. 1980. Morphology of Plants and Fungi. Harper and Row Publishing Inc., NY
8. Burnet, J. H. 1971. The Fundamentals of Mycology. ELBS Publications, London.
9. Mehrotra, R. S and Aneja, K. R. 1990. An Introduction of Mycology. Wiley Eastern, New Delhi.
10. Vashishta, B. R. and Sinha, A. K. (2007). Botany for Degree Students - Fungi. S. Chand, New Delhi.
11. Cavers F. 1911. The interrelationship of Bryophytes. New Phytologist.

———

Sem. I **Hours/Week: 4**
14PBO1102 **Credits: 3**

Laboratory Course-I

PLANT DIVERSITY-I (Thallophytes and Bryophytes)

Algae

Ulva, Caulerpa, Padina, Sargassum, Batrachospermum, Gracilaria, Nostoc and *Oscillatoria*.

Fungi

Plasmodiophora, Rhizopus, Pilobolus, Xylaria, Phyllochora, Aspergillus, Penicillium, Agaricus and *Fusarium.*

Lichen

Usnea.

Bryophytes

Reboulia, Anthoceros, Pogonatum and *Polytrichum*

Field Trip and Report submission.

———

Sem. I **Hours/Week: 6**
14PBO1103 **Credits: 5**

PLANT DIVERSITY-II
(Pteridophytes, Gymnosperms and Palaeobotany)

Objectives

1. To understand the major groups of lower vascular plants and their characteristics.
2. To trace their interrelationships and study their evolutionary trends.

Unit I

Peridophytes- General Topics. General characters - Reimer's classification (1954), Different theories of origin, life cycle, Telome concept. Sporangium development - eusporangiate type and leptosporangiate type. Range of structure, reproduction and evolution of the gametophytes- sex organs. Apogamy and Apospory. Detailed account on stelar and soral evolution. Heterospory and seed habit.

Unit II

Diversity in pteridophytes - morphology, anatomy, reproduction and evolution of the gametophytes and sporophytes of the following genera *Psilotum, Lycopodium, Selaginella, Equisetum, Alsophila* and *Marsilea.*

Unit III

Gymnosperms - general characters. Classification of gymnosperms (Sporne, 1965). Phylogeny and economic importance of gymnosperms. Comparative study of Cycadopsida, Coniferopsida, and Gnetopsida. Salient features of Pteridospermales, Bennettitales, Pentaxylales, Cycadales, Cordaitales, Coniferales and Gnetales.

Unit IV

A general account of distribution, morphology, anatomy, reproduction and life cycle of the following genera: Cycadopsida- *Cycas*, Coniferopsida- *Cupressus*- Gnetopsida- *Gnetum.*

Unit V

Palaeobotany - Geological time scale, fossilization and types of fossil. Carbon dating. Detailed study of the fossil forms - Pteridohytes: *Rhynia, Lepidodendron* and *Calamites.* Gymnosperms: *Lyginopteris, Williamsonia, Cordaites.*

Books

1. Vasista PC, Sinha AK and Anilkimar. 2005. Botany for degree students, Gymnosperms, S Chand, New Delhi.
2. Pandey BP. 1998. A Text Book of Botany Vol. II. S Chand, New Delhi.

Reference

1. Pandey, S.N., S.P. Misra and P.S. Trivedi. 2002. A Textbook of Botany Volume II. Vikas Publishing House Pvt Ltd, New Delhi.
2. Rashid.A. 2007. An Introduction to Pteridophyta - Vikas publications, New Delhi.
3. Johri, RM, Lata S, Tyagi K (2005), A text book of Gymnosperms, Dominate Pub and Distributor, New Delhi
4. Sporne, K.R. (1975). The Morphology of Pteridophytes, Hutchinson and Co., London.
5. Sporne, K.R. (1967). The morphology of gymnosperms, Hutchinson and Co., London.

———

Sem. I **Hours/Week: 6**

14PBO1104 **Credits: 5**

PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS

Objectives

1. To understand the basic principles of differentiation of cell types.
2. To know the process of growth and development through totipotency.

Unit I

Cambium: Development of cambium in root and stem. Cell type in vascular cambium. Infected vascular cambia, seasonal activity in cambium, cambium in wound healing and grafting. Vascular cambium and periderm formation in monocot and wound periderm.

Unit II

Anomalous Secondary Growth: Concepts-Modification of the common type of vascular cambium-Unique activity of the vascular cambium. Discontinuous, unidirectional and bidirectional activity of cambium. Anomalous secondary growth in Beet root and sweet potato.

Unit III

Male gametophyte: Structure and development, microsporogenesis, male gametophyte development. Pollen morphology, exine sculpturing, pollen kit, NPC formula. Viability of pollen grains. Pollination, pollen germination, growth and nutrition of pollen tube.

Female gametophyte: Ovule: Structure, ontogeny and types. Megasporogenesis. Embryosac - development, types, ultrastructure and nutrition of embryosac. Female gametophyte development.

Unit IV

Fertilization: Double fertilization; embryo development - different types. Endosperm development, types of endosperm, haustorial behavior of endosperm. Xenia and metaxenia.

Polyembryony - types and causes. Seed formation, dormancy and germination. Apomixis, Parthenogenesis.

Unit V

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristems; shoot and root development, leaf development and phyllotaxy; transition of flowering, floral meristems and floral development.

Books

1. Fahn.A. (1989) Plant Anatomy. Maxwell, Macmillan, Singapore.
2. Bhojwani, S.S., (1981) Embryology, of Angiosperms, Vikar & Bhatnagar, New Delhi

Reference

1. Clowes, F.A.L., (1961) Apical Meristems. Blackwell Scientific, Oxford.
2. Cutter, E.G., (1978) Plant Anatomy. Edward Arnold Ltd., London.
3. Esau, K., (1953) Plant Anatomy. Jon Willey & Sons Inc, New York.
4. Maheshwari, P.,(1988) An Introduction to the Embryology of Angiosperms, McGraw-Hill.
5. Raghavan, V., (1976) Experimental Embryogenesis in Vascular Plant, Academic press.

Sem. I **Hours/Week: 4**
14PBO1105 **Credits: 3**

Laboratory Course-II
(Pteridophytes, Gymnosperms, Palaeobotany, Anatomy, Embryology and Morphogenesis)

Pteridophytes

Psilotum, Lycopodium, Selaginella, Equisetum, Alsophila and *Marsilea.*

Gymnosperms

Cycas, Cupressus and *Gnetum.*

Palaeobotany

Rhynia, Lepidodendron, Calamites, Lyginopteris, Williamsonia and *Cordaites.*

Plant Anatomy and Embryology

- Study of cambia - non storied and storied.
- Study the anomalous primary and secondary features in *Aristolochia, Bignonia, Boerhaavia, Nyctanthes* and *Dracaena.*
- Study of stomata, trichomes, and laticifers.
- Examine of shoot apices in *Hydrilla* and *Philodendron.*
- Examine of root apical meristem in *Philodendron.*
- Study of leaf anatomy - structure, stomata, trichomes, types of stomata.
- Study of pollen morphotypes (at least 6 examples: Malvaceae, Asteraceae, Convolvulaceae, Labiatae and Graminae.)

- Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds and polyembryony in citrus, jamun (*Syzygium cumini*) etc. by dissections.
- Tests for pollen viability using stains and in vitro germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
- Wound healing.

Sem. I **Hours/Week: 4**
14PBO1201A **Credits: 4**

Core Elective-I

CELL AND MOLECULAR BIOLOGY

Objectives

1. To understand the structural organization and function of different cell organelles.
2. To study the basic principles of the central dogma of life.

Unit I

Major intracellular compartments in eukaryotic cells (brief study only). Structural organization of cell membranes: chemical composition; structure and function of membrane carbohydrates, membrane proteins and membrane lipids. Membrane functions.

Unit II

Cell growth and division: Phases of cell cycle, cell cycle control system, Cell cycle checkpoints - DNA damage checkpoint, centrosome duplication checkpoint, spindle assembly checkpoint. Cyclins and Cyclin-dependent kinases. Cell division: mitosis and meiosis (brief study only). Cytoskeleton structure and functions: actin filaments (microfilaments), microtubules, and intermediate filaments.

Unit III

Cell communication: general principles. Signaling molecules and their receptors, external and internal signals that modify metabolism, growth, and development of plants. *Receptors:* Cell surface receptors - ion-channel linked receptors, G-protein coupled receptors, and Tyrosine-kinase linked receptors (RTK). Plant two-component signaling systems. *Genetic code:* Cracking the genetic code - simulation synthetic polynucleotides and mixed copolymers, synthetic triplets. Important features of the genetic code, proof for the triplet code, Exceptions to the standard code.

Unit IV

Transcription in prokaryotes: Initiation - promoter structure, structure of RNA polymerase, structure and role of sigma factors. Elongation - elongation complex, process of RNA synthesis. Termination - rho-dependent and rho-independent termination. *Transcription in eukaryotes:* Types, structure and roles of RNA polymerases. Promoters - important features of class I, II, & III promoters. Enhancers and silencers. General transcription factors and formation of pre-initiation complex. Elongation factors, structure and function of transcription factors. *Post-transcriptional events:* Split genes, splicing signals, splicing mechanisms of group I, II, III, and tRNA introns. Alternative splicing, exon shuffling, *cis* and *trans* splicing. Structure, formation and functions of 5' cap and 3' tail of mRNA, RNA editing, mRNA export.

Unit V

Translation: Important features of mRNA - ORF, RBS. Fine structure, composition and assembly of prokaryotic and eukaryotic ribosomes. tRNA charging, initiator tRNA. *Stages in translation:* Initiation - formation of initiation complex in procaryotes and eukaryotes, initiation factors in prokaryotes and eukaryotes, Kozak sequence. Elongation - process of polypeptide synthesis, active centers in ribosome - 3-site model, peptidyl transferase, elongation factors. Termination - process of termination, release factors, ribosome recycling. *Protein sorting and translocation:* cotranslational and post-translational - signal sequences, SRP, translocon. Membrane insertion of proteins. Post-translational modification of proteins. Protein folding - self assembly, role of chaperones in protein assembly. *Principles of gene regulation: lac* operon and *trp* operon.

Book

Gardner *et al*. 2004, Principles of Genetics. John Wiley &Sons Inc. Singapore.

Reference

1. De Robertis and De Robertis, 1990, Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Freifelder D. 1987, Molecular Biology. Jones and Bartlett, Boston, USA.
3. Weaver, R.F. and Hedrick,P.W., 1989, Genetics. Wm, C. Brown Pub, Dubuque.
4. Watson J.D. *et. al*., 2004, Molecular biology of the gene, Pearson education, Singapore.
5. Lodish *et. al*., 2004, Molecular cell biology, COH freeman & Co. New York.

Sem. I **Hours/Week: 4**
14PBO1201B **Credits: 4**

Core Elective-II

FORESTRY AND WOOD SCIENCE

Objectives

1. To prepare students for careers in the forest services and wood products industry.
2. To educate students to provide technical expertise to the wood industries.

Unit I

World and Indian forest scenario; Forest types of India; Forest influences and protection; Rare and endangered species; Conservation strategies; Exotics and its significance; Silvicultural principles and practices; Genetic Engineering and its application in forestry; Remote sensing and GIS in forestry.

Unit II

Forest Resources and utilization; Forest products; Forest laws and policies, people and Forest; Social and community forestry; Forest industries; Role of social forestry in cottage industry; Role of forestry in Indian economy. Biomass conversion strategies - energy plantations.

Unit III

Nature and properties of wood: physical, chemical, mechanical and anatomy of wood. Durability of wood. Wood seasoning and preservation; Defects and abnormalities of wood; types of commercial wood species of India.

Unit IV

Wood deterioration- fungi, insects and other agents; Wood protection- Practical methods for preserving and protection, Chemical processing of wood.

Unit V

Composite wood: adhesives-manufacture, properties, uses, manufacture and uses of plywood, fiber boards and particle boards. Present status of composite wood, paper and rayon industries. Present position of supply of raw material to industries and wood substitution.

Activity: Raising nursery for social forestry

Books

1. De Vere Burton L., 2000, Introduction to Forestry Science, Delmar publishers, N Y.
2. J.L. Bowyer, R. Shmulsky and J.G. 2007. Haygreen. Forest Products and Wood Science: An Introduction, Blackwell Publishing Professional.
3. Franz F. P. Kollmann, Wilfred A. Jr. Cote. 2012. Principles of Wood Science and Technology: I Solid Wood, Springer.

Reference

1. Negi, S.S., 1994, India's Forests, Forestry and Wildlife, Indus Publishing Com., New Delhi.
2. Jha, L.K., 1996. Forestry for rural development, APH Publishing Corporation, New Delhi.

———

Sem. II **Hours/Week: 5**
14PBO2106 **Credits: 5**

PLANT PHYSIOLOGY

Objectives

1. To study the recent aspects of various physiological processes in plants.
2. To understand the application of physiology in agriculture.

Unit I

Water relations of plants: Water potential, osmotic potential and pressure potential - their relationships. Stomatal physiology, mechanism of transpiration and antitranspirants. Source -sink relationships in translocation of solutes. Mineral nutrition of plants. Mineral ion uptake - passive and active uptake, role of H+ ATPase as a carrier, co-transport (symport), counter transport (antiport).

Unit II

Photosynthesis: Chloroplast photoreceptors and their role in energy trapping, energy transforming, and electron transfer system in chloroplast membrane. Photo-oxidation of water and photo-phosphorylation. C3, C4, CAM pathway, photorespiration and its regulation. Photosynthetic efficiencies of C3, C4 and CAM plants, CO2 concentration mechanisms, mechanism of light activation of photosynthetic enzymes.

Unit III

Respiration: Glycolytic reactions, entry of pyruvate into mitochondria and Krebs' cycle. Pasteur effect, anaplerotic reactions, amphibolic nature of the Krebs' cycle. Mitochondrial electron transport and oxidative phosphorylation, unique electron transport enzymes of plant mitochondria, alternate electron pathways in plants and their significance, gluconeogenesis, glyoxylate cycle. Pentose phosphate pathway and its importance.

Unit IV

Biological nitrogen fixation, nif gene, assimilation of nitrate and ammonium. Applications of auxins, gibberellins, cytokinins in agriculture and horticulture. Physiology of growth retardants - ethylene and abscisic acid. Biological rhythm - circadian rhythm, photoperiodism - phytochrome mediated processes. Physiology of flowering and fruit ripening.

Unit V

Dormancy of seeds - causes and methods of breaking dormancy. Physiology of seed germination. Ageing and senescence - types and physiological/

biochemical changes. *Stress Physiology:* Response of plants to abiotic stresses; mechanism of tolerance to abiotic stress (drought and salinity).

Book

1. Pandey, S.N. & Sinha, 2010, Plant Physiology, Vikas Publishing, New Delhi.

Reference

1. Noggle, G.R. and Fritz, G.J. 2001, Introductory Plant Physiology, Prentaice - Hall, India.
2. Devlin, R.M., 2000, Plant Physiology, Affiliated East West Press Pvt. Ltd.
3. Epstein, E., 2000, Mineral Nutrition in Plants-Principles and Perspectives, Wiley.
4. Lincoln, T and Zeiger, Plant Physiology.2010 www.plantphys.net.

———

Sem. II **Hours/Week: 3**
14PBO2107 **Credits: 3**

Laboratory Course-III

PLANT PHYSIOLOGY

1. Determination of water potential (Shardakov's method).
2. Determination of solute potential.
3. Hill reaction.
4. Estimation of total acidity in CAM plants.
5. Apparent photosynthesis.
6. Effect of CO2 concentration on photosynthesis
7. Effect of quality of light on photosynthesis
8. Estimation of total free aminoacids and proline.
9. *In vivo* assay of NR and NiR.
10. Estimation of IAA.
11. Estimation of starch by perchloric method.
12. Estimation of nitrogen (Nessler's method).
13. Determination of activity of peroxidase and lipase.

———

Sem. II **Hours/Week: 5**
14PBO2108 **Credits: 4**

ECOLOGY AND PHYTOGEOGRAPHY

Objectives

1. To understand the basic concepts of ecosystem and biodiversity.
2. To study the principle of sustainable utilization and management of bioresources.

Unit I

Introduction to ecology, evolutionary ecology, environmental concepts - laws and limiting factors, ecological models. Characteristics of population: population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure, population growth. Competition and coexistence, intra-species interactions, inter- species interactions, scramble and contest competition model, mutualism and commensalism. Modes of speciation and reproductive isolating mechanisms. Community structure and community dynamics.

Unit II

Nature of ecosystem structure - abiotic and biotic components. Mineral cycling (C, N, P). Classification of ecosystems and their characteristics. Ecosystem dynamics - productivity, laws of thermodynamics, food chain and food webs, energy flow and the trophic levels and ecological pyramids. Ecological succession in water, grassland and desert ecosystems; pioneer and climax communities. Resilience of ecosystem and ecosystem management. The biosphere, biomes and impact of climate on biomes.

Unit III

Atmospheric ozone depletion, acid rains, global warming, global climate changes and their consequences on food crops and biodiversity. Climate change conferences - UNFCCC and IPCC. Coping with environmental variations and the mechanisms of evolution - genetic drift, gene flow, mutation and natural selection. Species richness - number of species in a community; and evenness - distribution of individuals among species.

Unit IV

Biodiversity - the types and their measurements; and species diversity and its importance. Phytogeography: Climate, atmosphere and the geological time scale; geographical history, continental drift, land bridges, shifting of

poles and plates. Megacentres of origin of crop diversity; phytogeographic regions of the world, and their characteristics with emphasis on vegetation. Phytogeography of the Western Ghats.

Unit V

Concepts of phytogeography: endemism, hotspots, plant explorations, endemism in Western Ghats, invasions and introductions, local plant diversity and its socio-economic importance. *Conservation Biology:* Biodiversity, its importance, assessment, loss and conservation. India's biodiversity. World organisations for conservation of biodiversity, Red List categories of IUCN. Principles and approaches to conservation.

Book

1. Sharma P.D, 2009. Ecology and Environement, Rastogi Publications, Meerut.

Reference

1. Odum, E.P., 1970. Fundamentals of Ecology, 3rd edn, W.B. Saunders Ltd., UK.
2. Melchias G 2001 Biodiversity and Conservation. Science Publishers Inc, NH USA.
3. Krishnamurthy K.V. 2003. An advanced text book on Biodiversity Principle and Practice. Oxford and IBH Publishing Co., New Delhi.

———

Sem. II **Hours/Week: 5**
14PBO2109 **Credits: 5**

RESEARCH METHODOLOGY

Objectives

1. To identify the influencing factors of research parameters.
2. To test the significance, validity and reliability of the research.

Unit I

Research - types, objectives and approaches. Census method, Sample - types; Sampling Techniques. Hypothesis: definition, characteristics, types, significance. Methods of collecting data: primary and Secondary- merits and demerits, Code of research ethics.

Unit II

Literature collection: web browsing. Review: Introduction, components and purpose. Structure of thesis and journal article. Manuscript for publication and proof correction. Structure and components of research proposal, National and International funding sources.

Unit III

Bibliometrics: definition and relevance; Laws - Lotka's Law, Bradford's Law, Zipf's Law. Bibliometrics databases, h-index, PageRank, Impact Factor and evaluation. The use of bibliometrics in research: Citation Research, Science Citation Index. The Institute for Scientific Information (ISI) and Thomson Reuter's Webmetric. Plagiarism, tailored research and retraction.

Unit IV

Biostatistics: Introduction, Classification of data; Frequency Distribution: Discrete, Continuous and Cumulative Frequency Distributions - Tabulation of data- Diagramatic and graphic representation of data; Histogram, Frequency polygon, Frequency curve, Ogive curve, Bar Charts: Simple, Multiple, Subdivided, percentage - Pie diagram.- Measures of Central values: Mean, Median and Mode- Measures of Dispersions: Range, Mean Deviation and Standard Deviation.

UNIT V

Coefficient of Variation - Skewness and Kurtosis. Probability: binomial, poisson and normal distributions. Correlation: types, methods, Regression analysis, Large sample (Z), small sample testing: t-test, chi-square and F test. ANOVA - one and two way, Duncan Multiple Range Test. Principles of

experimental design - randomization, replication, local control, size and shape of the plot, CRD, RBD.

Books

1. Kothari, C.R. 2000. Research Methodology - Methods & Techniques. Wishwa Prakashan.
2. Misra, R.P, 2000 Research Methodology - a handbook, Concept Publg Company, New Delhi.
3. Gupta, S.P., 1990 Statistical Methods, Sultan Chand & Sons, New Delhi.
4. Pillai and Bagavathi, 2008 Statistics, S.Chand & Company Ltd, New Delhi
5. Nageswara Rao, G. 1983. Statistics for Agricultural Science Oxford & IBH, New Delhi
6. Gupta, S.C, 2013. Fundamentals of statistics, Himalaya Publishers, Mumbai.

Reference

1. Hawkins, C and Sorgi, M. 2000 Research, Narosa Publishing House, New Delhi.
2. Daniel, W.W., 1983, Biostatistics; A Foundation for Analysis in the Health Science, John Wiley and Sons Inc., New York.

Reference for Bibliometrics

1. Ball, Philip. 2005. Index aims for fair ranking of scientists. *Nature* 436 (7053):900. http://dx.doi.org/10.1038/436900a.
2. Bornmann, Lutz, and Hans-Dieter Daniel. 2007. What do we know about the h index? *Journal of the American Society for Information Science and Technology* 58 (9):1381-1385. http://dx.doi.org/10.1002/asi.20609
3. Bornmann, Lutz, Rüdiger Mutz, and Hans-Dieter Daniel. 2008. Are there better indices for evaluation purposes than the h index? A comparison of nine different variants of the h index using data from biomedicine. *Journal of the American Society for Information Science and Technology* (5):830-837. http://www3. interscience. wiley.com/ cgi-bin/ fulltext/117908948/HTMLSTART
4. Costas, Rodrigo, and María Bordons. 2007. The h-index: Advantages, limitations and its relation with other bibliometric indicators at the micro level. *Journal of Informetrics* 1 (3):193-203.

   http://www.sciencedirect.com/science/article/B83WV-4NCK2JT-1/1/ddf6c25f8810c462fb8c22ae3d5b5d28

5. Craig, Iain D., Andrew M. Plume, Marie E. McVeigh, James Pringle, and Mayur Amin. 2007. Do open access articles have greater citation impact?: A critical review of the literature. *Journal of Informetrics* 1 (3):239-248.

   http://www.sciencedirect.com/science/article/B83WV-4P18BNV-1/1/0d60463e068ba604e67030229ce6d33b
6. Eysenbach, G. 2006. Citation advantage of open access articles. *PLoS Biol* 4 (5):e157. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt= Citation&list_uids=16683865
7. Thomson Reuters. 2008. Using bibliometrics: a guide to evaluating research performance with citation data.

   http://scientific.thomsonreuters.com/news/newsletter/2008-07/8465001/
8. Garfield, E 2006. The history and meaning of the journal impact factor. *JAMA* 295 (1):90-93. http://jama.ama-assn.org/cgi/content/full/295/1/90.

———

Sem. II **Hours/Week: 4**
14PBO2110 **Credits: 3**

Laboratory Course-IV:

Ecology and Phytogeography and Research Methodology

Ecology and Phytogeography

1. Chemical analysis of water and Soil -Calcium and Magnesium, Total hardness, Carbonates and Bicarbonates, Nitrates and Dissolved oxygen.
2. Vegetation Analysis: Quadrate, Line transect, Species Density, abundance and richness, Basal area and relative dominance.
3. Study of primary productivity (Winkler's method).
4. Field trip.

Research Methodology

1. Sampling by Random Number Table
2. Data Collection
3. Classification of Data: Discrete, continous and cumulative.
4. Stastistical diagrams: Histogram, Frequency curve,Bar chart and Ogive curve
5. Measures of Central Values: Mean, Median and Mode
6. Measures of Dispersion: Range, Mean Deviation and Standard Deviation.
7. Exercises with Tests of Significance
8. Exercises in the calculation of Citation Index.
9. Determination of Impact Factor of Author, Article and Journal.

———

Sem. II **Hours/Week: 4**
14PBO2202A **Credits: 4**

Core Elective:

BIOPHYSICS AND INSTRUMENTATION

Objectives

1. To understand how physical principles are applied to biological system.
2. To know the principles and applications of instruments.

Unit I

Introduction to biophysics, its importance in modern biology. *Bioenergetics:* First and second law of thermodynamic, internal energy, enthalpy, entropy, concept of free energy, standard free energy change of a chemical reaction, ATP and high energy phosphate compounds.

Unit II

Biophotonics: Redox potential, Oxidation and reduction, redox potential and its calculation by Nernst equation, examples of redox potential in biological system. Osmosis and osmotic pressure, role of osmosis in cell volume regulation. Iso, hypo, and hypertonic solutions, their influence on the cell. Ionic diffusion. Active and passive bioelectric properties of membranes.

Unit III

Microscopy: Bright field microscopy - magnification, resolving power, contrast. Dark field microscopy, phase-contrast microscopy, fluorescent microscopy, electron microscopy (SEM and TEM).

Unit IV

Centrifugation: Principle of sedimentation technique. Principle, procedure and application of differential centrifugation, density gradient centrifugation, ultracentrifugation. *Chromatography:* Principles, instrumentation, sampling and applications of Paper, thin layer, column chromatography - gas chromatography and HPTLC.

Unit V

Spectrophotometry: principles and instrumentation of UV/Vis. Flame photometer - general principles and instrumentation. Atomic absorption spectrophotometer, NMR, ESR. *Tracer techniques:* Important stable radioisotopes and their uses in research. Radiation hazards and precautions taken while handling radioisotopes. Measurement of radioactivity - autoradiography, GM counter and scintillation counter.

Book

1. Pranab Kumar Banerjee (2008) Introduction to Biophysics S. Chand, New Delhi.

Reference

1. R.N. Roy A text book of biophysics. New Central Book Agency Pvt. Ltd, Calcutta.
2. Upadhyay, Upadhyay &Nath Biophysical Chemistry. Himalaya Publ. House, Bangalore.
3. Mohan Arora Biophysics. Himalaya Publishing House, Bangalore.
4. R.P. Budhiraja Separation chemistry. New age international (P) Ltd, New Delhi.

———

Sem. II **Hours/Week: 4**
14PBO2202B **Credits: 4**

Core Elective:

PLANT PATHOLOGY

Objectives

1. To study the process of plant pathogenesis and disease establishment
2. To understand the basis of defence mechanism against pathogens and disease control

Unit I

Introduction - scope, significance and terminology of plant pathology. Diseases- concepts, components and causes. Classification of diseases: necrosis, hypertrophy, hyperplasia and hypoplasia.

Unit II

Pathogenesis - pathogens and their mode of dissemination, prepenetration, penetration and post penetration, entry through natural openings, wounds and intact plant surfaces, role of enzymes and toxins in disease development.

Unit III

Effect of infection on physiology of host viz. photosynthesis, respiration, carbohydrate metabolism, nitrogen metabolism, phenols, shikimic acid pathway, importance of phenol oxidation in plant diseases.

Unit IV

Defense mechanisms in plants, morphological and structural defense mechanisms, defense structures, existing before infection, biochemical

defense mechanisms, pre-existing defense mechanisms. Phytoalexins, defense through induced synthesis of proteins and enzymes.

Unit V

Control of plant diseases: biological, cultural and chemical methods, fungicidal, chemotherapy. Plant diseases: causal organisms, symptoms, disease cycle and control measures for the following diseases rots, damping off, rusts, wilt, root rot, leaf spot and leaf blight (one example for each type).

Book

1. Mehrotra R.S., 1994, Plant pathology, Tata Mc Grew publishing company Ltd.

Reference

1. Rangasamy G. 1998. Diseases of crop plants in India. Prentice- Hall of India, New Delhi
2. Sharma P.D., 2001, Microbiology and plant physiology Rastogi publications.
3. Harsfall JG & Cowling E B. 1979. Plant Disease, an advanced Treatise. Academic Press, NY.
4. Mukherjee KG and Jayanti Bhasin, 1986. Plant diseases of India. Tata MacGraw-Hill Publishing Company Ltd. New Delhi.

———

Sem. II **Hours/Week: 4**
14PSS2401 **Credits: 4**

IDC-1:

SOFT SKILLS

Objectives

* Introducing learners to the relevant soft skills at the territory level in order to make them gain competitive advantage both professionally and personally.

Module 1:

Basics of communication and Effective communication

Basics of communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication. Effective communication: Johari Window, The Art of Listening, Kinesthetic, Production of Speech, Organization of Speech, Mo des of delivery, Conversation Techniques, Dialogue, Good manners and Etiquettes.

Module II:

Resume writing and Interview skills

Resume Writing: What is Resume? Types of Resume? Chronological, Functional and Mixed Resume, Steps in preparation of Resume. Interview Skills: Common interview questions, Attitude, Body Language, The mock interviews, Phone interviews, Behavioral interviews.

Module III:

Group discussion and team building

Group Discussion: Group Discussion Basics, GD Topics for Practice, Points for GD Topics, Case-Based and Article based Group Discussions, Points for Case Studies, and Notes on Current Issues for GDS. Team Building: Team Vs Group - synergy, Stages of Team Formation, the Dabbawala. Leadership - Styles, Work ethics. Personal Effectiveness: Personal Effectiveness: Self Discovery, Self Esteem, and Goal setting. Conflict and Stress Management.

Module IV:

Numerical Ability

Average, Percentage, Profit and Loss, Simple Interest, Compound Interest, Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams Calendar, Rations and Proportions.

Module V:

Test of reasoning

Verbal Reasoning: Series Completion, Analogy, Data Sufficiency, Assertion and Reasoning, Logical Deduction. Non-Verbal Reasoning: Series, Classification

References

1. Aggarwal, R.S. 2010 *Quantitative Aptitude, S.Chand & Sons*
2. Aggarwal, R.S. 2010. *A Modern Approach to Verbal and Non Verbal Reasoning*. S.Chand
3. Covey, Stephen. 2004. *7 Habits of Highly effective people*, Free Press.
4. Egan, Gerard. 1994. *The Skilled Helper* (5th Ed). Pacific Grove, Brooks / Cole.
5. Khera, Shiv 2003. *You Can Win*. Macmillan Books , Revised Edition
6. Murphy, Raymond. 1998. *Essential English Grammar*. 2nd ed., Cambridge Univ. Press.
7. Prasad, L. M. 2000. *Organizational Behaviour, S.Chand*
8. Sankaran, K., & Kumar, M. 2010 *Group Discussion and Public Speaking*. M.I. Pub, Agra, Adams Media.
9. Schuller, Robert. (2010). *Positive Attitudes*. Jaico Books.
10. Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.
11. Yate, Martin. (2005). *Hiring the Best: A Manager's Guide to Effective Interviewing and Recruiting*.

———

Sem. III **Hours/Week: 6**
14PBO3111 **Credits: 5**

PLANT SYSTEMATICS

Objectives

1. To understand the relevance of molecular techniques in plant systematics.
2. To study the classical taxonomy with reference to different parameters.

Unit I

History of developments in Taxonomy: Natural systems; Phyletic systems; Phenetics; Cladistics. *Concepts of Taxonomic hierarchy:* Species, Genus, Family and other categories; species concept and intraspecific categories - subspecies, varieties and forms. *Botanical nomenclature:* History of ICBN, rule of priority, typification, author citation, retention, rejection and changing of names, naming a new species, synonyms, effective and valid publication.

Unit II

Construction of taxonomic keys: indented and bracketed - their utilization. Phenetic - Numerical Taxonomy - principles and methods; Cladistic - Principles and methods. *Taxonomic tools:* Herbarium, floras, Botanical gardens, cytological, phytochemical, biochemical and molecular techniques.

Unit III

Data sources of Taxonomy: Concepts of character; Sources of taxonomic characters - Morphology, anatomy, palynology, embryology, cytology, phytochemistry and genome analysis - nuclear and mitochondrial analysis.

Unit IV

Study of the following families (Bentham & Hooker) in detail with special reference to their salient features, interrelationships, evolutionary trends and economic significance: Menispermaceae, Nymphaeaceae, Capparaceae, Caryophyllaceae, Meliaceae. Aizoaceae, Rubiaceae, Asteraceae, Convolvulaceae, Solanaceae.

Unit V

Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae. Loranthaceae. Euphorbiaceae, Hydrocharitaceae, Commelinaceae, Araceae and Cyperaceae.

Books

1. Davis, P.H. & Heywood,V.M 1963, Principles of Angiosperm Taxonomy, Oliver & Boyd.
2. Harborne, J.B. & Turner,B.L, 1984, Plant Chemosystematics, Acad. Press, London.

3. Heywood,V.K & Moore, D.M., 1984, Current Concepts in Plant Taxonomy, AP, London.
4. Lawrence, G.H.M.,1955, The Taxonomy of Vascular Plants, Central Book Depot., MacMillan, New York.

Reference

1. Burkill, I.H., 1965, Chapters of the history of Botany in India, Government of India Press, Nasik, The Manager of Publications.
2. Grant, W.F., 1984, Plant Biosystematics, Acad Press Inc., Canada.
3. Young DA and Seiyler DS (eds.) Phytochemical and angiosperm phylogeny. Praeger publications. NY.
4. Heywood, V.H., 1967, Plant Taxonomy. English Language Book Society, London.
5. Hillis, DM., Moritz, C & Mable, BK (eds) 1996, Molecular Systematics, Sinaver Associates, Sunderland, USA.
6. Jeffrey, C., 1982, Introduction of Plant Taxonomy, Cambridge Uni. Press, Cambridge.
7. Jain, S.K., 1981, Glimpses of Indian Ethnobotany, Oxford & IBH Publ. Co., New Delhi.

———

Sem. III **Hours/Week: 4**
14PBO3112 **Credits: 3**

Laboratory Course-V:

PLANT SYSTEMATICS

I. Binomial identification using flora.

II Study of the following families with reference to their South Indian representatives and a minimum of one member each to be dissected and sketched (to scale):

Menispermaceae, Nymphaeaceae, Capparaceae, Caryophyllaceae, Meliaceae, Aizoaceae, Rubiaceae, Asteraceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae, Loranthaceae, Euphorbiaceae, Hydrocharitaceae, Commelinaceae, Araceae, Cyperaceae

III. Technical description of plants, semi-permanent preparations of dissected floral parts; exercises in key-making; exercises in the important Articles of the Code.

Field Trip Report

———

Sem. III **Hours/Week: 5**
14PBO3113 **Credits: 5**

BIOCHEMISTRY

Objectives

1. To fathom the chemical environment and the dynamics of the biological system.
2. To elucidate the interrelationships of the various pathways.

Unit I

Carbohydrates: Homoglycans: chemical structure and properties of starch, glycogen, cellulose, dextrin and inulin. Heteroglycan: chemical structure and properties of agar, alginic acid (sea weed polysaccharide), glycosaminoglycans and pectins. Glycocalyx oligosaccharide.

Unit II

Lipids and Biomembranes: Triglycerides, phosphoglycerols, derived lipids - steroids, prostaglandins and leukotrienes. Membrane lipids and their alignment in membrane. Membrane proteins and membrane receptors: adrenalin receptors, acetylcholine receptors and insulin receptors.

Unit III

Amino acids and peptides: Amino acids: general structure and classification. Glutathione: structure, metabolism and function. Biology of cyclosporin. Metabolism of phenylalanine and tyrosine; glycine, cysteine and methionine. Coenzyme A from valine, aspartate and cysteine; and polyamines from methionine and arginine.

Unit IV

Proteins: The peptide bond and primary structure. Protein sequencing strategies - chemical and enzymic. Secondary structure and backbone folding. Tertiary structure and stabilizing forces in collagen. Quaternary structure of haemoglobin and its regulatory features. Ligand binding and cooperative effect.

Unit V

Enzymes: Principles of catalysis, activation barrier and energy changes in reaction profile, initial velocity and principles of enzyme kinetics: Michaelis-Menten Equation, Km and Vmax measurements - LB blot; active site organization; and role of cofactors / vitamins. Enzyme regulation: pH, temperature and [S]. Inhibitions and regulation of glutamine synthetase.

Book

Stryer Lubert, 2005, Biochemistry, W.H. Freeman & Co., NY.

Reference

1. Apps *et al.*, 1992, Biochemistry, ELBS.
2. Caret *et al.*, 1993, Inorganic, Organic and Biological Chemistry, WMC Brown, USA.
3. Rawn, David, 1989, Biochemistry, Neil Patterson USA.

———

Sem. III **Hours/Week: 3**
14PBO3114 **Credits: 3**

Laboratory Course-VI:

BIOCHEMISTRY

1. Estimation of glycogen / total polysaccharides
2. Estimation of hexosamine
3. Determination of total proteins [Bradford's / Lowry's]
4. Study of Enzyme Kinetics (experiments with acid phosphatase)
5. Effect of temperature on enzyme activity.
6. Effect of pH on enzyme activity.
7. Effect of [E] on enzyme activity.
8. Effect of [S] on enzyme activity; measurement of V_{max} and K_m.
9. Estimation of Ascorbic acid [Calorimetric / volumetric]
10. Estimation of Riboflavin
11. Estimation of Phenolics [Folin - Ciocalteau]
12. Estimation of Tannins [Folin - Denis / Vanillin hydrochloride]
13. Estimation of total lipids and cholesterol.

———

Sem. III **Hours/Week: 4**
14PBO3203A **Credits: 4**

Core Elective-3:
GENETICS

Objectives

1. To understand the principle and the hereditary mechanisms.
2. To study the structure and functions of genetic materials.

Unit I

Mendel and his work: Material and crossing technique, Mendels Law of inheritance. Gene interaction and lethal genes: non-epistatic inter allelic, kinds of epistatic interactions, lethal genes. Quantitative inheritance.

Unit II

Linkage and crossing over, Multiple alleles, Sex linked inheritance, Sex determination in plants, theories of sex determination and chromosome basis of heredity. Modified Mendelian ratios. DNA is the genetic material: proof: Griffith's, Avery *et al*., and Hershy and Chase. RNA as genetic material.

Unit III

Organization of eukaryotic chromosome and bacterial genome. Special chromosome types - polytene & lamp brush. Chloroplast and Mitochondrial genomes. Watson and Crick model of DNA. Replication of DNA: types and mechanism. DNA repair mechanisms - mismatch and proof reading, photoreactivation, excision, recombination and SOS mechanisms in *E. coli*.

Unit IV

Gene mutation: Types, physical and chemical mutagens and their mode of action. Application of mutation. Mobile genetic elements- IS elements and transposons in maize and bacteria. Transposition, phenotypic and genotypic effects - evolutionary significance.

Unit V

Population genetics: gene frequency, gene pool, Hardy-Weinberg equilibrium. Gene frequencies - conservation and changes. Decline of human gene pool and eugenics Genomics: *Arabidopsis* genome and rice genome. Human genome project and the controversies.

Book

Verma, P.S. & V.K. Agarwal, 2003, Genetics. S. Chand, New Delhi-55.

Reference

1. Gardner E J, Simmons M J, Snustad D P (1991). *Principles of Genetics* (III Edn). John Wiley and Sons Inc. 8th Edn., New York.
2. Snustad D P, Simmons M J (2000). *Principles of Genetics* (III Edn). John Wiley and Sons.
3. Strickberger (2005). *Genetics* (III Edn). Prentice Hall of India Pvt. Ltd.
4. William S Klug, Michael R Cummings (1994). *Concepts of Genetics*. Prentice Hall.
5. Robert J Brooker (2009). *Genetics: Analysis and principles* (III Edn). McGraw Hill.
6. Daniel L Hartl, Elizabeth W Jones (2009). *Genetics: Analysis of genes and genomes* (VII Edn). Jones and Bartlett publishers.
7. D Peter Snustad and Michael J Simmons (2010). *Principles of genetics*. John Wiley & Sons.

———

Sem. III **Hours/Week: 4**
14PBO3203B **Credits: 4**

Core Elective-3:
PHARMACOGNOSY

Objectives

1. To study the different systems of Indian medicines and the bioactive principles.
2. To know the ethnopharmacological importance of medicinal plants.

Unit I

Traditional and alternative system of medicine - Principle, practice, short history and merits of herbal medicine- naturopathy, traditional chinese, folk medicine, Ayurveda, Siddha, Unani, Homeopathy, Aromatherapy and acupuncture. Global trend in herbal market. Status of Indian medicinal plant trade, medicinal plants prohibited from export, leading companies in India in trade of medicinal plants. WHO regulation of herbal medicine.

Unit II

Classification of crude drugs - alphabetical, taxonomical, morphological, chemical, pharmacological (therapeutical). Cultivation-sexual and asexual method of propagation, fertilizer and manure, pest and its control, collection, processing of herbal drugs - harvesting, drying, dressing, packing and storage.

Unit III

Medicinal useful plant parts - Root-*Hemidesmus indicus, Withania somnifera, Rauvolfia serpentina*; Rhizome - *Zingifera officinalae, Acorus calamus, Curcuma longa*; Stem- *Tinospora cordifolia, Santalum album, Cinchona officinalis;* Bark- *Terminalia arjuna, Cinnamomum verum, Saraca asoca*; Leaf - *Adhatoda vasica, Ocimum sanctum, Cynodon dactylon*; Flowers - *Crocus sativus, Syzygium aromaticum, Leucus aspera*; Fruits - *Phyllanthus emblica, Piper longum, Terminalia chebula;* Seeds- *Azadirachta indica, Vernonia anthelmintica, Ricinus communis*.

Unit IV

Herbal preparation methods and herbs - bolus, capsules, compresses, creams, decoctions, extracts, infusions, herbal tea, ointments, massage oils, medicinal vinegar, poultice & plasters, powders, salves, syrups, tinctures, tonic, maceration and baths and bathing remedies teas and dry extract (pills or capsules). Method of administration.

Unit V

Pharmaceutical plant products- alkaloids, glycosides, terpenoids, tannins, flavonoids, lipids, proteins. Nutracueticals, cosmecuticals, pharmaceuticals - fibre, sutures, surgical dressings, adaptogens, rasayana. Drug adulteration and methods of evaluation - physical, chemical and microscopic.

Books

1. James Green, 2000 Herbal Medicine-Maker's Handbook, Crossing Press, U.S.
2. Weiss, Rudolf Fritz 2000 Herbal Medicine, 2nd Edition Thieme Medical Publishers.
3. S. Somasundaram 1997. Maruthuva Thavaraiyal, Ilangovan Padhippagam, Palayamkottai.
4. Kokate CK, Purokit AP and Gokahale, 2006. Pharmacognosy, Nirali Prakashan.

Online Resources

- http://www.gallowglass.org/jadwiga/herbs/preparations.html
- http://shawnacohen.tripod.com/thetribaltraditions/id51.html
- http://www.vasundharaorissa.org/Research%20Reports/GlobalisationAndMedicinalplantsOfOrissa.pdf
- http://www.emea.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/09/WC500003393.pdf

———

Sem. III **Hours/Week: 4**
14PBO3402 **Credits: 4**

BIOPROCESS TECHNOLOGY

Objectives

1. To study the avenues of exploiting microbes in bioconversion technology.
2. To study the downstream processing for product recovery in fermentation.

Unit I

Principles of fermentation process, Bioprocess vs Chemical process, Media formulation - Growth factors, Buffers, O2, Antifoams and Media Optimization. Cell growth and quantitation - density, cell mass, growth pattern, yield factors and environmental conditions. Batch, Continuous and Fed batch culture.

Unit II

Bioreactor design, parts and functions, sterilization, impellers, baffles and sparger. Types of reactor - submerged reactor, mechanically stirred draught-tube reactor, continuous flow stir type reactor, airlift reactor, jet loop reactor, surface reactor and packed bed reactor.

Unit III

Bioprocess control and monitoring variables: O2 requirement and uptake-factors affecting KLa-aeration, agitation, pressure and pH, medium rheology. Computers in bioprocess. Flow measurement and control, control system - manual and automatic PID control.

Unit IV

Bioconversion and biocatalysts: Immobilization of cells and enzymes - methods and advantages. Selection of industrially important microorganisms. Strain improvement preservation and properties of industrial strains. Production strategies for insulin, lactic acid and vinegar. Scale-up and scale-down - problems and solutions.

Unit V

Downstream processing: recovery of microbial cells and products - Precipitation. Filtration and Centrifugation. Cell disruption - physical and chemical methods. Extraction - liquid-liquid extraction and aqueous-two phase extraction. Chromatography. Membrane processes, drying and crystallization.

Books

1. Stanbury, P F & Whitaker, A, 1995, *Principles of Fermentation Technology*, Pergamon.
2. Schuler ML & Fikret Kargi, 2002, *Bioprocess Engg: Basic Concepts*, PrenticeHall, NJ.
3. Wulf Crueger & Anneliese Cruger, 2004, *Biotechnology: A Textbook of Industrial Microbiology*, 2nd Edn., Panima Publishing Co.
4. E.MT. El-Mansi & C F A Bryce, 2002, *Fermentation Microbiology and Biotechnology*, Taylor & Francis Co., USA.
5. Bailley & Ollis, 1986, *Biochemical Engg Fundamentals*, McGraw Hill, New York.
6. Coulson, J M & Richardson, S F, 1984, *Chemical Engg*, Pergamon Press.
7. Mooyoung (ed.), 1985, *Comprehensive Biotechnology*, Vol. I, II, III & IV, Pergamon Press.

———

Sem. III **Hours/Week: 4**
14PBO3403 **Credits: 4**

HORTICULTURE AND LANDSCAPING

Objectives

1. To understand the methods of plant propagation
2. To know the state of art in landscape designing and its aesthetic values.

Unit I

Importance and scope of horticulture; divisions of horticulture; climate, soil and nutritional needs. Water irrigation; plant propagation methods - cutting, layering, grafting, and budding. Stock -scion relationship, micropropagation by root induction.

Unit II

Indoor gardening - foliage plants, flowering plants and hanging basket. Bonsai plants - training and pruning. Floriculture -cultivation of commercial flower crops: rose, jasmine and chrysanthemum. Flower decoration - dry and wet. Applications of cut flower technologies.

Unit III

Fruit crops - induction of flowering, flower thinning, fruit setting, fruit development. Cultivation of important fruit crops - mango, grapes and guava.

Unit IV

Landscaping principles - planning designs for house gardens, institutional and industrial gardens - bioaesthetic planning for rural gardens, recreational grounds, avenue planting, highway planting, railway planting - trees, shrubs, climbers, herbs and ground covers suited for different situations their culture, training and pruning - tree transplantation.

Unit V

Lawns: different grasses, maintenance of lawns and turf in play grounds, gardens and golf courses; special types of gardens: traffic islands, vertical garden, roof /terrace garden, bog garden, water garden, planning parks and public garden; beautification of urban areas.

Books

1. Arora JS. 1992. Introductory ornamental horticulture, Kalyani Publishers, New Delhi.
2. George Acquaah. 2002. Horticulture principles and practices, 2nd Edn. Pearson Edn, Delhi.
3. Manibushan Rao K. 1991. Text book of horticulture. MacMillan Publishing Co., New York.
4. Edmond JB et al., 1977. Fundamentals of horticulture. Tata McGraw Hill Ltd., New Delhi.
5. Rao KM. 2000. Text Book of Horticulture, MacMillan India Ltd., New Delhi.
6. Gopalswamy Iyyangar, 1970. Complete gardening in India, Kalyan Printers, Bangalore.

———

Sem. IV **Hours/Week: 6**
14PBO4115 **Credits: 5**

MICROBIOLOGY AND IMMUNOLOGY

Objectives

1. To study the microorganisms and their activities.
2. To understand and exploit their potentialities in agriculture, industry and other environmental aspects and to know the basic concepts of the immune system.

Unit I

General microbiology; scope, branches and history. Structure and organization of Spirochetes, Rickettsias, Chlamydias, Mycoplasmas, Viruses - Viroids and prions. Culture of microorganisms, synchronous, batch and continuous culture. chemostat and turbidostat, preservation of microbes.

Unit II

Food, dairy and environmental microbiology. Microbial contamination of food; food poisoning, food-borne infections and food preservation. Microbial contamination of milk, milk-borne diseases - preservation of milk and dairy products. Aquatic microbiology - fresh water and marine microbes. Treatment and disposal of contaminated waters and sewage. Soil microbes and their role in biogeochemical cycling.

Unit III

Industrial microbiology: selection of industrially useful microbes, fermentation processes, recovery of end products; production of alcohol, insulin, lactic acid, vinegar, hydrocarbons, single cell oil and single cell protein. Common immunizations, antibiotics and other chemotherapeutic agents and their mode of action. Drug resistance in microbes.

Unit IV

Immunology - introduction - immune system - organs - immune cells - haemetopoiesis -detailed study of T and B cells. General structure of antibodies - classes - cloning and expression of immunoglobin genes.

Unit V

Antigens - types, properties, antigen-antibody interaction. Types of immunity - innate and adaptive - emphasis on cell mediated and humoral immune reactions - Vaccines -Immunization schedule.

Books

1. Prescott *et al.*, 2009 7e, Microbiology. Wm. C. Brown Publishers.
2. Kuby J, 2000, Immunology, 4th edition, W H Freeman

Reference

1. Pelczar *et al.* 1998, Microbiology - Concepts & Applications. Tata McGraw Hill New Delhi.
2. Adams MR and Moss MO, 2008, Food Microbiology. Royal Soc. Chem., Cambridge, UK.
3. Dickinson M. 2003. Molecular Plant Pathology. BIOS Scientific Publishers, London.
4. Janeway and Travers, Immunobiology, 3rd edition Gerland Pub. Inc. NY.
5. Nandini Shetty 1996, lmmunology - An introductory Text Book, New Age Intl (P) Ltd.
6. Roitt *et al.*, 1998, Immunology 5th edition, Mosby International Ltd. London. UK.

———

Sem. IV **Hours/Week: 6**
14PBO4116 **Credits: 5**

GENETIC ENGINEERING AND BITECHNOLOGY

Objectives

1. To know the art of recombining genes and traits.
2. To develop the skills in handling genetic material.
3. To apply genetic concepts into manipulating living things for human welfare.
4. Understanding the revolutions that unfold in biotechnology.

Unit I

Crown gall and *Agrobacterium*; generation of bacterial genes (restriction enzymes) and eukaryotic (cDNA). Joining DNA molecules and the strategies - *E. coli* and T4 DNA ligases, linkers and homopolymers.

Unit II

Cloning vectors: ideal cloning vehicles; Natural vectors (*E. coli* and *Agrobacterium* based), *in vitro* vectors (pBR), sstrDNA vectors (M13) and shuttle vectors. Expression of cloned genes - problems and solution. Cloning strategies - cDNA libraries and genomic libraries.

Unit III

Engineering microbes: bioremediation of oil spills: oil-eating super bugs - genes from *Pseudomonas putida, Bacillus megaterium, and Alcanivorax borkumensis*. Biotechnology in aquaculture. Bt crops, Golden rice technology, Plantibodies, edible vaccines, and Blue roses. Strategies for crop improvement: engineering for tolerance against herbicide, resistance to disease.

Unit IV

Technology protection systems (GURT) - the terminator. GMOs and environment - rationale for biosafety of GMOs and GM foods. Principles of biosafety; potential risks; environmental impacts; safety of food and animal feed derived from GM crops; and patterns of gene flow. Issues concerning release of Bt brinjal.

Unit V

Synthetic biology - the art of extreme genetic engineering and creation of new life in lab. Artificial DNA and synthetic genome. The pioneering work of

JC Venter *et al.* Minimal genome, Modular components and expanded gene pool. Creation of synthetic organisms: top-down and bottom-up approaches. Potentials and applications; implications risks and ethical questions. Areas of research and future directions.

Books

1. Old RN and Primrose S B. 2004, Principles of gene manipulation - Blackwell Sci., USA.
2. Watson JD *et al.*, 2005. Recombinant DNA. Blackwell Science Publ. USA.

Reference

1. Adrian Slater *et. al.*, 2003, Plant Biotechnology, Oxford University press, U.K.
2. Glick BJ & Pasternack JJ. 2004. Molecular biotechnology. Panima Publ. Bangalore.
3. European Commission Report of a NEST High-Level Expert Group, 2005. Synthetic Biology: Applying Engineering to Biology.
4. Presidential Commission for the Study of Bioethical Issues, 2010. (www.bioethics.gov)
5. ETC Group, Canada, 2010. Extreme Genetic Engg - an introduction to synthetic biology.
6. Young, E and Alper, H, 2010. Synthetic Biology: A Review. *J Biomedicine and Biotechnology*.
7. Benner SA. & Sismour AM, 2005. Synthetic Biology, *Nature* Reviews, Genetics, 6: 533.

———

Sem. IV **Hours/Week: 4**
14PBO4117 **Credits: 3**

Laboratory Course-VII:

Microbiology, Immunology, Genetic Engineering & Biotechnology

1. Isolation and enumeration (CFU) of microorganisms in soil by serial dilution.
2. Bacterial staining - Simple, Gram's staining.
3. Isolation of bacteria from skin, mouth and urine.
4. Potability test of water - presumptive, confirmative and completed tests.
5. Quantitative estimation of bacteria in milk.
6. Testing quality of milk by methylene blue reductase (MBRT) and phosphatase test.
7. Morphological and biochemical identification of bacteria - indole test, methyl red test, Voges-Proskaur test, Citrate utilization test, TSI agar test.
8. Blood grouping
9. WIDAL- test for typhoid
10. RPR- test for syphilis
11. RF- test for rheumatoid arthritis
12. Immunoelectrophoresis
13. Macrophage isolation and observation
14. ELISA - Demo
15. Identification of local crop diseases (sugar cane, paddy, banana, brinjal and citrus).
16. Callus induction and regeneration.
17. Clonal propagation.
18. Embryo culture
19. Electrophoretic separation of DNA, protein and restriction digestion.
20. Isolation of protoplasts by enzymes and synthetic seeds.

———

Sem. IV
14PBO4119 **Credits: 2**

Self Paced Learning:

PLANT BREEDING AND EVOLUTION

Objectives

1. To study the importance of plant breeding in food production.
2. To understand the methodology of plant breeding.

Unit I

Plant breeding: objectives and historical aspect of plant breeding and the genetic basis. Modes of reproduction in relation to breeding methods: sexual, asexual and apomitic. Floral biology in relation to selfing and crossing techniques. Breeding methods: plant introduction - types and procedures. Centres of diversity and origin of cultivated plants.

Unit II

Hybridization: objectives and choice of parents; problems and causes of failure of hybridization - incompatibility and sterility. Methods of handling genetic consequence of hybridization. Method of handling segregation material for isolation of superior strains - bulk method and pedigree method of selection. Importance of interspecific and intergeneric hybridization in plant improvement.

Unit III

Inbreeding depression and heterosis: genetic basis and application in plant breeding. Steps in the production of single cross, double cross, three-way cross and synthetics - induced polyploidy in plant breeding. Role of auto and allopolyploidy. Heteroploids - mutagen and crop improvement. Population genetics: Hardy-Weinberg principle; gene frequencies; and the factors that change it.

Unit IV

Back crossing: theory and procedure for transferring various types of character. Preservation and utilization of germplasm. Breeding of rice, sugarcane, groundnut and maize. Breeding for disease resistance and drought tolerance.

Unit V

Evolution: origin of life. Theories of evolution of life forms: Lamarkism, Darwinism and Speciation. Variations - definition, causes and types.

Mutations (principles of Hugo de'veries). Role of mutations in speciation. Evidences for evolution, adaptive radiation, biological evolution.

Book

1. Gupta PK 2002 Cytology Genetics Evolution and Plant Breeding. Deep and Deep Publications, 2002

Reference

1. Chandrasekaran & Parthasarathy, (1990). Cytogenetics and Plant Breeding.
2. Sinha,U. and Sinha, S., (1992).Cytogenetics, Plant Breeding and Evolution.
3. J. R. Sharma (1996) Principles and Practice of Plant Breeding.
4. Chaudhari, H.K., (1995) Revised Ed., Elementary Principles of Plant Breeding.

———

Sem. IV **Hours/Week: 14**
14PBO4120 **Credits: 7**

PROJECT DISSERTATION

&

VIVA VOCE

———