M. Sc. BOTANY

SYLLABUS - 2018

SCHOOL OF EXCELLENCE
with
CHOICE BASED CREDIT SYSTEM (CBCS)

SCHOOL OF BIOLOGICAL SCIENCES
St. JOSEPH'S COLLEGE (Autonomous)
Special Heritage Status Awarded by UGC
Accredited at 'A' Grade (3rd cycle) by NAAC
College with Potential for Excellence Conferred by UGC
DBT-STAR & DST-FIST Sponsored College
TIRUCHIRAPPALLI - 620 002, INDIA

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)

POSTGRADUATE 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 the 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 as mentioned in the table below. The total number of minimum courses offered by a department are given in the course pattern.

POSTGRADUATE COURSE PATTERN (June 2018 onwards)

Part	Semester	Specification	No. of Courses	Hours	Credits	Total Credits
1	I-IV	**Core Courses** Theory Practical	 12-14 3-6	84	68	81
	II	**Self-Paced Learning**	1	-	2	
	III	**Interdisciplinary Core**	1	6	5	
	IV	**Comprehensive Examination** **Project Work**	1 1	- 6	2 4	
2	I-III	**Core Electives**	3	12	12	12
3	II	**IDC (Soft Skills)**	1	4	4	**12**
	III	**IDC (WS)** **IDC (BS)**	1 1	4 4	4 4	
4	I	**Extra Credit Courses-1 (MOOC)**	1	-	(2)	(4)
	III	**Extra Credit Courses-2 (MOOC)**	1	-	(2)	
5	IV	Outreach Programme (SHEPHERD)	1	-	5	**5**
		TOTAL		**120**		**110 (+4 extra credits)**

Note: IDC: Inter-Departmental Courses, BS: Between School, WS: Within School

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.

Course Pattern

The Post-Graduate degree course consists of five vital components. They are core course, core electives, IDCs, Extra credit courses, and the Outreach Programme.

Core Courses

A core course is the course offered by the parent department related to the major subjects, components like theories, practicals, Inter disciplinary core, self paced learning, comprehensive examination, Project work, field visits, library record and etc.

Inter-disciplinary Core

Inter-disciplinary Core should be shared by the various Departments of every School. This course should be opted by all the students belonging to the particular school. Each department of the respective school should allocate themselves the schedule and the units of the course.

Core Elective

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

Extra Credit Courses

In order to facilitate the students gaining extra credits, the extra credit courses are given. According to the guidelines of UGC, the students are encouraged to avail this option of enriching by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

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 IDCs. 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 IDCs are of application oriented and inter disciplinary in nature.

Subject Code Fixation

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

Year of Revision	PG Code of the Dept	Semester	Specification of Part	Running number in the part
↓	↓	↓	↓	↓
18	P##	*x*	*x*	*xx*
18	**PBO**	**1**	**1**	**01**

For Example :

I MSc - Botany, first semester **'Plant Diversity-I'**
The code of the paper is **18PBO1101**.
Thus, the subject code is fixed for other subjects.

Specification of the Part

I - Core Courses: (Theory, Practical, Self paced Learning, Inter-disciplinary Core, Core, Comprehensive Examination, Project work)
II - Core Electives
III - Inter Departmental Courses (WS, Soft Skill & BS)
IV - Extra credit courses
V - Outreach Programme (Shepherd)

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-Semster & End-Semester Tests

Centralised – Conducted by the office of Controller of Examinations

1. Mid-Semester Test & End-Semester 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-Semester and End-Semester 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.
6. English Composition once a fortnight will form one of the components for UG General English.

SEMESTER EXAMINATION

Testing with Objective and Descriptive questions

Part-A: Objective MCQs only (30 Marks)

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: Descriptive (70 Marks)

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 marks

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.

GRADING SYSTEM

1. Grading

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added. The marks thus obtained, will then be graded as per the scheme provided in the following Table-1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester **Grade Point Average (GPA)** and **Cumulative Grade Point Average (CGPA)** respectively. These two are calculated by the following formulae:

GPA = $\frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$ **WAM** (Weighted Averag Marks) = $\frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$

where,

'C_i' is the Credit earned for the Course-*i,*
'G_i' is the Grade Point obtained by the student for the Course '*i*',
'M' is the marks obtained for the course '*i*', and
'*n*' is the number of Courses **Passed** in that semester.

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

2. Classification of Final Results

i) The classification of final results shall be based on the CGPA, as indicated in the following Table-2.

ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly, the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99, and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii) Absence from an examination shall not be taken as an attempt.

Table-1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above but below 90	9	A+
70 and above but below 80	8	A
60 and above but below 70	7	B+
50 and above but below 60	6	B
Below 50	NA	RA

Table-2: Final Result

CGPA	Classification of Final Results	Corresponding Grade
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-appearance

Credit based weighted Mark System is to be adopted for individual semesters and cumulative semesters in the column 'Marks Secured' (for 100).

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

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) extra credits offered by the parent department courses.

M. Sc. Botany

Course Pattern - 2018 Set

Sem.	Code	Course	Hr	Credit
I	18PBO1101	Plant Diversity-I (Thallophytes and Bryophytes)	6	5
	18PBO1102	Laboratory Course 1	4	3
	18PBO1103	Plant Diversity-II (Pteridophytes, Gymnosperms & Paleobotany)	6	5
	18PBO1104	Plant Anatomy, Embryology and Morphogenesis	6	5
	18PBO1105	Laboratory Course 2	4	3
	18PBO1201A	Core Elective – 1: Ecology & Phytogeography (OR)	4	4
	18PBO1201B	Core Elective – 1: Forestry and Wood Science		
	18PBO1401	Extra credit course 1: MOOC-I	-	(2)
		Total for Semester I	**30**	**25**
II	18PBO2106	Plant Physiology	6	5
	18PBO2107	Laboratory Course 3	3	3
	18PBO2108	Biochemistry	5	4
	18PBO2109	Laboratory Course 4	3	3
	18PBO2110	Cell and Molecular Biology	5	5
	18PBO2111	Self-phased learning: Plant Breeding and Evolution	-	2
	18PBO2202A	Core Elective-2: Biophysics and Instrumentation (OR)	4	4
	18PBO2202B	Core Elective-2: Plant Pathology		
	18PSS2301	IDC-1: Soft Skills	4	4
		Total for Semester II	**30**	**30**
III	18PBO3112	Plant Systematics	5	5
	18PBO3113	Laboratory Course 5	4	3
	18PBO3114	Genetics	3	3
	18SBS3101	Inter disciplinary core:Solid waste management	6	5
	18PBO3203A	Core Elective-3: Pharmacognosy (OR)	4	4
	18PBO3203B	Core Elective-3: Bioinformatics and Bionanotechnology		
	18PBO3301	IDC-2 (WS): Bioprocess Technology	4	4
	18PBO3302	IDC-3 (BS): Horticulture and Landscaping	4	4
	18PBO3402	Extra Credit course II: MOOC-II	-	(2)
		Total for Semester III	**30**	**28**
IV	18PBO4115	Microbiology and Immunology	5	5
	18PBO4116	Genetic Engineering and Biotechnology	5	4
	18PBO4117	Laboratory Course 7	4	3
	18PBO4118	Research Methodology	4	4
	18PBO4119	*Comprehensive Examination*	--	2
	18PBO4120	Project Work	12	4
		Total for Semester IV	**30**	**22**
I-III	18PBO4601	Outreach Programme (SHEPHERD)	-	5
		Total for all Semesters	**120**	**110+(4)**

Programme Outcomes (POs):

1. Post graduate students are to be passionately engaged in initial learning with an aim to think differently as agents of new knowledge, Poststanding and applying new ideas in order to acquire employability/ self-employment.
2. Postgraduate students are trained to take up higher learning programmes.
3. Postgraduate students are made to be competent and socially responsible citizen of India.
4. Postgraduate students are to be exposed to technical, analytical and creative skills.
5. Postgraduate students are to be imparted with a broad conceptual background in the Biological sciences/ Computing sciences/ Languages and culture/ Management studies/ Physical sciences/

Programme Specific Outcomes (PSOs):

1. Graduates will acquire knowledge on various goups of plants and study their utilization and conservation.
2. Graduates will learn about the internal organization of plants and their role in functioning of plant system.
3. Graduates understands the ecological principles and their importance for sustainable utilization.
4. Graduates learn various techniques of plant breeding to enable better crop production fo human welfare.
5. Graduates will acquire basic knowledge on statistics and learn its application in biological studies.
6. Graduates will develop skills on bioprocess technology which enable the scientific production of bioactive compounds of economic value.
7. Graduates will acquire knowledge on the production of GMOs which play a significant role in field of agriculture and medicine.
8. Graduates will learn the principle and methodology of thesis writing and research publications.

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Semester I **Hours/Week: 6**
18PBO1101 **Credits : 5**

PLANT DIVERSITY-I: THALLOPHYTES AND BRYOPHYTES

Course Outcomes:

1. To understand the major groups of cryptogamic plants and theircharacteristics.
2. To study their interrelationships and trace their evolutionarytrends.
3. To know the classification,life cycle and economic importance of Algae.
4. To study the general features,classification and economic importance of Fungi.
5. To acquire basic knowledge on Lichens,
6. To understand Bryophytes and their salient features.
7. To understand the classification of Bryophytes.
8. To learn the economic importance of Bryophytes.

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*and *Scytonema.*

Unit-II:

Chlorophyta: *Chlamydomonas, Volvox, Cladophora, Coleochaete, Ulva, Caulerpa, Oedogonium,* and *Spirogyra*. Phaeophyta: *Ectocarpus, Padina*and*Sargassum.* Rhodophyta: *Batrachospermum, Gracillaria and Polysiphonia. Centric* and *Pinnate Diatoms.*

Unit-III: Fungi

General features, occurrence and distribution; Classification of fungi (Ainsworth, 1973; Alexopoulos and Mims, 1983), General characters of majordivisions-Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Ecology of fungi, Reproduction (vegetative, asexual and sexual), Spore dispersal mechanisms.Economic importance of fungi.

Unit-IV:

Heterothallism; heterokaryosis; parasexuality; sex hormones in fungi; degeneration of sex.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 *Usnea*.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, Porella,* Anthocerotopsida: *Anthoceros, Notothyllus*. Bryopsida: *Sphagnum* and *Polytrichum*. Economic importance of bryophytes.

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. PremPuri, 1973. Bryophytes - a broad perspective. Atma Ram & Sons, New Delhi.

Reference:

1. Delevoryas, T., 1977, Plant Diversification. Holt, Rinehart &Wintson, NewYork.
2. Chapman, V.J. &Chapman,D.J. The Algae. ELBS &MacMillan,London
3. Srivastava, H.N., 1999, Fungi. PradeepPublications,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, NewDelhi.
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, NewDelhi.
10. Vashishta, B. R. and Sinha, A. K. (2007). Botany for Degree Students - Fungi. S. Chand, NewDelhi.
11. Cavers F. 1911. The interrelationship of Bryophytes. New Phytologist.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBO1101			Title of the Paper PLANT DIVERSITY-I (Thallophytes and Bryophytes)							Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	4	5	5	5	4	4	4	5	3	3	5	4.27
CO2	5	5	4	5	4	5	3	4	5	5	5	4.54
CO3	5	5	4	4	5	5	4	4	5	5	5	4.63
CO4	5	5	4	4	5	5	4	4	5	5	5	4.63
CO5	4	4	5	5	5	5	4	5	5	3	5	4.54
CO6	4	4	5	5	5	5	3	4	5	4	4	4.36
CO7	4	5	5	5	4	4	4	5	3	5	5	4.54
CO8	5	5	4	4	5	5	4	4	5	3	5	4.54
											Overall Mean Score for COs	4.42

Result: The Score for this Course is 4.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

***Values Scaling*:**

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester I **Hours/Week: 4**
18PBO1102 **Credits : 3**

Laboratory Course-1

PLANT DIVERSITY-I: (THALLOPHYTES AND BRYOPHYTES)

Course Outcomes:

1. To study the internal organization of thallophytes and Bryophytes.
2. To learn the range of thallus organization in various thallophytes and Bryophytes.

Algae

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

Fungi

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

Lichen

Usnea.

Bryophytes

Reboulia, Anthoceros, Pogonatum and *Polytrichum*

Field Trip and Report submission.

Semester I **Hours/Week: 6**
18PBO1103 **Credits : 5**

PLANT DIVERSITY-II: (PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)

Course Outcomes:

1. To understand the major groups of lower vascular plants and theircharacteristics.
2. To trace their interrelationships and study their evolutionarytrends.
3. To study their classification and life cycle patterns of representative genera.
4. To study the classification,phylogeny and economic importance of Gymnosperms.
5. To study the morphology,anatomy and reproduction of representative genera.
6. To acquire knowledge on Geological periods,fossilization and types of fossils.
7. To understand some Pteridophyte fossil genera and their life cycle.
8. To acquire knowledge on gymnosperm fossils.

Unit-I:

Pteridophytes - General characters - Reimer's classification (1954), life cycle.Theories of origin of sporophyte.Telomeconcept.Sporangium development-eusporangiate and leptosporangiatetype.Apogamy and Apospory.Detailed account on stelar and soral evolution in Pteridophytes.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-*Biota,*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, NewDelhi.
2. Pandey BP. 1998. A Text Book of Botany Vol. II. S Chand, NewDelhi.

Reference:

1. Pandey, S.N., S.P. Misra and P.S. Trivedi. 2002. A Textbook of Botany Volume II. Vikas Publishing House Pvt Ltd, NewDelhi.
2. Rashid.A. 2007. An Introduction to Pteridophyta-Vikas publications, NewDelhi.
3. Johri , RM, Lata S , Tyagi K (2005), A text book of Gymnosperms , Dominate pub and Distributer, NewDelhi
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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBO1103				Title of the Paper PLANT DIVERSITY-II (Pteridophytes, Gymnosperms & Paleobotany)						Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	5	4	5	4	4	4	4	5	3	3	5	4.1
CO2	5	4	4	5	4	5	3	4	5	5	5	4.4
CO3	5	4	5	5	5	5	4	4	5	5	5	4.7
CO4	5	5	4	4	4	5	3	4	5	5	5	4.4
CO5	4	3	5	3	5	5	4	3	4	3	5	4.0
CO6	5	4	3	5	4	5	3	4	3	4	4	4.0
CO7	5	4	5	4	4	4	4	5	3	3	5	4.1
CO8	5	5	4	4	4	5	3	4	5	5	5	4.4
						Overall Mean Score for COs						**4.3**

Result: The Score for this Course is 4.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester I **Hours/Week: 6**
18PBO1104 **Credits : 5**

PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS

Course Outcomes:

1. To understand various types of tissues present in plants
2. To acquire knowledge about the tissues of stem, root and leaves
3. To understand the primary and secondary structure of dicots and monocots with reference to root, stem and leaves
4. To acquire basic knowledge of the structure and development of male and female gametophytes in plants
5. To acquire knowledge on the structure and development of dicot and monocot embryos
6. To understand the Morphogenesis and its relation to morphology
7. To study various type of endosperms.
8. To understand polyembryony and its uses.

Unit-I:

General account and theories of organization of apical meristems of shoot apex and root apex, quiescent center. Structural diversity and phylogenetic trends of specialization of xylem and phloem.Cambium - origin - cellular structure, cell division, storied and non-storied types. Cambium in budding and grafting - wound healing role. Trichomes, periderm and lenticels.

Unit-II:

Anatomical characteristics and vascular differentiation in primary and secondary structure of root and stem in Dicot and Monocot. Origin of lateral roots - Root stem transition - Anatomy of Dicot and Monocot leaves. Leaf abscission, stomata types, nodal anatomy, petiole anatomy, vascularization of flower and seedling.

Unit-III:

Microsporangium - Microsporogenesis, Microspores - morphology - ultrastructure - Micro gametogenesis - Pollen - Stigma - Incompatibility - Methods to overcome incompatibility - Mega sporangium - Mega gametogenesis - Female gametophyte - Monosporic - Bisporic and Tetrasporic - Nutrition of embryo sac and fertilization.

Unit-IV:

Endosperm - Types - Endosperm haustoria - Cytology and physiology of endosperms, functions of endosperms - Embryo development in Dicot and

Monocot, Nutrition of embryo - Polyembryony - Causes, Apomixis - Causes, Apospory - Their role in plant improvement programs and seed development.

Unit-V:

Definition - Morphogenesis and its relation to morphology - Turing's diffusion reaction theory - Morphogenetic factors - growth regulators - genetic and environment - polarity. Molecular basis of morphogenesis. Cellular level morphogenesis - Nuclear transplantation experiments with *Acetabularia* - Sach's and Errer's laws - Asymmetric divisions and their significance. Morphogenesis at tissue level - Differentiation, dedifferentiation and redifferentiation of vascular tissue in vitro and in vivo and in wounds. Plant galls and their importance in morphogenesis.

Text Book

1. Fahn, A. (1989). Plant Anatomy. Maxwell Pvt. Ltd., Singapore.
2. Bhojwani, S. S. and Bhatnagar, S. P. (1981).Embryology of Angiosperms.Vikas Publishing House Pvt. Ltd., New Delhi.
3. Murphy, T. M. and Thompson, W. F. (1988).Molecular Plant Development.Prentice Hall of India Pvt. Ltd., New Jersey.

Reference

1. Cutter, E. G. (1978).Plant Anatomy. Edward Arnold Publishers Ltd., London.
2. Easu, K. (1953). Plant Anatomy. John Wiley & Sons Inc., New York.
3. Pandey, B. P. (1989). Plant Anatomy. S. Chand and Co. Ltd., New Delhi.
4. Agarwal, S. B. (1990). Embryology of Angiosperms - a fundamental approach. SahityaBhawan, Agra.
5. Bard, J. (1990). Morphogenesis. Cambridge University Press, London.
6. Burgess, J. (1985). An Introduction to Plant Cell Development. Cambridge University Press, London.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBO1104	Title of the Paper PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS										Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	5	4	5	4	4	5	4	5	3	3	5		4.27
CO2	5	4	4	5	4	4	3	4	5	5	4		4.27
CO3	5	4	5	5	3	5	4	5	4	5	5		4.54
CO4	5	4	5	4	5	5	3	4	5	3	5		4.36
CO5	4	3	4	3	5	5	4	3	4	3	3		3.72
CO6	5	4	5	5	4	4	3	4	3	4	4		4.09
CO7	5	4	5	4	4	5	4	5	3	3	5		4.20
CO8	4	3	4	3	5	5	4	3	4	3	3		4.30
											Overall Mean Score for COs		4.21

Result: The Score for this Course is 4.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{TotalNo.of POs\& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 4**
18PBO1105 **Credits : 3**

Laboratory Course-2

PTERIDOPHYTES, GYMNOSPERMS, PALAEOBOTANY, ANATOMY, EMBRYOLOGY AND MORPHOGENESIS

Course Outcomes

1. To study the internal organization of Pteridophytes and Gymnosperms.
2. To understand the similarities and differences between Pteridophytes and Gymnosperms.

Pteridophytes

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

Gymnosperms

Cycas, *Cupressus, Gnetum.*

Palaeobotany

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

Plant Anatomy and Embryology

- Study of cambia - non storied and storied.
- Study the anomalous primary and secondary features in *Aristolochia and Bignonia.*
- Micrometry of xylem elements.
- Study of leaf anatomy-structure, stomata, trichomes, types of stomata. Study of pollen morphotypes (Malvaceae and Asteraceae)
- Isolation of different stages of embryo and polyembryony in citrus, jamun (*Syzygiumcumini*)
- Tests for pollen viability using stains and *in vitro* germination.Pollen germination using hanging drop technique.

Semester I **Hours/Week: 4**
18PBO1201A **Credits : 4**

Core Elective-1

ECOLOGY AND PHYTOGEOGRAPHY

Course Outcomes:

1. To understand the basic concepts of ecosystem and energy flow.
2. To acquire knowledge on population dynamics.
3. To understand the causes and consequences of climate change.
4. To study the principle and concepts of Phytogeography.
5. To acquire knowledge on biodiversity and their importance.
6. To learn the conservation strategies of biodiversity.

Unit-I:

Introduction to ecology: ecosystem structure; and dynamics - food chain and food webs, energy flow, mineral cycling (C, N& P).Plant succession - types. Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, natality and mortality and age structure, population growth and population interactions.

Unit-II:

Greenhouse effect, global warming, global climatic changes and the consequences.Climate change conferences-role of UNFCCC and IPCC. Paris 2015 COP21: legality and respective capabilities, long-term goal, mitigation, carbon markets, transparency, compliance, adaptation. Carbon economy and carbon credits.

Unit-III:

Biodiversity: types-species, genetic, ecosystem and habitat. Importance of genetic diversity with reference to crops and farm animals.Preserving the crop genetic resources-germplasm collections and the Svalbard Global Seed Vault.Centres of origin of diversity-Vavilov'sandFAO's.

Unit-IV:

Phytogeography: geographical history, continental drift, land bridges and shifting of poles. Phytogeography of the Western Ghats.Concepts of phytogeography:Endemism, hotspots and hottest hotspots, plant introductions and explorations, invasions and exotic species.

Unit-V:

Conservation: approaches-*in situ* and *ex situ* and their evaluation. Biodiversity, its importance, assessment, loss and conservation and World

organisation for conservation of biodiversity, biodiversity act (2002), Red List categories of IUCN, means and ways for 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 Gabriel 2001 Biodiversity and Conservation, Science Publ., NHUSA
3. Krishnamurthy K.V. 2003. An advanced text book on Biodiversity Principle and Practice. Oxford and IBH Publishing Co. NewDelhi.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBO1201A					Title of the Paper Core Elective-I: ECOLOGY & PHYTOGEOGRAPHY						Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	4	4	5	4	3	5	5	5	3	3	5		4.18
CO2	4	5	5	4	3	5	3	4	5	5	4		4.27
CO3	3	5	5	5	5	5	5	5	5	5	3		4.63
CO4	5	3	3	5	4	5	4	4	4	5	4		4.18
CO5	5	5	4	4	3	5	4	4	4	3	3		4.00
CO6	4	5	5	4	5	4	3	3	4	5	3		4.09
									Overall Mean Score for COs				**4.22**

Result: The Score for this Course is 4.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 4**
18PBO1201B **Credits : 4**

Core Elective-1

FORESTRY AND WOOD SCIENCE

Course Outcomes:

1. To prepare students for careers in the forest services and wood processing industry.
2. To educate students to protect and conserve forests.
3. To acquire knowledge on forest resources and their utilization.
4. To understand the physical,chemical and mechanical properties of commercial wood.
5. To understand the raw materials needed for industries.
6. To acquire knowledge on wood substitution.

Unit-I:

World and Indian forest scenario; Forest types of India; Factors that influences forest and forest protection.Rare and endangered species. Conservation strategies; Exotics and its significance; Silviculture- 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 and 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 materials to industries and woodsubstitution.

Books

1. De Vere Burton L., 2000, Introduction to Forestry Science, Delmar publishers, NY
2. J.L. Bowyer, R. Shmulsky and J.G. 2007. Haygreen. Forest Products and Wood Science: An Introduction, Blackwell PublishingProfessional.
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 Co., NewDelhi.
2. Jha, L.K., 1996. Forestry for rural development, APH Publishing Corporation, NewDelhi.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PBO1201B				Title of the Paper Core Elective-I: FORESTRY AND WOOD SCIENCE						Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	4	4	5	4	3	5	5	5	3	3	5	4.18
CO2	4	5	5	4	3	5	3	4	5	5	4	4.27
CO3	3	5	5	5	5	5	5	5	5	5	3	4.63
CO4	5	3	3	5	4	5	4	4	4	5	4	4.18
CO5	5	5	4	4	3	5	4	4	4	3	3	4.00
CO6	4	5	5	4	5	4	3	3	4	5	3	4.09
											Overall Mean Score for COs	**4.22**

Result: The Score for this Course is 4.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: 6**
18PBO2106 **Credits : 5**

PLANT PHYSIOLOGY

Course Outcomes:

1. To understand plant's diverse physiological functions.
2. To study the recent aspects of various physiological processes inplants.
3. To understand the application of physiology inagriculture.
4. To know how plants function at molecular, cellular and whole plant level.
5. To develop knowledge and confidence to pursue advance courses and research.
6. To get career as a field botanist or teacher in academic institutions.
7. To understand nitrogen metabolism in plants.
8. To understand physiology of flowering.

Unit-I:

Water relations of plants: Water potential, osmotic potential, pressure potential and water transport process. Stomatal physiology, mechanism of transpiration and antitranspirants.Mineral nutrients and deficiency symptoms, mineral ion uptake.Various mechanism of solute transport.

Unit-II:

Photosynthesis: Light reaction general concepts. Role of chlorophylls and accessory pigments; antennae molecules and active center molecules; evidences for two photosystems; Mechanism of electron transport; proton transport and ATP synthesis. Carbon reactions: The C_3 cycle and its regulations; Photorespiration and its regulations; CO_2 concentrating mechanisms: algal and cyanobacterial pumps, C_4cycle, CrassulaceanAcid Metabolism.Synthesis of starch and sucrose.

Unit-III:

Respiration: Glycolysis, gluconeogenesis and their regulation. Oxidation of pyruvate and the Citric Acid cycle.Pasteur effect, anaplerotic reactions, amphibolic nature of the Citric Acid cycle. Respiratory chain complexes and oxidative phosphorylation, unique electron transport enzymes of plant mitochondria, alternate electron pathways in plants and their significance.TheGlyoxylatecycle.Pentose phosphate pathway and its importance.

Unit-IV:

Nitrogen in the environment; assimilation of nitrate and ammonium - GS-GOGAT; biological nitrogen fixation.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.

Unit-V:

Physiology of flowering and fruit ripening.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).

Books:

1. Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy, 2015. Plant Physiology. Sixth Edition,Sinauer Associates.
2. Pandey, S.N. &Sinha, 2010, Plant Physiology, Vikas Publishing, NewDelhi.

Reference:

1. Noggle, G.R. and Fritz, G.J. 2001, Introductory Plant Physiology, Prentice-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. Frank B. Salisbury & Cleon W. Ross, 1992, Plant Physiology 4thEdition, Wadsworth Publishing Co.,Belmont.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBO2106					Title of the Paper PLANT PHYSIOLOGY						Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	5	4	3	4	5	5	3	5	4	3	5	4.18	
CO2	5	5	4	5	4	3	4	5	5	5	5	4.54	
CO3	5	5	4	5	4	4	3	5	3	5	4	4.27	
CO4	5	3	3	5	4	5	4	4	4	5	4	4.18	
CO5	5	5	4	4	3	5	4	4	4	3	3	4.00	
CO6	4	5	4	5	3	4	4	5	4	3	4	4.09	
CO7	5	4	3	4	5	5	3	5	4	3	5	4.18	
CO8	5	5	4	4	3	5	4	4	4	3	4	4.09	
									Overall Mean Score for COs			4.21	

Result: The Score for this Course is 4.21 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{TotalNo.of POs\& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 3**
18PBO2107 **Credits : 3**

Laboratory Course-3
PLANT PHYSIOLOGY

Course Outcomes

1. To study the effect of various physical factors on photosynthesis.
2. To estimate the quantity and activity of various enzymes.

Experiments

1. Determination of water potential (Shardakov'smethod).
2. Determination of solute potential.
3. Hills reaction.
4. Estimation of total acidity in CAMplants.
5. Apparentphotosynthesis.
6. Effect of CO_2 concentration onphotosynthesis
7. Effect of quality of light onphotosynthesis
8. Estimation of total free aminoacidsandproline.
9. *In vivo* assay of NR andNiR.
10. Estimation of IAA.
11. Estimation of starch by perchloricmethod.
12. Estimation of nitrogen (Nessler'smethod).
13. Determination of activity of peroxidase andlipase

Semester II **Hours/Week: 5**
18PBO2108 **Credits : 4**

BIOCHEMISTRY

Course Outcomes:

1. To fathom the chemical environment and the dynamics of the biological system.
2. To elucidate the interrelationships of the various pathways.
3. To learn the structure and functions of carbohydrates.
4. To acquire knowledge on lipids.
5. To study amino acids and their metabolism.
6. To study the structure and functions of proteins.

Unit-I:

Carbohydrates: Homoglycans: chemical structure and functions of starch, glycogen, cellulose, dextrin and inulin. Heteroglycan: chemical structure and functions of agar, alginic acid (sea weed polysaccharide), glycosaminoglycans and pectins. Glycocalyxoligosaccharide.Over view of metabolism of carbohydrate.

Unit-II:

Lipids and Biomembranes: Triglycerides, phosphoglycerols, derived lipids - steroids, prostaglandins and leukotrienes. Structure of membrane model, lipid bilayer. Structure of membrane proteins and membrane receptors: adrenalin receptors, acetylcholine receptors and insulin receptors.Over view of metabolism of lipids.

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.Over view of metabolism of vitamins.

Unit-IV:

Proteins: The peptide bond and primary structure. Secondary structure, domain, motif and backbone folding.Tertiary structure and stabilizing forces in collagen.Quaternary structure of haemoglobin and its regulatoryfeatures.Protein sequencing strategies - chemical and enzymic.Ramachandran plot.

Unit-V:

Enzymes: Principles of catalysis, activation barrier and energy changes in reaction profile, initial velocity and principles of enzyme kinetics: Michaelis-Menten Equation, K_M and V_{Max}measurements - LB blot; active site organization; and role of cofactors/vitamins. Enzyme regulation: pH, temperature and substrate concentration. Inhibitions and regulation of glutamine synthetase.

Books:

1. StryerLubert, 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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBO2108					Title of the Paper BIOCHEMISTRY						Hours 5	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	5	3	4	4	4	4	4	4	4	4	4		4.0
CO2	4	4	3	3	5	3	5	5	4	5	5		4.1
CO3	5	3	4	4	4	5	3	4	3	4	4		3.9
CO4	5	4	3	5	4	4	4	5	3	5	4		4.1
CO5	5	5	4	4	3	5	4	4	4	3	3		4.0
CO6	4	4	3	5	3	3	4	5	4	3	3		3.7
Overall Mean Score for COs													4.0

Result: The Score for this Course is 4.0 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 3**
18PBO2109 **Credits : 3**

Laboratory Course-4
BIOCHEMISTRY

Course Outcomes

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

Experiments

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 Vmax and Km.
9. Estimation of Ascorbic acid (Calorimetric /volumetric)
10. Estimation of Riboflavin
11. Estimation of Phenolics(Folin –Ciocalteau)
12. Estimation of Tannins (Folin-Denis / V anillin hydrochloride)
13. Estimation of total lipids and cholesterol

Semester II **Hours/Week: 5**
18PBO2110 **Credits : 5**

CELL AND MOLECULAR BIOLOGY

Course Outcomes:

1. To understand the structural organization and function of different cell organelles.
2. To study the cell cycle.
3. To understand the phenomenon of cell signaling
4. To acquire knowledge on genetic code
5. To study the mechanism of transcription in prokaryotes
6. To study the mechanism of translation in eukaryotes
7. To understand post-translation mechanism
8. To understand the principles of gene regulation.

Unit-I

Phases and control system of Cell cycle, Cell cycle checkpoints-DNA damage, centrosome duplication, spindle assembly. Cyclins and Cyclin-dependent kinases, apoptosis. Cytoskeleton structure and functions: actin filaments (microfilaments), microtubules, and intermediate filaments.

Unit-II

Cell communication: general principles. Signaling molecules and their receptors. Receptors: Cell surface receptors-ion-channel linked receptors, G-protein coupled receptors, and Tyrosine-kinase linked receptors (RTK). Programmed cell death.

Unit-III

Transcription: Genetic code, cracking the genetic code. Important features of the genetic code, proof for the triplet code, exceptions to the standard code. RNA polymerases and their role.Transcription signals-promoters and terminators. Detailed account of transcription in *E. coli* and differences in eukaryotes.

Unit-IV

Transcription in eukaryotes: transcription factors, initiation, elongation and termination.Post-transcriptional events: Split genes, splicing signals, splicing mechanisms. Alternative splicing, exon shuffling, cis&trans splicing. Organization of mRNA, RNA editing, mRNA export. Translation: features of mRNA-ORF and ribosomal binding site (RBS).

Unit-V

Stages in translation: Initiation (initiation factors in prokaryotes and eukaryotes, Kozakand Shine-Dalgarno sequences); Elongation (process of polypeptide synthesis, active centers in ribosome, elongation factors) and Termination (process of termination, release factors, ribosome recycling). Protein sorting and translocation: Post-translational modification of proteins. Protein folding-self assembly and role of chaperones. Principles of gene regulation: *lac* and *trp* operons of *E. coli*. Gene families and hormonal control in eukaryotes.

Books

1. Freifelder D. 1987, Molecular Biology. Jones and Bartlett, Boston, USA

Reference

1. Cooper GM 2000.The Cell-a molecular biology approach. 2nd e. Sinauer Associates.
2. Lodish *et al* 2004.Molecular Cell Biology, COH freeman & Co. New York.
3. De Robertis & De Robertis 1990. Cell and Molecular Biology, Saunders College, Philadelphia
4. Weaver RF & Hedrick PW 1989.Genetics.Wm, C. Brown Pub, Dubuque
5. Watson JD *et al.* 2004.Molecular biology of the gene, Pearson education, Singapore.
6. Gardner *et al.* 2004.Principles of genetics.John Wiley & Sons Inc. Singapore.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBO2110	Title of the Paper CELL AND MOLECULAR BIOLOGY										Hours 5	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	5	5	4	5	5	5	3	3	3	3	4		4.09
CO2	5	5	5	4	3	5	3	4	5	4	5		4.36
CO3	5	3	4	4	4	5	3	4	3	4	4		3.90
CO4	5	4	3	5	4	4	4	5	3	5	4		4.18
CO5	5	4	5	5	4	3	4	5	5	4	5		4.45
CO6	5	5	4	3	4	5	4	5	4	5	5		4.45
CO7	5	5	4	5	5	5	3	3	3	3	4		4.09
CO8	5	4	5	5	4	3	4	5	5	4	5		4.45
									Overall Mean Score for COs				4.24

Result: The Score for this Course is 4.24 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{TotalNo.of POs\& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: -**
18PBO2111 **Credits : 2**

Self-paced Learning:
PLANT BREEDING AND EVOLUTION

Course Outcomes:

1. To study the progress made in the field of plant breeding.
2. To understand the principles, techniques and applications of plant breeding.
3. To understand the modes of reproduction in crops
4. To learn the hybridization techniques
5. To acquire knowledge on heterosis, mutation and polyploidy
6. To study the theories of evolution

Unit-I:

Plant Breeding: Historical aspect of plant breeding and genetic basis. Objectives of plant breeding-Modes of reproduction in relation to breeding methods, sexual, asexual and apomitic reproduction-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-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-Role of interspecific and intergeneric hybridization in plant improvement.

Unit-III:

In breeding 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 changeit.

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 droughttolerance.

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.Impact of evolution on human life.

Books:

1. Chaudhari, H.K., (1995) Revised Ed., Elementary Principles of Plant Breeding.

Reference:

1. Chandrasekaran & Parthasarathy, (1990). Cytogenetics and Plant Breeding.
2. Sinha,U. and Sinha, S. (1992). Cytogenetics, Plant Breeding and Evolution.
3. Sharma,J. R. (1996) Principles and Practice of Plant Breeding.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBO2111					Title of the Paper Self-phased Learning: PLANT BREEDING AND EVOLUTION								Hours -	Credits 2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	3	5	3	2	1	4	5	3	4	2	4	3	3.3	
CO2	5	3	5	3	4	3	4	4	2	3	3	4	5	3.7	
CO3	4	3	2	5	3	3	2	3	2	2	3	3	2	2.9	
CO4	5	4	3	3	2	2	5	3	3	5	4	3	3	3.5	
CO5	4	3	5	2	3	2	2	3	3	3	2	4	3	3.3	
CO6	5	3	5	4	3	4	3	2	4	3	3	3	4	3.5	
										Overall Mean Score for COs				3.4	

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II — **Hours/Week: 4**
18PBO2202A — **Credits : 4**

Core Elective-2:
BIOPHYSICS AND INSTRUMENTATION

Course Outcomes:

1. To understand the importance of Biophysics in modern biology.
2. To study the laws of thermodynamics.
3. To understand the concept of redox potential in biological system.
4. To study various types of microscopy and their applications.
5. To study various types of centrifugation.
6. To acquire knowledge on spectroscopy and tracer techniques.

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,the role of osmosis in cell volume regulation.The 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, procedure and application. Types of centrifugation- density gradient centrifugation, ultracentrifugation and differential centrifugation.*Chromatography:* Principles, instrumentation, and applications of Paper, thin layer, column chromatography, gas chromatography, HPTLCand GC-MS.

Unit V

Spectrophotometry: principles and instrumentation of UV/Vis, Atomic absorption spectrophotometer(AAS), NMR, ESR. *Tracer*

*techniques:*Important stable radioisotopes and their uses in research. Radiation hazards and precautions in 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. Roy R.N. 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. Budhiraja R.P. Separation chemistry. New age international (P) Ltd, New Delhi.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBO2202A	Core Elective-2: BIOPHYSICS AND INSTRUMENTATION										Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	5	4	5	4	4	4	4	5	3	4	4	4.18	
CO2	4	4	4	5	3	3	4	4	5	5	5	4.18	
CO3	5	3	5	3	4	5	4	3	5	4	5	4.18	
CO4	4	5	4	5	4	4	4	4	3	5	4	4.18	
CO5	4	3	3	4	5	5	4	5	5	3	4	4.09	
CO6	5	4	5	5	5	4	4	4	5	4	5	4.54	
Overall Mean Score for COs												4.22	

Result: The Score for this Course is 4.22 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 4**
18PBO2202B **Credits : 4**

Core Elective-2:
PLANT PATHOLOGY

Course Outcomes:

1. To study the process of plant pathogenesis and diseaseestablishment
2. To understand the basis of defence mechanism against pathogens
3. To acquire knowledge on the effect of infection on host physiology
4. To understand the various types of defence mechanism
5. To acquire knowledge on some common plant diseases
6. To learn the different types of disease control mechanism

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, pre-penetration, 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:

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). Control of plant diseases: biological, cultural and chemical methods, fungicidal, chemotherapy. Biotechnology in relation to Plant pathology.Agricultural terrorism.

Books:

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, NewDelhi
2. Sharma P.D., 2001, Microbiology and plant physiology Rastogipublications.
3. Harsfall JG & Cowling E B. 1979. Plant Disease, an advanced Treatise. Academic Press,NY.
4. Mukherjee KG and JayantiBhasin, 1986. Plant diseases of India. Tata MacGraw-Hill publishing company Ltd. New Delhi.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PBO2202B	Title of the Paper Core Elective-2: PLANT PATHOLOGY										Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	5	4	5	4	4	4	4	5	3	4	4	4.18	
CO2	4	4	4	5	3	3	4	4	5	5	5	4.18	
CO3	5	3	5	3	4	5	4	3	5	4	5	4.18	
CO4	4	5	4	5	4	4	4	4	3	5	4	4.18	
CO5	4	3	3	4	5	5	4	5	5	3	4	4.09	
CO6	5	4	5	5	5	4	4	4	5	4	5	4.54	
									Overall Mean Score for COs			4.22	

Result: The Score for this Course is 4.22 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: 4**
18PSS2301 **Credits : 4**

IDC: SOFT SKILLS

Course Outcomes:

1. Students are taught the various nuances of grooming such as, good manners and etiquettes and they are trained to practice them in the class rooms.
2. Students are empowered with public speaking skills via extempore speeches and prepared speeches, presented before the class and assessed by the trainer as well as the companions which eventually helps build self confidence of the students.
3. Students learn the different types of resumes and different types of interview skills and write and print their own resumes and present before the interview panel for their mock interview.
4. Students actively learn the ten parameters of group discussion, perform on the stage with their colleagues, which is videotaped, reviewed and evaluated.
5. As students go through their teenage, self discovery becomes a tool to develop their personality facilitated with scientific psychological personality tests.
6. Students are guided to knowing their SWOT (Strengths, Weaknesses, Opportunities and Threats)and setting their short term and long term goals for their lives.

Module 1: Basics of Communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication, **Effective Communication**: The Art of Listening, Exercises in Kinesthetics, Production of Speech, Organization of Speech, Modes of delivery, Conversation Techniques, Dialogue, Good manners and Etiquettes, Politeness markers & Listening links.

Module II: Resume Writing: What is Resume? Types of Resume? Chronological, Functional and Mixed Resume, Steps in preparation of Resume, structure and framework for writing resume, Intensive training / personalized training on resume writing. **Interview Skills**: Common interview questions, Attitude, Body Language, The mock interviews, Phone interviews, Behavioral interviews.

Module III: 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 & Practicum with video coverage. **Team Building:** Team Vs Group – Synergy,

Stages of Team Formation, Broken Square-Exercise, Win as much as you win- Exercise, Leadership – Styles, Work ethics.

Module IV: Personal Effectiveness: Self Discovery, Self Esteem, Goal setting, Problem-solving, Conflict and Stress Management

Module V: Numerical Ability: Average, Percentage, Profit and Loss, Problems on ages, Simple Interest, Compound Interest, Area, Volume and Surface Area,Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Calendar, Clocks, Permutations and Combinations, Probability.

Module VI: Test of Reasoning: Series Completion, Analogy, Data Sufficiency, Blood Relations, Assertion and Reasoning, Logical Deduction, Direction. **Non-Verbal Reasoning**: Series, Classification

Text Book

1. Melchias, G., Balaiah John., John Love Joy (Eds) 2015. *Winners in the making*. St.Joseph's College, Trichy-2

References

1. Aggarwal, R. S. *Quantitative Aptitude, S.Chand & Sons*
2. Aggarwal, R.S. (2010). *A Modern Approach to Verbal and Non Verbal Reasoning*. S. Chand & Co, Revised Edition.
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 University Press.
7. Prasad, L. M. (2000). *Organizational Behaviour, S.Chand & Sons.*
8. Schuller, Robert. (2010). *Positive Attitudes*. Jaico Books.
9. Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.
10. Yate, Martin. (2005). H*iring the Best: A Manager's Guide to Effective Interviewing and Recruiting*.

Modules	Topics	Examination Pattern	
		CIA	Online
I	Basics of Communication	15	5
II	Resume Writing & Interview Skills	15	5
III	Group Discussion & Team Building	10	5
IV	Personal Effectiveness	10	5
V	Numerical Ability (Common Session)	5	10
VI	Test of Reasoning (Common Session)	5	10
Total		**60**	**40**

Semester III **Hours/Week: 5**
18PBO3112 **Credits : 5**

PLANT SYSTEMATICS

Course Outcomes:

1. To understand the relevance of molecular techniques in plantsystematics.
2. To study the classical taxonomy with reference to differentparameters.
3. To contrast keys to classify plants
4. To understand the principles of phylogenetic systematics
5. To understand principles of biological classification and nomenclature
6. To recognize important families of angiosperms.
7. To understand various evidences in support of classification.
8. To understand salient features of selected families.

Unit-I:

Taxonomic History: Natural systems; Phyletic systems - APG;Phenetics; Cladistics. *Concepts of Taxonomic hierarchy:* Species, Genus, Family and other categories; species concept and infraspecific categories - subspecies, varieties and forms. *Botanical nomenclature:* History of ICN aims and principles; rule of priority, nomenclatural types, author citation, retention, rejection and changing of names, naming a new species, synonyms, effective and valid publication.

Unit-II:

Plant Identification: Taxonomic keys, written description, specimen comparison.*Taxonomic tools:* Herbaria and data information, Floras and Botanical gardens. *Systematic Evidence:* Morphology, anatomy, palynology, embryology, cytology, phytochemistry.

Unit-III:

Molecular systematics-plant genomes: nuclear, chloroplast and mitochondria. Molecular markers, generating molecular data, restriction site mapping, gene sequencing, analysis of molecular data, alignment of sequences, methods of phylogeny reconstruction.

Unit-IV:

Study of the following families (Bentham & Hooker) in detail with special reference to their salient features, interrelationships, evolutionary trends &

economic significance: Menispermaceae, Capparaceae, Caryophyllaceae, Meliaceae, Aizoaceae, Convolvulaceae.

Unit-V:

Scrophulariaceae, Acanthaceae, Verbenaceae, Loranthaceae, Hydrocharitaceae, Commelinaceae and Cyperaceae.

Books:

1. Davis, P.H. & Heywood,V.M 1963, Principles of Angiosperm Taxonomy, Oliver &Boyd.
2. Crawford, D.J. 2003. Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.
3. Heywood,V.K & Moore, D.M., 1984, Current Concepts in Plant Taxonomy, AP, London.

Reference:

1. Burkill, I.H., 1965, Chapters of the history of Botany in India, Government of India Press, Nasik, The Manager ofPublications.
2. Grant, W.F., 1984, Plant Biosystematics, Acad Press Inc.,Canada.
3. Harborne, J.B. &Turner,B.L, 1984, Plant Chemosystematics, Acad. Press, London.
4. Hillis, DM., Moritz, C & Mable, BK (eds) 1996, Molecular Systematics, Sinaver Associates, Sunderland,USA
5. Jain,S.K., 1981, Glimpses of Indian Ethnobotany, Oxford & IBH Publ. Co., NewDelhi.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBO3112					Title of the Paper PLANT SYSTEMATICS						Hours 5	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	4	3	5	4	5	4	5	4	5	4	3		4.18
CO2	5	3	3	5	5	4	4	5	4	3	5		4.18
CO3	5	4	5	4	5	4	4	5	4	3	5		4.36
CO4	4	5	4	4	4	5	4	3	3	5	4		4.09
CO5	5	4	3	5	4	3	3	4	4	3	5		3.90
CO6	5	5	4	4	5	4	4	5	4	4	5		4.45
CO7	4	3	5	4	5	4	5	4	5	4	3		4.18
CO8	5	4	3	5	4	3	3	4	4	3	5		3.90
											Overall Mean Score for COs		4.19

Result: The Score for this Course is 4.19 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBO3113 **Credits : 3**

Laboratory Course-5
PLANT SYSTEMATICS

Course Outcomes

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

Exercises

I. Binomial identification usingflora.
II. Study of the following families with reference to their South Indian representatives and minimum of one member each to be taxonomically described, dissected and sketched (toscale): Menispermaceae, Nymphaeaceae, Capparaceae, Caryophyllaceae, Meliaceae, Aizoaceae, Rubiaceae, Asteraceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae, Loranthaceae, Euphorbiaceae, Hydrocharitaceae, Commelinaceae, Araceae, Cyperaceae
III. Exercises inkey-making.
IV. Exercises in the important Articles of theCode.
V. Submission of 5 herbarium sheets and digital description of any 5 plantspecies.
VI. Field TripReport

Semester III **Hours/Week: 3**
18PBO3114 **Credits : 3**

GENETICS

Course Outcomes:

1. To understand the principle and the hereditary mechanisms.
2. To study the structure and functions of genetic materials.
3. To acquire knowledgeon linkage and crossing over
4. To understand the organization of prokaryotic and eukaryotic genomes
5. To understand the mechanism of DNA repair
6. To acquire knowledge on population genetics

Unit-I

Mendel and his work: Laws of inheritance. Back cross and Test cross. Gene interaction and Modified Mendelian ratios. Quantitative inheritance and multiple alleles.Problem solving in genetics.

Unit-II

Linkage and crossing over, 3-point cross and gene mapping methods. DNA is the genetic material: proof: Griffith's, Avery *et al*., and Hershy and Chase.

Unit-III

Organization of eukaryotic and bacterial genomes. Watson and Crick model of DNA helix. Semi-conservative replication mechanism of DNA: replication of linear and circular DNA. Replication of RNA genomes.

Unit-IV

Molecular mechanisms of DNA repair (mismatch and proof reading, photoreactivation, excision, recombination and SOS repair). Mobile genetic elements- IS elements and transposons in maize and bacteria.

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.

Book

1. Malacinski GM and Freifelder D 2008Essentials of Molecular Biology, 4th E Jones & Bartlett.
2. Verma, P.S. & V.K. Agarwal, 2003, Genetics. S. Chand, New Delhi.

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBO3114					Title of the Paper GENETICS						Hours 3	Credits 3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	4	3	5	4	5	4	5	4	5	4	5		4.36
CO2	5	3	3	5	4	4	3	4	3	4	5		3.90
CO3	4	4	4	4	3	3	4	5	5	3	4		3.90
CO4	5	5	4	5	4	5	3	3	4	5	5		4.36
CO5	5	4	3	5	4	3	3	4	4	3	5		3.90
CO6	4	3	3	3	5	4	5	4	5	4	4		4.00
									Overall Mean Score for COs				**4.07**

Result: The Score for this Course is 4.07 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 6**
18SBS3101 **Credits : 5**

Inder Disciplinary Core:
SOLID WASTE MANAGEMENT

Course Outcomes:

1. To understand the importance of solid waste management.
2. To study the method s of collection of wastes.
3. To acquire knowledge on decomposition of organic matter.
4. To know the methods of solid waste management.
5. To learn the technology of vermicomposting.
6. To learn the technique of Mushroom cultivation.
7. To understand the importance and medicinal values of mushroom.
8. To understand the preparation of recipes of mushroom

Unit-I

Definition-scope and importance of solid waste management-Types of solid wastes-garbage, rubbish, agricultural, hospital and domestic wastes. Collection-transport and processing of solid wastes.Waste as a resource-organic compost-process of composting-Role of microbes in composting. Significance of organic compost.

Unit-II

Organic matter decomposition- Decomposition of litter, cellulose, hemicelluloses, lignin, water soluble components and proteins.Carbon assimilation and immobilization.Microbes associated with organic matter decomposition.Factors affecting organic matter decomposition.

UnitIII

Solid waste management- methods of solid waste management- open dumping, land filling, incineration, pyrolsis Biogas production-mechanism of methane gas formation. Factors affecting methane formation Utilization of Biogas.

Unit-IV

Vermicomposting-Earthworm and it's characteristics-internal anatomy-digestive, excretory, respiratory and reproductive systems.Preparatory methods of vermiculture.Economic and ecological importance of vermicompost and vermi wash.

Unit-V

Mushroom culture- classification-Tests for identification-Characteristics of common edible mushrooms-Nutritive value of mushrooms. Culture techniques-preparation of spawn- Preparation compost- spawn running and harvesting. Preservation and storage.Recipes of mushroom.

Text Book

1. Dubey, RC. (2009). A Text book of microbiology, S. Chand & Co. Ltd, New Delhi.

Reference

1. NIIR Board, 2004, The Complete Technology Book on Biofertilizers and Organic Farming, National Institute of Industrial Research.
2. Mohoney, R. Lab Techniques in Zoology, (UK: Butterworth, 1966)
3. Vasantaraj David, S. and Kumaraswamy, T. Elements of Economic Entomology, (Chennai: Popular Book Depo, 1998).

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SBS3101			Title of the Paper SOLID WASTE MANAGEMENT										Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	5	4	5	4	3	3	4	5	3	4	4	4	4	4.0	
CO2	5	3	5	3	4	3	4	4	2	3	3	4	5	3.7	
CO3	4	3	3	5	3	3	4	3	4	4	3	3	4	3.5	
CO4	5	4	3	3	2	2	5	3	3	5	4	3	3	3.5	
CO5	4	3	5	3	3	3	3	3	3	3	3	4	3	3.3	
CO6	5	3	5	4	3	4	3	2	4	3	3	3	4	3.5	
CO7	4	3	5	2	2	5	3	5	3	4	5	4	2	3.7	
CO8	4	5	3	5	3	5	2	4	2	5	3	3	4	3.7	
Overall Mean Score for COs														3.5	

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

***Values Scaling*:**

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PBO3203A **Credits : 4**

Core Elective-3: PHARMACOGNOSY

Course Outcomes:

1. To study the different systems of Indian medicines and the bioactive principles
2. To know the pharmacological importance of medicinal plants
3. To study the classification of drugs
4. To acquire knowledge on collection and processing of herbal drugs
5. To know about some important medicinal plants with their binomial and uses
6. To acquire knowledge on phytochemicals and their applications

Unit I

Traditional and alternative system of medicine-Principle, practice, short history and merits of herbal medicine- naturopathy, Chinese medicine, 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. Conservation of medicinal plants.

Unit III

Medicinally useful plant parts-Root -*Hemidesmusindicus, Withaniasomnifera*, *Rauvolfiaserpentina*; Rhizome -*Zingiberofficinalis, Acoruscalamus*, *Curcuma longa*; Stem- *Tinosporacordifolia, Santalum album*, *Cinchona officinalis;*Bark - *Terminaliaarjuna, Cinnamomumverum, Saracaasoca*; Leaf -*Adhatodavasica, Ocimum sanctum, Cynodondactylon*; Flowers -*Crocussativus*, *Syzygiumaromaticum, Leucusaspera*; Fruits - *Phyllanthusemblica, Piper longum, Terminaliachebula;*Seeds - *Azadirachtaindica,Vernoniaanthelmintica, Ricinuscommunis.*

Unit IV

Herbal preparation methods-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 remediesteas and dry extract (pills or capsules).

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. Evans, 2009. Pharmacognosy, Elsevier Publications, Edinburgh.
2. James Green, 2000 Herbal Medicine-Maker's Handbook, Crossing Press, U.S.
3. Weiss, Rudolf Fritz 2000 Herbal Medicine, 2nd Edition Thieme Medical Publishers
4. Kokate CK, Purokit AP and Gokahale, 2006.Pharmacognosy, Nirali Prakashan.
5. Somasundara, S 1997. *Maruththuva Thavaraiyal*, Ilangovan Padhippagam, Palayamkottai

Online Resources

http://www.gallowglass.org/jadwiga/herbs/preparations.html

http://shawnacohen.tripod.com/thetribaltraditions/id51.html

http://www.vasundharaorissa.org/Research%20Reports/Globalisation And MedicinalplantsOfOrissa.pdf

http://www.emea.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/09/WC500003393.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBO3203A					Title of the Paper Core Eletive-3: PHARMACOGNOSY						Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	5	4	5	4	4	4	4	5	3	4	4		4.18
CO2	4	4	4	5	3	3	4	4	5	5	5		4.18
CO3	5	3	5	3	4	5	4	3	5	4	5		4.18
CO4	4	5	4	5	4	4	4	4	3	5	4		4.18
CO5	4	3	3	4	5	5	4	5	5	3	4		4.09
CO6	5	4	5	5	5	4	4	4	5	4	5		4.54
									Overall Mean Score for COs				4.22

Result: The Score for this Course is 4.22 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBO3203B **Credits : 4**

Core Elective-3:
BIOINFORMATICS AND BIONANOTECHNOLOGY

Course Outcomes:

1. To know importance of Bioinformatics in Biology
2. To know the various data bases available
3. To understand the basic concepts of Nanotechnology
4. To acquire knowledge on synthesis of green nano-particles
5. To study the characteristics of nanoparticles
6. To understand the interaction of nanoparticles with living system.

Unit-I

Overview of Bioinformatics-Need for Bioinformatics technology-Data format and processing-secondary resources and applications-Role of structural bioinformatics-Biological data integration system. Bioinformatics and its applications.

Unit-II

Bioinformatics data bases-Genomic data bases-NCBI, EMBL,DDBJ and Gen-Bank. Proteomic data bases-Swiss-Prot, Uni-Prot, ExPASY and PDB. RNA data bases-Rfam and GtRNA. Phylogenetic analysis-Construction of Phylogenetic tree with reference to DNA and Protein sequences.Biological importance of computerized Phylogenetic analysis.

Unit-III

Nanotechnology - origin, scope and importance. Nanoparticles-definition. Principles: quantization effects - inverse relationship between size and reactive surface area. Properties: surface effects, the effects of size, shape and surface area. Advances made with plant nanobionics-bomb detection, glowing plants, augmented photosynthesis, *etc*. Essentials of nanostructure generation: top-down vs. bottom-up. Physical, chemical and biogenic synthesis of nanomaterials-biomimetics, green plants and microorganisms. Role of biomolecules - reducing and/or capping agents: proteins, viruses and carbohydrates.

Unit-IV

Detection and measurement of nanoparticles-physical characterization by UV, FTIR, SEM, FESEM, DLS, X-ray diffraction and Zeta potential.Targeted

nanoparticles: active & passive targeting. Application: medicine, manufacturing & materials, delivery vehicles, cancer therapy, tissue engineering, fluorescent biological labels, biological assays, imaging agents, biosensors, manipulation of cells and biomolecules.

Unit-V

Interactions between nanoparticles and living systems, interaction with cells, exposure of living systems to nanomaterials - toxicity effects.Mediators of the toxicity of particles. Factors influencing the interaction of nanomaterials over mammalian cells: uptake, transport and biodistribution of nanoparticles in living system, toxicity on cellular processes. Overview of EU regulatory aspects.

Book

1. Sharon, M. & Sharon, M 2012. Bio-Nanotechnology- Concepts and Applications, CRC Press.
2. *Atkinson WI.2011. Nanotechnology.Jaico Book House, New Delhi.*

References

1. Barbara Panessa-Warren, 2006 Understanding cell- nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory
2. European Commission, SCENIHR, 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union
3. Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ. of Queensland.
4. Jain K.K. Nanobiotechnology molecular diagnostics: Current techniques and application (Horizon Bioscience) 2006 Taylor & Francis 1st edition.
5. Volker Maila nder and Katharina Landfester 2009 Interaction of nanoparticles with cells biomacromolecules, 10 (9): 2379-2400 DOI: 10.1021/bm900266r

Online Resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/
2. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html
3. http://www.particle-works.com/applications/controlled-drug-release/Applications

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBO3203B					Title of the Paper Core Elective-3: BIOINFORMATICS AND BIONANOTECHNOLOGY						Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	5	4	5	4	4	4	4	5	3	4	4	4.18	
CO2	4	4	4	5	3	3	4	4	5	5	5	4.18	
CO3	5	3	5	3	4	5	4	3	5	4	5	4.18	
CO4	4	5	4	5	4	4	4	4	3	5	4	4.18	
CO5	4	3	3	4	5	5	4	5	5	3	4	4.09	
CO6	5	4	5	5	5	4	4	4	5	4	5	4.54	
						Overall Mean Score for COs						**4.22**	

Result: The Score for this Course is 4.22 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PBO3301 **Credits : 4**

IDC-2 (WS):
BIOPROCESS TECHNOLOGY

Course Outcomes:

1. To introduce the principle, importance and components of a fermenter.
2. To study the basic concepts of unit operations and unit processes.
3. To understand the chemical engineering and its relation to other disciplines.
4. Ability to list chemical Monitoring process, units, and the corresponding equipment.
5. To study the production strategies of commercial products.
6. To understand the separation techniques, types and various effluent treatment process.

Unit-I:

Principles of fermentation process, Bioprocess vs Chemical process, Media formulation-Growth factors, Buffers, O_2, 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.

Unit-V:

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

Books

1. Stanbury, P F & Whitaker, A, 1995, Principles of Fermentation Technology, Pergamon.

References

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PBO3301					Title of the Paper IDC-2 (WS): BIOPROCESS TECHNOLOGY						Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	4	5	5	4	5	5	5	4	4	3	5		4.45
CO2	5	3	3	5	4	4	4	3	5	3	5		4.00
CO3	4	4	4	4	3	4	4	5	4	3	5		4.00
CO4	4	5	4	5	4	5	5	4	5	5	5		4.63
CO5	5	5	5	5	4	4	4	4	4	3	5		4.36
CO6	4	4	4	4	5	4	5	5	5	3	5		4.36
									Overall Mean Score for COs				4.30

Result: The Score for this Course is 4.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PBO3302 **Credits : 4**

IDC-3 (BS): HORTICULTURE AND LANDSCAPING

Course Outcomes:

1. To understand the importance and divisions of horticulture
2. To learn the various methods of plantpropagation
3. To know the art of indoorgardening
4. To acquire knowledge on floriculture
5. To study the types and components of gardens
6. To acquire knowledge on landscaping

Unit-I:

Importance and scope of horticulture; divisions of horticulture; climate, soil and nutritional needs. Water irrigation; plant propagation methods-Cutting, Grafting, BuddingandLayering.Role of Tissue Culture in Horticulture plants.

Unit-II:

Indoor gardening-foliage, 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. Role of Orchids in Cut flower industries.

Unit-III:

Fruit crops-induction of flowering, flower thinning, fruit setting, fruit development. Cultivation of important fruit crops-Mango and Guava. Field visit: Horticulture Department or Garden.

Unit-IV:

Landscaping principles-planning designs for house gardens, institutional and industrial gardens-bioaesthetic , avenue 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.

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.

References:

1. Manibushan Rao K. 1991. Text book of horticulture. MacMillan Publishing Co., New York.
2. Edmond JB *et al*., 1977. Fundamentals of horticulture. Tata McGraw Hill Ltd., New Delhi.
3. Rao KM. 2000. Text Book of Horticulture, MacMillan India Ltd., New Delhi.
4. Gopalswamy Iyyangar, 1970. Complete gardening in India, Kalyan Printers, Bangalore..

Semester IV **Hours/Week: 5**
18PBO4115 **Credits : 4**

MICROBIOLOGY AND IMMUNOLOGY

Course Outcomes:

1. To study the microorganisms and theiractivities.
2. To study the structure and organization of bacteria and viruses.
3. To understand the application of microbes in food and dairy microbiology.
4. To exploit their potentialities in agriculture, industry and therapeutic aspects.
5. To study the production and applications of antibiotics.
6. To understand the role of soil microbes in biogeochemical cycles.
7. To understand the basic concepts of the immunesystem.
8. To acquire knowledge on types and properties of antigens and antibodies.

Unit-I:

General microbiology; scope, branches and history.Structure and organization of Bacteria, Actinomycetes.Brief study on Spirochetes, Rickettsias, Chlamydias and Mycoplasmas, Viruses –Structure, organization,Classification and replication.Brief account on Viroids, virusoids and prions.Culture of microorganisms, synchronous, batch and continuous culture.Chemostat and turbid stat, preservation ofmicrobes.

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-Immune system: structure and functions of primary and secondary lymphoid organs - immune cells - haemetopoiesis -detailed study of T and B cells, MHC molecules and antigen processing and presentation. General structure of antibodies - classes-Generation of antibody diversity.Monoclonal antibodies.

Unit-V:

Antigens-types, antigenicity and immunogenicity.Antigen-antibody interaction. Types of immunity - innate and adaptive - emphasis on cell mediated and humoral immune responses. Immune response during bacterial (Tuberculosis) parasitic (malaria) and viral (HIV) infections.Autoimmune disorders. Vaccines - Immunization schedule.

Books:

1. Prescott *et al*., 2009 7e, Microbiology. Wm. C. BrownPublishers.
2. Kuby J, 2000, Immunology, 4thedition, W HFreeman

Reference:

1. Pelczar*et al.* 1998, Microbiology - Concepts & Applications. Tata McGraw Hill NewDelhi.
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, 3rdedition Gerland Pub. Inc.NY.
5. NandiniShetty 1996, lmmunology - An introductory Text Book, New Age Intl (P)Ltd.
6. Roitt*et al*., 1998, Immunology 5thedition, Mosby International Ltd. London.UK.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PBO4115					Title of the Paper MICROBIOLOGY AND IMMUNOLOGY						Hours 5	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	4	5	3	5	5	5	5	5	5	4	5	4.63	
CO2	5	5	4	3	4	3	5	4	5	5	5	4.36	
CO3	4	4	4	4	3	4	4	5	4	4	5	4.09	
CO4	4	5	4	5	4	5	5	4	5	5	5	4.63	
CO5	5	5	5	5	4	4	4	4	4	3	5	4.36	
CO6	4	4	4	4	5	4	5	5	5	3	4	4.27	
CO7	5	5	5	5	4	4	4	4	4	3	5	4.36	
CO8	4	4	4	4	5	4	5	5	5	3	4	4.27	
											Overall Mean Score for COs	**4.37**	

Result: The Score for this Course is 4.37 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester IV **Hours/Week: 5**
18PBO4116 **Credits : 4**

GENETIC ENGINEERING AND BIOTECHNOLOGY

Course Outcomes:

1. To understand the role of enzymes in genetic engineering
2. To acquire knowledge in various cloning vectors
3. To understand the role of engineered vectors in bioremediation
4. To acquire knowledge on GM foods and their impact
5. To know the art of recombining genes andtraits.
6. Understanding the revolutions that unfold inbiotechnology

Unit-I:

Crown gall and *Agrobacterium*; generation of bacterial genes (restriction enzymes) and eukaryotic (cDNA).Joining DNA molecules and the strategies - *E. coli* and T_4 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:

Metagenomics.Engineered microbes - bioremediation of oil spills: oil-eating super bugs (*B.megatarium*, *P. putida,* &*A.borkumensis*); Bt crops, golden rice technology, plantibodies and edible vaccines. Strategies for crop improvement: engineering for resistance against herbicides and diseases. Antisense RNA technology. CRISPR

Unit-IV:

Technology protection systems (GURT) - the terminator.Biosafety aspects 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 Btbrinjal.Essentials of IPRs and patents.

Unit-V:

Synthetic biology-scope and importance.Artificial DNA and synthetic genome.Contribution of JC Venter.Minimal genome, expanded gene pool.

Creation of synthetic organisms: top-down and bottom-up approaches. Potentials and applications; ethical issues of synthetic organisms.

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. *Journal of Biomedicine and Biotechnology.*
7. Benner SA. &Sismour AM, 2005. Synthetic Biology, *Nature* Reviews, Genetics, 6:533

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PBO4116	Title of the Paper GENETICS ENGINEERING AND BIOTECHNOLOGY									Hours 5	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	5	4	4	4	3	4	4	5	4	5	5	4.27
CO2	5	5	5	5	5	5	5	5	4	5	5	4.90
CO3	5	5	5	5	5	5	5	5	5	5	5	5.00
CO4	5	5	4	5	4	5	5	5	5	5	5	4.81
CO5	5	5	5	5	4	4	5	5	5	5	5	4.81
CO6	4	4	5	5	5	4	5	5	5	5	4	4.63
Overall Mean Score for COs												4.74

Result: The Score for this Course is 4.74 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 4**
18PBO4117 **Credits : 3**

Laboratory Course-7
MICROBIOLOGY, IMMUNOLOGY, GENETIC ENGINEERING AND BIOTECHNOLOGY

Course Outcomes:

1. To learn various techniques of isolation and enumeration of microorganisms from various sources.
2. To understand the immunological techniques.
3. To learn the technique of isolation of DNA.
4. To develop protocols for plant tissue culture and synthetic seed production.

Experiments

1. Isolation and enumeration (CFU) of microorganisms in soil by serialdilution.
2. Bacterial staining - Simple, Gram'sstaining.
3. Isolation of bacteria from skin, mouth andurine.
4. Potability test of water - presumptive, confirmative and completedtests.
5. Quantitative estimation of bacteria inmilk.
6. Testing quality of milk by methylene blue reductase (MBRT) and phosphatasetest.
7. Morphological and biochemical identification of bacteria - indole test, methyl red test, Voges-Proskaur test, Citrate utilization test, TSI agartest.
8. Blood grouping
9. WIDAL- test for typhoid
10. RPR- test forsyphilis
11. RF- test for rheumatoid arthritis
12. Immunoelectrophoresis
13. ELISA-Demo
14. Identification of local crop diseases (sugar cane, paddy, banana, brinjalandcitrus).
15. Callus induction andregeneration.
16. Clonalpropagation.
17. Embryo culture
18. Electrophoretic separation of DNA, protein and restrictiondigestion.
19. Preparation of synthetic seeds.

Semester IV **Hours/Week: 4**
18PBO4118 **Credits : 4**

RESEARCH METHODOLOGY

Course Outcomes:

1. To identify the influencing factors of research parameters
2. To understand the types and objectives of research.
3. To acquire knowledge on sampling techniques.
4. To acquire knowledge on Literature collection and thesis writing.
5. To test the significance, validity and reliability of the research
6. To acquire knowledge on basic concepts in Biostatistics.

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: Books, Research articles and e-resources. Structure of thesis &research article.Manuscript for publication and proof correction.Structure and components of research proposal, National and International funding sources.

Unit-III:

Bibliometrics: definition and relevance; Bibliometrics databases, h-index, SNIP, Page Rank, Impact Factor and evaluation. The use of bibliometrics in research: Citation Research, Science Citation Index. The Institute for Scientific Information (ISI), Thomson Reuter's Webmetric and ORCID.Plagiarism, Tailored Research and Retraction.Indian Patent Act.

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, Pie diagram.– Measures of Central values: Mean, Median and Mode- Measures of Dispersions, : Range, Mean Deviation, Standard Deviation.

Unit-V:

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 Pub. 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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PBO4118					Title of the Paper RESEARCH METHODOLOGY						Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	4	4	4	5	4	4	4	3	4	5	4		4.09
CO2	4	4	5	4	4	4	4	4	4	5	5		4.27
CO3	4	5	5	4	4	5	4	5	4	4	5		4.45
CO4	5	5	3	5	5	4	5	4	4	4	5		4.45
CO5	4	5	5	5	4	5	5	5	5	5	5		4.81
CO6	4	4	5	5	5	4	5	5	5	5	5		4.72
Overall Mean Score for COs													**4.70**

Result: The Score for this Course is 4.7 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: -**
18PBO4119 **Credits : 2**

COMPREHENSIVE EXAMINATION

Course Outcomes:

1. To acquire knowledge for attending competitive exams in biology.
2. To study the structure and function of biomolecules.
3. To understand the mechanism of DNA replication and repair.
4. To learn the technique of synthesizing rDNA.
5. To understand the mechanism of photosynthesis.
6. To understand components of eosystem.

Unit-I:

Structure and function of biomolecules; metabolism; principles of enzyme catalysis; protein & nucleic acids; bioenergetics; membrane structure and function; intracellular organelles; cell division and cell cycle; genes andchromosomes.

Unit-II:

Mendelian inheritance; quantitative genetics; mutation; DNA replication, repair and recombination; DNA damage and repair mechanisms; gene expression-transcription & translation; RNA synthesis and processing; protein synthesis and processing.

Unit-III:

Recombinant DNA methods; transgenic organisms; and Bioremediation.Gametogenesis and fertilization; embryogenesis; seed formation and germination; meristem and morphogenesis; organogenesis in plants.

Unit-IV:

Photosynthesis; Respiration; nitrogen metabolism; plant hormones; sensory photobiology; solute transport and photo-assimilate translocation; secondary metabolites; stress physiology; principles and methods of taxonomy; concepts of species and hierarchical taxa.

Unit-V:

Major habitat types of the subcontinent, geographic origins and migrations of species; Environment; Species interactions; Ecological succession; Ecosystem structure and function; Biogeography; Climate change; Conservation Biology; Evolutionary thoughts.