M.Sc. BOTANY

LOCF SYLLABUS – 2021

SCHOOLS OF EXCELLENCE

WITH CHOICE BASED CREDIT SYSTEM (CBCS)

DEPARTMENT OF BOTANY
SCHOOL OF BIOLOGICAL SCIENCES
ST.JOSEPH'S COLLEGE (AUTONOMOUS)
Special Heritage Status Awarded by UGC
Accredited at A^{++} Grade (IV Cycle) by NAAC
College with Potential for Excellence by UGC
DBT-STAR & DST-FIST Sponsored College
Tiruchirappalli - 620 002, Tamil Nadu, 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 maintain and uphold the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from the academic year 2014 – 15, to meet and excel the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system enhances the optimal utilization of both human and infrastructural resources. It also enhances academic mobility and enriches employability. The School system preserves the identity, autonomy and uniqueness of every department and reinforces Student centric curriculum designing and skill imparting. These five schools adhere 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 School System caters to the needs of stake-holders, especially the employers.

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 credits and hours of each course of a programme is given in the table of Programme Pattern. 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 programme pattern table. The total number of minimum courses offered by the Department is given in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)
LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

OBE is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities and assessments should all help the students achieve the specific outcomes

Outcome Based Education, as the name suggests depends on Outcomes and not Inputs. The outcomes in OBE are expected to be measurable. In fact each Educational Institute can state its own outcomes. The ultimate goal is to ensure that there is a correlation between education and employability

Outcome –Based Education (OBE): is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve, stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs):

PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Programme Educational Objectives (PEOs): The PEOs of a programme are the statements that describe the expected achievement of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after Graduation.

Some important terminologies repeatedly used in LOCF.

Core Courses (CC)

A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Specific Elective Courses (DSE)

Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

DSE: Four courses are offered, one course in each semester.

Note: To offer **one DSE**, a minimum of two courses of equal importance / weightage is a must.

One DSE Course in semester two is offered as interdisciplinary/common course among the departments in a School (Common Core Course) at the PG level.

Generic Elective Courses

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

Generic Elective courses are designed for the students of **other disciplines**. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

Two GE Courses are offered, one each in semesters II and III. The GE course offered in semester II is within the school level and the GE in semester III is Between Schools level

The Ability Enhancement Courses (AEC)

One Main discipline related Ability Enhancement Course for 3 credits is offered for a PG programme by the Department.

Skill Enhancement Courses (SECs)

These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme.

One SEC is offered in semester II as a compulsory course on Soft Skills, offered by the Department of Human Excellence, common to all the students of PG programme.

Self–paced Learning: It is a course for two credits. It is offered to promote the habit of independent/self learning of Students. Since it is a two credit course, syllabus is framed to complete within 45 hours. It is not taught in the regular working hours.

Comprehensive Examinations: A detailed syllabus consisting of five units to be chosen from the courses offered over the five semesters which are of immense importance and those portions which could not be accommodated in the regular syllabus.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL and etc.

Course Coding:

The following code system (10 alphanumeric characters) is adopted for Post Graduate courses:

21	PXX	N	XX	NN/NNX
Year of Revision	PG Department Code	Semester number.	Part Category	running number/with choice

N:- Numerals X :- Alphabet

Part Category

CC - Core Theory

CP- Core Practical

IS- Internship

SP- Self Paced Learning

CE- Comprehensive Examination

PW- Project Work & viva-voce

Electives Courses

ES – Department Specific Electives

EG- Generic Electives

EC - Additional core Courses for Extra Credits (If any)*

Ability Enhancement Courses

AE – Ability Enhancement Course

SE – Skill Enhancement Course – Soft skills

CW - SHEPHERD & Gender Studies (Outreach)

CIA AND SEMESTER EXAMINATION

Continuous Internal Assessment (CIA):

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

MID-SEM & END-SEM TEST

Centralised – Conducted by the office of COE

1. Mid-Sem Test & End-Sem Test: (2 Hours each); will have Objective and Descriptive elements; with the existing question pattern PART-A; PART-B; PART-C and PART D.
2. One of the CIA Component II/III for UG & PG will be of 15 marks and compulsorily a online objective multiple choice question type.
3. The online CIA Component must be conducted by the Department / faculty concerned at a suitable computer centre.
4. The one marks of PART-A of Mid-Sem and End-Sem Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS.
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.

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.

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

WEIGHTAGE of K – LEVELS IN QUESTION PAPER

(Cognitive Level)	Lower Order Thinking			Higher Order Thinking			Total
K- LEVELS	K1	K2	K3	K4	K5	K6	%
SEMESTER EXAMINATIONS	15	20	35	30			**100**
MID / END Semester TESTS	12	20	35	33			**100**

QUESTION PATTERN FOR SEMESTER EXAMINATION	
SECTION	**MARKS**
SECTION–A (No choice ,One Mark) **THREE** questions from each unit **(**15x1 =15)	**15**
SECTION-B (No choice ,2-Marks) **TWO** questions from each unit (10x2 =20)	**20**
SECTION-C (Either/or type) (7- Marks) **ONE** question from each unit (5x7 =35)	**35**
SECTION-D (3 out of 5) (10 Marks) **ONE** question from each unit (3x10 =30)	**30**
Total	**100**

BLUE PRINT OF QUESTION PAPER FOR SEMESTER EXAMINATION							
DURATION: 3. 00 Hours.							**Max Mark : 100**
K- LEVELS / **SECTIONS**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION–A (One Mark, No choice) (15x1 =15)	15						**15**
SECTION-B (2-Marks, No choice) (10x2=20)		10					**20**
SECTION-C (7- Marks) (Either/or type) (5x7=35)			5				**35**
SECTION-D (10 Marks) (3 out of 5) (3x10=30) Courses having only **K4** levels				3			**30**
Courses having **K4** and **K5** levels **One K5 level question is compulsory**				2	1		
(Courses having **all the 6** cognitive levels **One K5 and K6 level questions can be compulsory**				1	1	1	
Total	**15**	**20**	**35**	**30**			**100**

QUESTION PATTERN FOR MID/END TEST		
SECTION		**MARKS**
SECTION–A (No choice, One Mark)	(7x1 =7)	**7**
SECTION-B (No choice , 2-Marks)	(6x2 =12)	**12**
SECTION-C (Either/or type) (7- Marks)	(3x7 =21)	**21**
SECTION-D (2 out of 3) (10 Marks)	(2x10=20)	**20**
	Total	**60**

BLUE PRINT OF QUESTION PAPER FOR MID/END TEST							
DURATION: 2. 00 Hours.							**Max Mark: 60.**
K- LEVELS / **SECTIONS**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION –A (One Mark, No choice) (7 x 1 = 7)	7						**07**
SECTION-B (2-Marks, No choice) (6 x 2 = 12)		6					**12**
SECTION-C (Either/or type) (7-Marks) (3 x 7 =21)			3				**21**
SECTION-D (2 out of 3) (10 Marks) (2x10=20) Courses having only **K4** levels				2			**20**
Courses having **K4** and **K5** levels **One K5 level question is compulsory**				1	1		
Courses having **all the 6** cognitive levels **One K6 level question is compulsory**					1	1	
Total Marks	**07**	**12**	**21**	**20**			**60**
Weightage for 100 %	**12**	**20**	**35**	**33**			**100**

Assessment pattern for two credit courses.

S. No.	Course Title	CIA	Semester Examination	Total Marks
1	Self Paced Learning Course	25 + 25 = 50	50 Marks MCQ (COE)	100
2	Comprehensive Examinations	25 +25 = 50	50 Marks (MCQ) (COE)	100
3	Internship	100	--	100
4	Field Visit	100	--	100
5	Ability Enhancement Course (AEC) for PG (3 credits)	50 (Three Components)	50 (COE) Specific Question Pattern	100
Assessment Pattern for Courses in Part - IV				
6	Value Education Courses and Environmental Studies	50	50 Marks (For 2.00 hours) (COE)	100
7	Skill Enhancement Courses(SECs)	50 marks (by Course in-charge) 50 Marks (by an External member from the Department)		100
8	SEC: SOFT SKILLS (For UG and PG)	100	(Fully Internal)	100

EVALUATION

GRADING SYSTEM

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

$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$	$WAM\,(Weighted\,Average\,Marks) = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$
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_i 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.

CLASSIFICATION OF FINAL RESULTS:

i) The classification of final results shall be based on the CGPA, as indicated in 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) A Pass in SHEPHERD will continue to be mandatory although the marks will not count for the calculation of the CGPA.

iv) Absence from an examination shall not be taken an attempt.

Table-1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	**10**	**O**
80 and above and below 90	**9**	A+
70 and above and below 80	**8**	**A**
60 and above and below 70	**7**	**B+**
50 and above and below 60	**6**	**B**
Below 50	**0**	**RA**

Table-2: Final Result

CGPA	Corresponding Grade	Classification of Final Result
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**
5.0 0 to 5.99	**B**	**Above Average**
Below 5.00	**RA**	**Re-appearance**

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

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 is _____ by completing the minimum of 110 credits.

The candidate has also acquired _____ (if any) extra by attending MOOC courses.

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

The Programme Outcomes(POs)/Programme Specific Outcomes(PSOs) are the qualities that must be imbibed in the graduates by the time of completion of their programme. At the end of each programme the PO/PSO assessment in done from the CO attainment of all curriculum components. The POs/PSOs are framed based on the guidelines of LOCF. There are five POs UG programme and five POs for PG programme framed by the college. PSOs are framed by the departments and they are five in numbers.

For each Course, there are five Course Outcomes to be achieved at the end of the course. These Course outcomes are framed to achieve the POs/PSOs. All course outcomes shall have linkage to POs/PSOs in such a way that the strongest relation has the weight 3 and the weakest is 1. This relation is defined by using the following table.

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

Mean Scores of COs = $\frac{\text{Sum of values}}{\text{Total No.of POs \& PSOs}}$		**Mean Overall Score =** $\frac{\text{Sum of Mean Scores}}{\text{Total No.of COs}}$	
Result	**Mean Overall Score**	**< 1.2**	**# Low**
		≥ 1.2 and < 2.2	**# Medium**
		≥ 2.2	**# High**

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

The Programme Outcomes (POs)/Programme Specific Outcomes(PSOs) are the qualities that must be imbibed in the graduates by the time of completion of their programme. At the end of each programme the PO/PSO assessment in done from the CO attainment of all curriculum components. The POs/PSOs are framed based on the guidelines of LOCF. There are five POs UG programme and five POs for PG programme framed by the college. PSOs are framed by the departments and they are five in numbers.

For each Course, there are five Course Outcomes to be achieved at the end of the course. These Course outcomes are framed to achieve the POs/PSOs. All course outcomes shall have linkage to POs/PSOs in such a way that the strongest relation has the weight 3 and the weakest is 1. This relation is defined by using the following table.

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

Mean Scores of COs $= \frac{\text{Sum of values}}{\text{Total No.of POs \& PSOs}}$		**Mean Overall Score** $= \frac{\text{Sum of Mean Scores}}{\text{Total No.of COs}}$	
Result	**Mean Overall Score**	**< 1.2**	**# Low**
		≥ 1.2 and < 2.2	**# Medium**
		≥ 2.2	**# High**

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

Vision

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

Mission

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value-driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

Programme Educational Objectives (PEOs)

- Graduates will be able to accomplish professional standards in the global environment.
- Graduates will be able to uphold integrity and human values.
- Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

Programme Outcomes (POs)

1. Graduates will be able to apply assimilated knowledge to evolve tangible solution to emerging problems.
2. Graduates will be able to analyze and interpret data to create and design new knowledge.
3. Graduates will be able to engage in innovative and socially relevant research and effectively communicate the findings.
4. Graduates will become ethically committed professional and entrepreneurs upholding human values.
5. Graduates imbibed with ethical values and social concern will be able to understand and appreciate cultural diversity, social harmony and ensure sustainable environment.

Programme Specific Objectives (PSOs)

1. Graduates are prepared to be creators of new knowledge in the field of life sciences, causing innovation and entrepreneurship, employable in various sectors such as private, government, and clinical /biomedical research organizations.
2. Graduates are trained to study and evolve the biomolecular mechanisms for the life processes in health and diseases.
3. Graduates are groomed to carry on research in biology on chemical basis, by exploring their knowledge independently.
4. Graduates are encouraged to design and conduct experiments, to analyze and interpretbiological problems behind the research.
5. Graduates ought to have the ability of effectively communicating the findings of Biological sciences with existing knowledge ethically.

M.Sc BOTANY					
PROGRAMME STRUCTURE					
Sem.	**Specification**	**No. of Courses**	**No. of Hours**	**Credits**	**Total Credits**
I-IV	Core Courses : Theory	**11**	**54**	**46**	**67**
I-IV	Core Courses : Practical	7	23	**20**	
III	Field Visit	-	-	**1**	
II	Self-paced learning	1	-	**2**	2
IV	Comprehensive Examination	1	-	**2**	2
IV	Project work & Viva Voce	1	7	**7**	7
I-IV	Discipline Specific Elective	4	20	**16**	16
I	Ability Enhancement Course	1	4	**3**	3
II	Skill Enhancement Course (Soft Skills)	1	4	**3**	3
III	Generic Elective IDC (WS)	1	4	**3**	3
IV	Generic Elective IDC (BS)	1	4	**3**	3
II-IV	Online courses (MOOC)	3	-	**(6)**	**(6)**
I-IV	**Outreach Programme**	**-**	**-**	**4**	4
	Total		**120**		**110(6)**

M.Sc. BOTANY							
PROGRAMME PATTERN							
Course Details					**Scheme of Exams**		
Sem	**Code**	**Course Title**	**Hrs**	**Cr**	**CIA**	**SE**	**Final**
I	21PBO1CC01	Plant Diversity-I: Thallophytes and Bryophytes	5	4	100	100	100
	21PBO1CC02	Plant Diversity-II: Pteridophytes, Gymnosperms & Paleobotany	5	4	100	100	100
	21PBO1CC03	Plant Anatomy, Embryology and Morphogenesis	5	4	100	100	100
	21PBO1CP01	Laboratory Course-1: Thallophytes, Bryophytes, Pteridophytes, Gymnosperms And Palaeobotany	4	4	100	100	100
	21PBO1CP02	Laboratory Course-2: Plant Anatomy, Embryology And Morphogenesis	2	2	100	100	100
	21PBO1ES01A	**DSE-1:** Ecology and Phytogeography	5	4	100	100	100
	21PBO1ES01B	**DSE-1:** Forestry and Wood Science					
	21PBO1AE01	**AEC :** Horticulture and Landscape designing	4	3	50	50	50
		Total	**30**	**25**			
II	21PBO2CC04	Plant Physiology	6	6	100	100	100
	21PBO2CC05	Biochemistry	5	5	100	100	100
	21PBO2CP03	Laboratory Course -3: Plant Physiology	3	3	100	100	100
	21PBO2CP04	Laboratory Course -4: Biochemistry	3	3	100	100	100
	21PBO2SP01	**Self-Paced learning:** Plant Breeding and Evolution	-	2	50	50	50
	21PBO2ES02A	**DSE-2:** Biophysics and Instrumentation	5	4	100	100	100
	21 PBO2ES02B	**DSE-2:** Plant Pathology					
	21PSS2SE01	**SEC:** Soft skills	4	3	100	-	100
	21PBO2EG01	**GE- 1**(WS): Medicinal Botany	4	3	100	100	100
		Extra Credit courses (MOOC)-1	-	(2)			
		Total	**30**	**29(2)**			
III	21PBO3CC06	Plant Systematics	5	5	100	100	100
	21PBO3CP05	Laboratory Course -5: Plant Systematics	4	3	100	100	100
	21PBO3CC07	Research Methodology	5	4	100	100	100
	21PBO3CC08	Pharmacognosy	4	3	100	100	100
	21PBO3CP06	Laboratory Course -6: Research Methodology	3	2	100	100	100
	21PBO3ES03A	**DSE-3:** Organic Farming	5	4	100	100	100
	21PBO3ES03B	**DSE-3:** Bioinformatics and Bionanotechnology					
	21PBO3EG02	**GE-2** (BS): Horticulture and Landscaping	4	3	100	100	100
	21PBO3FV01	Field Visit		1	100	-	100
		Extra Credit Courses (MOOC)-2		(2)			
		Total	**30**	**25(2)**			
IV	21PBO4CC09	Microbiology and Immunology	5	5	100	100	100
	21PBO4CC10	Genetic Engineering and Biotechnology	5	5	100	100	100
	21PBO4CC11	Cell and Molecular Biology	4	3	100	100	100
	21PBO4CP07	Laboratory Course- 7: Microbiology, Immunology, Genetic Engineering And Biotechnology	4	3	100	100	100
	21PBO4ES04A	**DSE-4:** Intellectual Property Rights	5	4	100	100	100
	21PBO4ES04B	**DSE-4:** Genetics					
	21PBO4PW01	**Project work** & Viva voce	7	5	100	100	100
	21PBO4CE01	Comprehensive Examination	-	2	50	50	50
		Extra Credit courses (MOOC)-3		(2)			
		Total	**30**	**27(2)**			
I-IV	21PCW4OR01	Outreach programme (SHEPHERD)		**4**			
		Total (Four Semesters)	**120**	**110(6)**			

*The courses with a scheme of Exam 50 in CIA and SE will be converted to 100 for grading.

GENERIC ELECTIVE -1: 2nd Semester Within school (WS)- Offered to students belong to other Departments in the School							
Course Details					Scheme of Exams		
School	Course Code	Course Title	Hrs	Cr	CIA	SE	Final
SBS	21PBI2EG01	Herbal Technology	4	3	100	100	100
	21PBT2EG01	Medical Biotechnology	4	3	100	100	100
	21PBO2EG01	Medicinal Botany	4	3	100	100	100
SCS	21PCA2EG01	Applied Statistics using R	4	3	100	100	100
	21PMA2EG01	Mathematical Foundations	4	3	100	100	100
	21PCS2EG01	Mobile Adhoc Networks (MANET)	4	3	100	100	100
SLAC	21PEN2EG01A	Indian Literature in Translation	4	3	100	100	100
	21PEN2EG01B	English Literature For Competitive Examinations					
SMS	21PCO2EG01	Supply Chain Management	4	3	100	100	100
	21PEC2EG01	Labour Economics	4	3	100	100	100
	21PHR2EG01	Organizational Behaviour	4	3	100	100	100
	21PCC2EG01	Stress Management	4	3	100	100	100
SPS	21PCH2EG01	Industrial Products	4	3	100	100	100
	21PPH2EG01A	Solar Energy and Utilization	4	3	100	100	100
	21PPH2EG01B	Renewable Energy Resources	4	3	100	100	100

GENERIC ELECTIVE -2: 3rd Semester Between schools (BS)- Offered to students in the Departments belong to other Schools (Except the school offering the course)							
Course Details					Scheme of Exams		
School	Course Code	Course Title	Hrs	Cr	CIA	SE	Final
SBS	21PBI3EG02	First Aid Management	4	3	100	100	100
	21PBT3EG02	Food Technology	4	3	100	100	100
	21PBO3EG02	Horticulture and Landscaping	4	3	100	100	100
SCS	21PCA3EG02	Web Design	4	3	100	100	100
	21PMA3EG02	Operations Research	4	3	100	100	100
	21PCS3EG02	Advances in Computer Science	4	3	100	100	100
	21PDS3EG02	Deep Learning	4	3	100	100	100
SLAC	21PEN3EG02	English for Effective Communication	4	3	100	100	100
SMS	21PCO3EG02	Basics of Taxation	4	3	100	100	100
	21PEC3EG02	Managerial Economics	4	3	100	100	100
	21PHR3EG02	Counselling and Guidance	4	3	100	100	100
	21PCC3EG02	Dynamics of Human Behaviour in Business	4	3	100	100	100
SPS	21PCH3EG02	Health Science	4	3	100	100	100
	21PPH3EG02A	Physics for Competitive Exam	4	3	100	100	100
	21PPH3EG02B	Nano Science	4	3	100	100	100

Semester	Course Code	Title of the Course	Hours	Credits
I	**21PBO1CC01**	**CORE-1: PLANT DIVERSITY-I: THALLOPHYTES AND BRYOPHYTES**	**5**	**4**

CO. No.	CO- Statements	Cognitive Levels (K- levels)
On successful completion of this course, students will be able to		
CO-1	acquire knowledge about the structure, reproduction and life cycle of Algae, Fungi, Lichen and Bryophytes.	**K1**
CO-2	learn the major classes and types of Algae, Fungi, Lichen and Bryophytes and their variations in life cycles and life history.	**K2**
CO-3	recognize the economic importance and biomedical applications of Algae, Fungi, Lichen and Bryophytes.	**K3**
CO-4	comprehend the structural organization of gametophyte and sporophyte in different classes of Bryophytes.	**K 4**
CO-5	apply the ICT tools for identification of lower plants.	**K5 & K6**

Unit-I: **(15 Hours)**

Algae: Phycology- Introduction and brief history, Algology in India (Contributions of eminent Indian Algologists, Classification of algae (F. E. Fritsch, 1945), Types of Life cycle. General characteristics, thallus organization, occurrence, reproduction and economic importance of algae.

Unit-II: **(15 Hours)**

Chlorophyta**:** Detail study of structure, reproduction and life cycle of *Chlamydomonas*, *Volvox*, *Cladophora*, *Ulva*, *Caulerpa*, *Oedogonium* and *Spirogyra*. Phaeophyta: Detail study of structure, reproduction and life cycle of *Ectocarpus*, *Padina* and *Sargassum*. Rhodophyta: Detail study of structure, reproduction and life cycle of *Batrachospermum*, *Gracillaria* and *Polysiphonia*. Centric and Pinnate Diatoms.

Unit-III: **(15 Hours)**

Fungi: General features, occurrence and distribution, Mode of nutrition and reproduction in fungi (vegetative, asexual and sexual), Classification of fungi (Ainsworth, 1973; Alexopoulos and Mims, 1979). General characters of major divisions-Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Ecology of fungi, Spore dispersal mechanisms, Economic importance of fungi.

Unit-IV: **(15 Hours)**

Heterothallism; parasexuality; sex hormones in fungi; interrelationship of Myxomycetes, Oomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes, Fossil Fungi. Lichens - Classification of Lichens (Hale, 1969), Nature of association of phycobionts and mycobionts, structure and reproduction in *Usnea*, Economic and ecological importance of lichens, Identification of lichens: MATLAB software, Image processing techniques.

Unit-V: **(15 Hours)**

Bryophyta: Classification (Rothmaler, 1951), 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*, *Polytrichum*. Economic importance of bryophytes.

Books for Study

1. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
2. Vashishta, B. R. and Sinha, A. K. 2007. Botany for Degree Students - Fungi. S. Chand, New Delhi.

Books for Reference

1. Hale, Jr. M. E., 1983, Biology of Lichens. Edward Arnold, Mayland.
2. Alexopoulus, C. J. and Mims, C. W. 1979. Introductory Mycology. Wiley Eastern Ltd., NY.
3. Bessey, E. A. 1979. Morphology and Taxonomy of Fungi. Vikas Pub, NewDelhi.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
I	**21PBO1CC01**					**CORE-1: PLANT DIVERSITY-I: THALLOPHYTES AND BRYOPHYTES**					**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	2	3	2	2	1	2	2	2	2	2	2.2	
CO-2	2	3	2	2	1	2	2	2	2	3	2.1	
CO-3	2	2	3	2	2	2	2	2	2	1	2.0	
CO-4	2	2	2	3	2	2	2	2	2	3	2.2	
CO-5	2	2	2	2	3	1	2	2	2	2	2.2	
Mean Overall Score											**2.1**	
Result											**Medium**	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBO1CC02	CORE-2: PLANT DIVERSITY-II: PTERIDOPHYTES, GYMNOSPERMS & PALEOBOTANY	5	4

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	acquire knowledge on fossilization and geological period.	**K1**
CO-2	understand and analyse the characteristic features of lower vascular plants.	**K2 & K3**
CO-3	comprehend the economic importance of Pteridophytes and Gymnosperms.	**K4**
CO-4	apply interrelationships to form the life cycle patterns.	**K5**
CO-5	create the evolutionary trends and classification of organism.	**K6**

Unit-I: **(15 Hours)**

Pteridophytes - General characters, Reimer's classification (1954) and life cycle. Theories of origin of sporophyte, Telome concept, Sporangium development - eusporangiate and leptosporangiate type, Apogamy and Apospory. Detailed account on stelar and soral evolution in Pteridophytes, Heterospory and seed habit.

Unit-II: **(15 Hours)**

Morphology, anatomy, reproduction and evolution of gametophytes and sporophytes of the following genera: *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum*, *Alsophila* and *Marsilea*.

Unit-III: **(15 Hours)**

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

Unit-IV: **(15 Hours)**

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

Unit-V: **(15 Hours)**

Palaeobotany - Geological time scale, fossilization and types of fossil, Carbon dating. Indian fossil flora – Rajmahal hill flora and the Deccan Intertrappean flora. Detailed study of the fossil forms: Pteridohytes –*Rhynia*, *Lepidodendron* and *Calamites*; Gymnosperms - *Lyginopteris*, *Williamsonia* and *Cordaites*.

Books for Study

1. Sharma, O.P. 2017. Pteridophyta, McGraw Hill Education, New York.
2. Bhatnagar, S.P. and Alok Moitra. 2020. Gymnosperms**,** New Age International (P) Ltd., Publishers, Bengaluru.

Books for Reference

1. Rashid.A. 2007. An Introduction to Pteridophyta, Vikas publications, NewDelhi.
2. Johri , RM, Lata S , Tyagi K (2005), A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.
3. Vasista PC, Sinha AK and Anilkimar. 2005. Botany for degree students, Gymnosperms, S Chand, NewDelhi.

Semester	**Course Code**			**Title of the Course**							**Hours**	**Credits**
I	**21PBO1CC02**			**CORE-2: PLANT DIVERSITY-II: PTERIDOPHYTES, GYMNOSPERMS & PALEOBOTANY**							**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	2	2	2	1	2	2	2	3	2	2.1	
CO-2	2	2	2	1	1	2	1	2	2	2	1.7	
CO-3	2	2	2	2	1	1	2	2	2	2	1.8	
CO-4	3	2	2	1	2	2	2	2	2	2	2.1	
CO-5	2	3	2	2	1	3	2	2	2	1	2.0	
Mean Overall Score											**1.94**	
Result											**Medium**	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBO1CC03	CORE-3: PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS	5	4

CO No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	acquire knowledge about the tissues of stem, root and leaves in plants.	K1
CO-2	describe the primary and secondary structure of dicots and monocots with reference to root, stem and leaves.	K2
CO-3	attain basic knowledge of the structure and development of male and female gametophytes in plants.	K3 & K4
CO-4	Compare and determine the structure and development of dicot and monocot embryos.	K5
CO-5	integrate the morphogenesis, endosperm development and polyembryony.	K6

Unit-I: **(15 Hours)**

General account on theories of organization of shoot and root apical meristem, quiescent centre. 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: **(15 Hours)**

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

Unit-III: **(15 Hours)**

Microsporangium – Microsporogenesis, Microspores – morphology, ultrastructure, Microgametogenesis, Pollen-Stigma Incompatibility, Methods to overcome incompatibility. Megasporangium – Megagametogenesis, Female gametophyte – Monosporic, Bisporic and Tetrasporic, Nutrition of embryo sac and fertilization.

Unit-IV: **(15 Hours)**

Endosperm – Types, haustoria, Cytology and physiology and functions of endosperms, Embryo development - Dicot and Monocot, Nutrition of embryo. Polyembryony - Causes, Apomixis - Causes, Apospory - Their role in plant improvement programs and seed development.

Unit-V: **(15 Hours)**

Morphogenesis- 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, 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.

Books for Study

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.

Books for Reference

1. Bard, J. 1990. Morphogenesis. Cambridge University Press, London.
2. Agarwal, S. B. 1990. Embryology of Angiosperms - a fundamental approach, Sahitya Bhawan, Agra.
3. Pandey, B. P. 1989. Plant Anatomy. S. Chand and Co. Ltd., New Delhi.

Semester	**Course Code**			**Title of the Course**							**Hours**	**Credits**
I	**21PBO1CC03**			**CORE-3: PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS**							**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	2	3	2	2	3	2	2	2	2	2.3	
CO-2	2	3	2	2	1	2	3	2	2	2	2.1	
CO-3	2	2	3	2	1	3	3	2	3	1	2.2	
CO-4	3	3	2	1	1	3	2	2	1	2	2.1	
CO-5	2	3	2	2	3	2	3	2	2	3	2.6	
Mean Overall Score											**2.3**	
Result											**High**	

Semester	Course Code	Title of the Course	Hours	Credit
I	21PBO1CP01	LABORATORY COURSE 1: THALLOPHYTES, BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY	4	4

Algae:
Ulva, Caulerpa, *Padina, Sargassum*, *Batrachospermum*, *Gracilaria*, *Nostoc* and *Oscillatoria*.
Fungi:
Plasmodiophora, *Rhizopus*, *Fusarium*, *Pilobolus*, *Xylaria*, *Aspergillus*, *Penicillium*, *Agaricus* and *Peziza*.
Lichen:
Usnea, *Parmelia*.
Bryophytes:
Reboulia, *Anthoceros, Pogonatum* and *Polytrichum*
Pteridophytes:
Psilotum, *Lycopodium, Selaginella, Equisetum, Alsophila* and *Marsilea*.
Gymnosperms:
Cycas, *Cupressus*, *Gnetum*.
Palaeobotany:
Rhynia, *Lepidodendron, Calamites*, *Lyginopteris*, *Williamsonia*, *Cordaites*.

Field Trip and Report submission.

Semester	Course Code	Title of the Paper	Hours	Credit
I	21PBO1CP02	LABORATORY COURSE 2: PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS	2	2

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 (*Syzygium cumini*)
- Tests for pollen viability using stains and *in vitro* germination, Pollen germination using hanging drop technique.

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBO1ES01A	DSE–1: ECOLOGY & PHYTOGEOGRAPHY	5	4

CO No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	describe the basic concepts of ecosystem and energy flow.	K1
CO-2	apply the knowledge gained on population dynamics to manage social dynamics.	K2 & K3
CO-3	evaluate the causes and consequences of climate change.	K4
CO-4	analyse the importance of biodiversity to human development.	K5
CO-5	create strategies to conserve local biodiversity.	K6

Unit-I: **(15 Hours)**

Introduction to ecology, Ecosystem structure and dynamics - food chain and food webs, energy flow. Mineral cycling (C, N & P). Plant succession – types and mechanism, Concept of climax vegetation, ecological indicators. Characteristics and dynamics of population-population size, growth, density and age structure.

Unit-II: **(15 Hours)**

Greenhouse effect - global warming, global climatic changes and 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: **(15 Hours)**

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's and FAO's.

Unit-IV: **(15 Hours)**

Conservation: approaches - *in situ* and *ex situ* and their evaluation. Biodiversity - importance, assessment, loss and conservation. World organization for conservation of biodiversity, biodiversity act (2002), Red List categories of IUCN, means and ways for conservation.

Unit-V: **(15 Hours)**

Phytogeography: geographical history, continental drift hypothesis, land bridges and shifting of poles. Phytogeographic regions of India. Theory on plant distribution - Age and area theory, Tolerance. Concepts of endemism and hotspots, invasive and exotic species.

Books for Study

Kormondy, E.J. 2017.Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.

Books for References

1. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
2. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.
3. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.
4. Alexander von Humboldt, Aime Bonpl and, Stephen T. Jackson (eds.) 2013. Essay on the Geography of Plants, University of Chicago Press.

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBO1ES01A	DSE–1: ECOLOGY & PHYTOGEOGRAPHY	5	4

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean score of COs
CO-1	3	2	2	2	2	3	2	2	2	2	2.2
CO-2	2	3	2	2	3	3	2	2	2	2	2.3
CO-3	2	3	2	2	2	2	2	2	2	2	2.1
CO-4	2	2	3	2	2	2	2	2	2	3	2.2
CO-5	2	2	2	3	3	2	3	2	2	2	2.3
Mean Overall Score											2.22
Result											High

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBO1ES01B	DSE–1: FORESTRY AND WOOD SCIENCE	5	4

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	outline the physical, chemical and mechanical properties of commercial wood.	K1 & K2
CO-2	acquire knowledge on wood substitution.	K3
CO-3	evaluate the raw materials needed for industries.	K4
CO-4	conserve and plan sustainable utilization of forests resources.	K5
CO-5	relate the gained skills for careers in the forest service and wood processing industry.	K6

Unit-I: **(15 Hours)**

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: **(15 Hours)**

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: **(15 Hours)**

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: **(15 Hours)**

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

Unit-V: **(15 Hours)**

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

Books for Study

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

Books for Reference

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

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
I	**21PBO1ES01B**					**DSE–1: FORESTRY AND WOOD SCIENCE**					**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	2	3	2	2	3	2	2	3	2	2.4	
CO-2	2	3	2	3	2	2	3	2	2	1	2.2	
CO-3	2	2	3	2	1	3	3	2	3	1	2.2	
CO-4	3	3	2	3	2	3	2	2	3	2	2.5	
CO-5	2	3	2	3	1	2	3	2	3	1	2.4	
Mean Overall Score											**2.4**	
Result											**High**	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBO1AE01	AEC: HORTICULTURE AND LANDSCAPE DESIGNING	4	3

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	learn the brief history, divisions, classification and structure of horticultural and production of horticultural crops.	K1 & K2
CO-2	highlight the aesthetics of horticulture and post-harvest handling of techniques and marketing.	K3
CO-3	analyse plant growth environment in relation with soil, nutrients, fertilizers and nursery techniques.	K4
CO-4	design propagation methods and propagation through various specialized underground structures.	K5
CO-5	develop practical skills in micro propagation techniques, bonsai, topiary techniques and wet and dry flower decorations.	K6

Unit-1: (12 Hours)

Importance and scope of horticulture, Divisions of horticulture, Famous gardens in world & India; Tools & Implements used in horticulture, Plant Propagation: Vegetative Propagation - Cutting, Layering, Grafting & Budding. Cultural practices: Thinning, Training, Trimming & Pruning.

Unit-II: (12 Hours)

Role of tissue culture in Horticulture; Hydroponics. Nursery: definition, objectives and scope and building up of infrastructure for nursery, Preparation of Nursery beds, Transplantation – steps and Methods, Techniques of Bonsai, terrarium and topiary.

Unit-III: (12 Hours)

Cultivation Crops: Cardamom, pepper, ginger, and turmeric, Post-harvest and Conservation management**,** IPR issues, Import and export marketing. Floriculture: Cultivation of commercial flower crops – Rose, Orchids and *Anthurium*– economic important vegetable and fruit crops; citrus, banana, and cucurbits. Flower decoration – Dry and wet decoration.

Unit-IV: (12 Hours)

Gardening: Definition, objectives and scope, different types of gardening. Principles, methods and types of gardens and garden implements, Designing outdoor garden– hedges, edges, fences, trees, climbers, rockeries, arches, Roof garden, Indoor gardening and kitchen garden.

Unit-V: (12 Hours)

Lawn making and maintenance, water garden – cultivation of water plants, common water plants, glass house, Ornamental pants, hanging basket establishment and plant protection measures. Parks: components, types of parks, Xeriscaping. Field Visit to Horticultural station.

Books for Study

1. Subba Rao, N. S. 1997. Biofertilizers in Agriculture and Forestry. India Book House Limited, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
2. Bose, T. K., Maiti, R. G., Dhua, R. S. and Das, P. 1999. Floriculture and Landscaping. Naya Prokash, Calcutta.

Books for Reference

1. Acquaah, G. 2002. Horticulture principles and practices (2nd.ed.), Pearson Education (Singapore) Pvt. Ltd.
2. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. International Book Distributory Co.

Semester	Course Code					Title of the Course					Hours	Credits
II	21PBO1AE01					AEC: HORTICULTURE AND LANDSCAPE DESIGNING					4	3
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	2	3	2	2	3	3	2	3	2	2.5	
CO-2	2	3	2	3	3	2	3	2	3	3	2.6	
CO-3	2	3	3	2	3	3	3	2	3	2	2.6	
CO-4	3	3	3	3	2	3	3	3	2	2	2.7	
CO-5	2	2	3	2	3	3	2	3	2	3	2.5	
Mean Overall Score											**2.6**	
Result											**High**	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBO2CC04	CORE-4: PLANT PHYSIOLOGY	6	6

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	Gain a cognizance of the metabolic and physiological process unique to plants.	**K1**
CO-2	Impart an insight into the various plant water relations and mineral nutrition.	**K2**
CO-3	Comprehend the interaction between the environment and plant growth and development.	**K3**
CO-4	Assimilate with critical insight and in-depth analysis of main themes of plants physiology at the molecular level.	**K4**
CO-5	Demonstrate testable hypotheses, design targeted experiments, analyze data and present in a scientific manuscript.	**K5 & K6**

Unit-I **(18 Hours)**

Water and Plant cells: Diffusion and osmosis, water potential. Water balance of plants: absorption by roots, transport through the xylem, transpiration. Mineral nutrition: essential nutrients, deficiencies, plant disorders. Solute transport: passive and active transport, molecular basis of inter and intra cellular uptake and transport. Pattern, pathway and mechanism of translocation in the phloem.

Unit-II **(18 Hours)**

Photosynthesis: The light reactions- nature of light, properties and various roles of pigments, organisation of photosynthetic apparatus and light absorbing antenna systems, molecular basis of electron transport and its coupling to ATP synthesis. The carbon reactions- The Calvin-Benson cycle, photorespiration, inorganic carbon concentrating mechanisms (The C4 carbon cycle, Crassulacean Acid Metabolism), and carbon allocation (starch and sucrose).

Unit-III **(18 Hours)**

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. Oxidative pentose phosphate pathway and its roles. Respiratory chain complexes and oxidative phosphorylation, internal and external NAD(P)H dehydrogenase, alternative oxidase. Non phosphorylating mechanisms and their roles. Bottom-up regulation of plant respiration. The Glyoxylate cycle.

Unit-IV **(18 Hours)**

Nitrogen in the environment; assimilation of nitrate and ammonium - GS- GOGAT; biological nitrogen fixation. Plant responses to light signals: the phytochromes and the blue-light responses

(cryptochromes, phototropins and zeaxanthin). Biosynthesis, metabolism, transport, physiological and developmental effects of auxin, gibberellin, cytokinin, ethylene and abscisic acid.

Unit-V **(18 Hours)**

Flowering and fruit development: Floral evocation, Circadian rhythm, photoperiodism, vernalisation. Physiology of fruit development and ripening. Physiology of seed development, maturation, dormancy, germination and tropisms. Ageing and senescence-types and physiological/ biochemical changes. Abiotic stress (drought, heat and salinity): Plant responses and mechanisms of tolerance.

Books for Study

1. William G. Hopkins and Norman P.A. Huner 2009. Introduction to Plant Physiology - 4th ed. John Wiley & Sons, Inc.USA.
2. Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy, 2015. Plant Physiology. 6th Ed., Sinauer Associates.

Books for 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.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
II	**21PBO2CC04**					**CORE-4: PLANT PHYSIOLOGY**					**6**	**6**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO1	3	3	3	2	2	3	3	3	2	3	2.7	
CO2	3	3	3	2	2	3	3	3	2	2	2.6	
CO3	3	3	3	3	3	3	3	3	2	3	2.9	
CO4	3	3	3	2	2	3	3	3	2	2	2.6	
CO5	3	3	3	3	3	3	3	3	3	3	3	
										Mean Overall Score	**2.76**	
										Result	**High**	

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PBO2CC05**	**CORE-5: BIOCHEMISTRY**	**5**	**5**

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	describe the classification and structural organization of proteins.	**K1**
CO-2	identify the enzyme kinetics and illustrate the regulatory process.	**K2**
CO-3	apply basic principles of chemistry to biological systems.	**K3**
CO-4	infer the metabolism of amino acids and its regulation.	**K4**
CO-5	design biochemical techniques to carry out experiments.	**K5 & K6**

Unit-I: (15 Hours)

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, proteoglycanas, glycoproteins and pectins. Glycocalyxoligo saccharide. Over view of metabolism of carbohydrate.

Unit-II: (15 Hours)

Lipids and Biomembranes: Triglycerides, phosphoglycerols, derived lipids- steroids, prostaglandins, spingolipids, leukotrienes and lipopoly saccharides. 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: (15 Hours)

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: (15 Hours)

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 regulatory features. Protein sequencing strategies - chemical and enzymatic. Ramachandran plot.

Unit-V: (15 Hours)

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. Industrial applications of enzymes.

Books for Study

1. Stryer Lubert, 2005, Biochemistry, W.H. Freeman & Co., NY.
2. Lehninger, Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M.(2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p: 677-878.
3. Biochemistry by Donald Voet, Judith G. Voet, Publisher: John Wiley & Sons (2011), Fourth Edition, ISBN-10: 0071737073, ISBN-13: 978-0071737074.

Books for Reference

1. Caret et al., 1993, Inorganic, Organic and Biological Chemistry, WMC Brown, USA
2. Biochemistry Seventh Edition by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 74 Publisher: W. H. Freeman; Seventh Edition (December 24, 2010).

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
II	**21PBO2CC05**					**CORE-5: BIOCHEMISTRY**					**5**	**5**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	2	3	3	2	1	2	3	2	2	3	2.3	
CO-2	1	3	2	2	2	3	3	1	2	3	2.1	
CO-3	2	2	3	2	3	2	3	3	2	1	2.3	
CO-4	3	1	3	3	1	2	2	2	3	2	2.2	
CO-5	1	3	2	2	2	2	3	1	2	3	2.1	
										Mean Overall Score	**2.2**	
										Result	**High**	

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PBO2CP03**	**LABORATORY COURSE 3: PLANT PHYSIOLOGY**	**3**	**3**

Experiments

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

****

Semester	Course Code	Title of the Course	Hours	Credit
II	21PBO2CP04	LABORATORY COURSE 4: BIOCHEMISTRY	3	3

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 [S] on enzyme activity; measurement of V_{max} and Km.
7. Estimation of Ascorbic acid (Calorimetric /volumetric)
8. Estimation of Phenolics (Folin –Ciocalteau)
9. Estimation of Tannins (Folin-Denis / Vanillin hydrochloride)
10. Estimation of cholesterol
11. Thin Layer Chromatography
12. Native-PAGE

****

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PBO2SP01**	**SELF-PACED LEARNING: PLANT BREEDING AND EVOLUTION**	**-**	**2**

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	outline the progress made in the field of plant breeding.	**K1**
CO-2	comprehend the principles, techniques, modes of reproduction in crops and applications of plant breeding.	**K2**
CO-3	demonstrate the theories of evolution.	**K3**
CO-4	analyse the hybridization techniques.	**K4 & K5**
CO-5	Test the knowledge on heterosis, mutation and polyploidy.	**K6**

Unit-I:

Plant Breeding: Historical aspect of plant breeding and genetic basis. Breeding methods- sexual, asexual and apomitic reproduction. Floral Biology in relation to selfing and crossing techniques. Centres of diversity and origin of cultivated plants. Role of National and International Institutes.

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:

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

Unit-IV:

Back Crossing: Theory and procedure for transferring various types of character. Preservation and utilization of germplasm. Breeding of rice, sugarcane, groundnut and maize. Application of biotechnology to plant breeding - embryo rescue, somaclonal variation, doubled haploid, protoplast fusion and transgenic.

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 for Study

1. Chaudhari, R. C. 2017. Introductory Principles of Plant Breeding, Kindle Edition.
2. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers,
3. Manokaran, K. V. 2010. Essentials of Plant Breeding. PHI Learning Private Limited Publishers.

Books for Reference

1. Brown, PC and Campos, H. 2014. Introduction to Plant Breeding.2nd Edition, Wiley Blackwell Publishers.
2. Izak Bos and Caligari, P. 2007. Selection Methods in Plant Breeding. Springer.

Semester	Course Code					Title of the Course					Hours	Credits
II	21PBO2SP01					SELF-PACED LEARNING: PLANT BREEDING AND EVOLUTION					-	2
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	3	2	2	2	2	3	3	1	2	2.3	
CO-2	2	3	2	2	3	2	3	2	3	1	2.3	
CO-3	2	3	2	3	1	2	3	3	2	3	2.4	
CO-4	1	3	2	3	2	2	3	2	3	2	2.3	
CO-5	2	2	2	3	2	2	3	2	3	3	2.4	
Mean Overall Score											**2.4**	
Result											**High**	

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PBO2ES02A**	**DSE-2: BIOPHYSICS AND INSTRUMENTATION**	**5**	**4**

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	acquire knowledge on various types of centrifugation, spectroscopy and tracer techniques.	**K1 & K2**
CO-2	relate the importance of biophysics in modern biology.	**K3**
CO-3	explain the laws of thermodynamics.	**K4**
CO-4	evaluate and illustrate the concept of redox potential in biological system.	**K5**
CO-5	integrate various types of microscopy and their applications.	**K6**

Unit-I: (15 Hours)

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: (15 Hours)

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. Theiso, hypo, and hypertonic solutions, their influence on the cell. Ionic diffusion. Active and passive bioelectric properties of membranes.

Unit-III: (15 Hours)

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

Unit-IV: (15 Hours)

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, HPTLC and GC-MS.

Unit-V: (15 Hours)

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.

Books for Study

1. Banerjee, PK (2008) Introduction to Biophysics, S. Chand, New Delhi.
2. McMahon, G. (2007) Analytical Instrumentation: A Guide to Laboratory, Portable and Miniaturized Instruments. John Wiley & Sons, Ltd. ISBN: 9780470027950.

Books for 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.

Semester	Course Code					Title of the Course					Hours	Credits
II	21PBO2ES02A					DSE-2: BIOPHYSICS AND INSTRUMENTATION					5	4
Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean score of COs	
CO-1	3	3	2	1	2	2	3	2	1	2	2.1	
CO-2	2	3	2	2	3	2	3	2	2	1	2.2	
CO-3	2	2	3	2	1	2	2	3	2	2	2.1	
CO-4	1	2	2	3	2	1	3	2	3	2	2.1	
CO-5	1	2	2	3	2	2	3	2	2	3	2.2	
Mean Overall Score											2.1	
Result											High	

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PBO2ES02B**	**DSE-2: PLANT PATHOLOGY**	**5**	**4**

CO. No.	CO-Statements	Cognitive Levels (K- levels)
On successful completion of this course, students will be able to		
CO-1	acquire knowledge on pathogenesis and disease establishment in plants	**K1**
CO-2	learn the process of plant pathogenesis and disease establishment	**K2**
CO-3	recognize the effect of Microbe infection on host physiology	**K3**
CO-4	comprehend the various different types of disease control mechanism	**K4**
CO-5	familiarize the concepts in plant immunity and various defence mechanism in plants	**K 5 & K6**

Unit-I: (15 Hours)

Concept of plant disease – definitions of disease, disease cycle and pathogenicity. General symptoms and Classification of plant diseases. History of Plant Pathology with special references to Indian work.

Unit-II: (15 Hours)

Pathogenesis- pathogens and their mode of dissemination, pre-penetration, penetration and post penetration changes. Role of Chemical Weapons (Enzymes, Toxins and Growth regulators) in disease development.

Unit-III: (15 Hours)

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: (15 Hours)

Plant diseases: causal organisms, symptoms, disease cycle and control measures for the following diseases: White rust of Crucifers, Bacterial blight of paddy, yellow vein Mosaic of Bhindi, covered smut of Barley, Spike disease in Sandal. Integrated Disease Management (IDM) –Plant diseases control: Cultural, physical, chemical and biological methods.

Unit-V: (15 Hours)

General concepts on plant immunity: morphological, structural defence mechanisms and biochemical defence mechanisms, pre-existing defence mechanisms. Phytoalexins, defence through induced synthesis of proteins and enzymes. Molecular Basis of Defence Mechanism: Signal Transduction, Recognition of the pathogen by the host, transmission of the alarm signal to the host defence providers.

Books for Study

1. Singh, RS. 2018. Introduction to Principles of Plant Pathology, 4th ed. Scientific International, Bengaluru, India.
2. Mehrotra, RSand Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher Co. Ltd., New Delhi.

Books for Reference

1. Sharma PD. 2001. Microbiology and plant pathology, Rastogi publications, Meerut.
2. Rangasamy G. 1998. Diseases of crop plants in India. Prentice- Hall of India, New Delhi.
3. Mukherjee KG and Jayanti Bhasin, 1986. Plant diseases of India. Tata MacGraw-Hill, New Delhi.
4. Harsfall JG and Cowling EB. 1979. Plant Disease, an Advanced Treatise. Academic Press, NY.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
II	**21PBO2ES02B**					**DSE-2: PLANT PATHOLOGY**					**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	2	2	2	2	2	3	3	3	2	2	2.3	
CO-2	2	3	2	2	2	3	2	2	2	3	2.3	
CO-3	2	2	2	2	2	3	3	2	2	2	2.5	
CO-4	2	2	2	2	2	3	3	3	2	2	2.2	
CO-5	2	2	3	2	2	2	3	3	2	2	2.3	
Mean Overall Score											**2.3**	
Result											**High**	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PSS2SE01	SEC: SOFT SKILLS	4	3

Programme Specific outcomes (PSOs)

After the successful completion of the course, students will learn:

- The dynamics of effective and professional communication skills and put them into daily use.
- To write a Professional resume using creative methods of online platforms.
- the dynamics of interview skills and GD preparations and presentations in public platforms and present the best of themselves as job seekers.
- To understand, analyze and express their personality styles and personal effectiveness in various environments.
- To learn and update themselves with the required knowledge in Numerical ability and Test of Reasoning for competitive examinations.

Course outcomes (COS)

On successful completion of this course, students will be able to:

- exposed and trained in various nuances of Soft Skills in a Professional manner responding to the requirements of national and international market
- synthesize the knowledge and practical skills learnt to be personal effective in any managerial positions
- construct plans and strategies to work for better human society
- illustrate the problems at work and home and design solutions and maintain a balance of work and home
- connect on a continuum and maintain growth and sustainability and creativity in employment that increases in productivity, profit for individuals and the society.

Module 1: Effective Communication & Professional communication

Effective communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication. JOHARI Window as a tool of effective communication.

Professional Communication: The Art of Listening, The passage, Kinesthetic, Production of Speech, Speech writing , Organization of Speech, Modes of delivery, Conversation Techniques, Good manners and Etiquettes, Different kinds of Etiquettes, Politeness markers.

Module II. Resume Writing & Interview Skills

Resume Writing: Meaning and Purpose. Resume Formats. Types of s Resume. Functional and Mixed Resume**,** Steps in preparation of Resume, Model resumes for an IT professional Chronological, Types of interviews, Creative resumes using online platforms

Interview Skills: Common interview questions, Dos and Don’ts for an interview, Attitude, Emotions, Measurement, Body Language, Facial expressions, Different types of interviews, Telephonic interviews, Behavioral interviews and Mock interviews (Centralized).

Module III: Group Discussion & Team Building

Group Discussion: Group Discussion Basics, GD as the first criterion for selecting software testers, Essentials of GD, Factors that matter in GD, GD parameters for evaluation, Points for GD Topics, GD Topics for Practice, Tips for GD participation. Video shooting of GD presentation & Evaluation (Centralized)

Team Building: Characteristics of a team, Guidelines for effective team membership, Pedagogy of team building, Team building skills. Team Vs Group – synergy, Types of synergy, Synergy relates to leadership ,Stages of Team Formation, Broken Square-Exercise, Leadership, Leadership styles, Conflict styles, Conflict management strategies & Exercises

Module IV: Personal Effectiveness

Personal Effectiveness: Self Discovery: Personality, Characteristics of personality, kinds of self, Personality inventory table, measuring personality, intelligence and Exercises

Self Esteem: Types -High & Low self-esteem, Ways of proving self-esteem, Hypersensitive to criticism, activities. Goal setting: Goal setting process, Decision making process & Exercises.

Stress Management: Identifying stress, Symptoms of stress, Responding to Stress, Sources of stress, Coping with stress and Managing stress.

Module V: Numerical Ability

Average, Percentage, Profit and Loss**,** Problems of ages, Simple Interest, Compound Interest, , Area, Volume and Surface Area, Illustration, Time and Work, Pipes and Cisterns, Time and Distance**,** Problems on Trains**,** Illustrations, Boats and Streams, Calendars and Clocks.

Module VI: Test of Reasoning

Verbal Reasoning: Number series, letter series, coding and decoding, logical sequence of words, Assertion and Reasoning, Data Sufficiency, Analogy, Kinds of relationships.

Non-Verbal Reasoning: Completion of Series**,** Classification, analogical, Pattern comparison, Deduction of figures out of series, Mirror Reflection Pattern, Hidden figures, Rotation pattern, Pattern completion and comparison, Sense of direction, Blood relations.

Text cum Exercise book

1. Melchias G, Balaiah John, John Love Joy (Eds), 2018. Winners in the Making: A primer on soft skills. SJC, Trichy.

Books for 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 & C0,Revised Edition.
3. Covey, Stephen. (2004). *7 Habits of Highly effective people,* Free Press.
4. Egan, Gerard. (1994). *The Skilled Helper* (5^{th} Ed). Pacific Grove, Brooks/Cole.

5. Khera ,Shiv (2003). *You Can Win*. Macmillan Books , Revised Edition.

Other Text Books

* Murphy, Raymond. (1998). *Essential English Grammar*. 2nd ed., Cambridge University Press.

* Prasad, L. M. (*2000). Organizational Behaviour, S.Chand & Sons.*

* Sankaran, K., & Kumar, M. *Group Discussion and Public Speaking* . M.I. Pub, Agra, 5th ed., Adams Media.

* Schuller, Robert. (2010) . *Positive Attitudes*. Jaico Books.

* Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.

** Yate, Martin. (2005). H*iring the Best: A Manager's Guide to Effective Interviewing and Recruiting**

Semester	Course Code	Title of the Course	Hours	Credits
II	**21PBO2EG01**	**GENERIC ELECTIVE 1 (WS): MEDICINAL BOTANY**	**4**	**3**

CO. No.	CO- Statements	Cognitive Levels (K- levels)
On successful completion of this course, students will be able to		
CO-1	obtain the knowledge about understanding of principle and treatment methods of various Traditional system of medicines.	**K1 & K2**
CO-2	comprehend the current trade status and role of medicinal plants in socio economic growth.	**K3**
CO-3	investigate the suitable conservation method for medicinal plants using modern biotechnology tools to ensure the sustainable utilization.	**K4**
CO-4	evaluate the Ethno botany knowledge based drug products efficacy and its various applications in drug industries.	**K 5**
CO-5	create new drug formulations using therapeutically valuable phytochemical compounds for the healthy life of society.	**K6**

Unit I: **(12 Hours)**

Key Historical events, Scope and importance of medicinal plants. Traditional medicinal systems: Siddha, Ayurvedha, Homeopathy, Chinese medicine, Unani, Naturopathy and Aromatherapy. Status of Indian medicinal plant trade, medicinal plants prohibited from export, leading companies in India in trade of medicinal plants.

Unit II: **(12 Hours)**

Classification of herbal drugs based on the Alphabetical, Morphological, Taxonomical, Chemical and pharmacological. Collection and processing of herbal raw materials for drugs preparation-Post Harvesting care, Drying, Dressing, Packing and Storage. Conservation and mass propagation of important medicinal plants through *In vitro* propagation methods. Role of NMPB, CDRI and CIMAP on medicinal plants conservation and research development. WHO regulation and Guidelines for quality control and trade of herbal medicine.

Unit III: **(12 Hours)**

Ethnobotany - concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Role of ethnobotany in modern Medicine Medico-Ethnobotanical sources – Eg. Contribution of Kani Tribes. Ethnobotany and plant genetic resources conservation of medicinal plants with special reference to India. Major tribes of South India and their ethno botanical knowledge.

Unit IV: **(12 Hours)**

Phytotherapeutic compounds of medicinal plants - Alkaloids, Glycosides, Terpenoids, Tannins, Flavonoids and Phenols. Patent guidelines for Phytotherapeutic compounds. Identification and utilization of the medicinal herbs in curing various ailments – *Catharanthus roseus* (Anti-cancer), *Aegle marmelos* (Cardiotonic), *Withania somnifera* (Drugs acting on nervous system), *Cardiospermum halicacabum* (Anti-rheumatic) and *Centella asiatica* (Memory booster), *Phyllanthus emblica* (Rejuvenating) and *Phyllanthus niruri* (Hepato-protective).

Unit V: **(12 Hours)**

Medicinally useful plant parts: Root – *Hemidesmus indicus* and *Rauvolfia serpentina*; Rhizome – *Acorus calamus* and *Curcuma longa*; Stem- *Tinospora cordifolia* and *Santalum album*,; Bark – *Terminalia arjuna* and *Saraca asoca*; Leaf – *Andrographis paniculata* and *Cynodon dactylon*; Flowers – *Crocus sativus* and *Syzygium aromaticum* ; Fruits - *Piper longum* and *Terminalia chebula*; Seeds – *Azadirachta indica* and *Trigonella foenum-graecum*.

Books for Study

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.
6. Cultivation of Medicinal and Aromatic crops by A.A. Farooqui and B.S. Sreeramu (2004).
7. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
8. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd Edn. Agrobios, India.
9. Quality control and evaluation of Herbal Drugs by Pulok.K. Mukarjee (2019).

Web Resources

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

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBO2EG01	GENERIC ELECTIVE 1 (WS): MEDICINAL BOTANY	4	3

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean score of COs
CO-1	3	2	3	1	3	3	3	1	2	2	2.3
CO-2	3	2	3	3	3	1	2	3	3	2	2.5
CO-3	3	3	3	2	3	2	3	3	2	3	2.7
CO-4	3	1	3	2	3	2	3	1	2	2	2.2
CO-5	2	3	2	2	3	1	1	2	3	2	2.1
									Mean Overall Score		2.36
									Result		High

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBO3CC06	CORE-6: PLANT SYSTEMATICS	5	5

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	perceive interdisciplinary approaches on classification of angiosperms.	**K1**
CO-2	gain confidence and proficiency in evaluating comparative data and in making sound taxonomic judgements.	**K2**
CO-3	demonstrate specific mastery in recognise, compare and contrast distinctive attributes among the major groups of angiosperms.	**K3**
CO-4	acquire the vital skills for conducting extensive field and herbarium studies.	**K4 & K5**
CO-5	equip themselves with skills in writing short species description, illustration, field identification and scientific photography.	**K6**

Unit-I: **(15 Hours)**

Overview of Plant Systematics - Phenetics (artificial, natural classification) and Cladistics (Phylogenetic systematics): terms and concepts, taxon selection, character analysis, cladogram construction, cladogram analysis - Angiosperm Phylogeny Group classification: principles of APG system, short version of APG I, APG II and APG III, detailed version of APG IV.

Unit-II: **(15 Hours)**

Taxonomic hierarchy: principal ranks - species concept and infraspecific categories (subspecies, varieties and forms) - genus concept and infrageneric categories (subgenus, section and series) - family concept and infrafamily categories (subfamily, tribe and sub tribe).

Unit-III: **(15 Hours)**

Botanical nomenclature: ICN principles; scientific names; authorship; nomenclatural types; valid publication; priority of publication; conservation of names; retention and rejection; taxonomic revision; synonyms; names of hybrids and cultivated plants.

Unit-IV: **(15 Hours)**

Plant identification: field inventory; herbarium techniques, Flora (e-flora), monographs; journals; taxonomic key. Systematic evidence: morphology; anatomy; palynology; embryology; cytology; phytochemistry.

Unit-V: **(15 Hours)**

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.

Books for Study

1. Michael G. Simpson. 2019. Plant Systematics - 3rd ed., Academic Press, New York, USA.
2. Crawford, D.J. 2003. Plant Molecular Systematics, Cambridge University Press, Cambridge, UK.
3. Heywood, VK & Moore, DM. 1984. Current Concepts in Plant Taxonomy, Academic Press, London.

Books for Reference

1. Grant, WF. 1984. Plant Biosystematics, Academic Press Inc., Canada.
2. Harborne, JB. &Turner, BL. 1984. Plant Chemosystematics, Academic Press, London.
3. Hillis, DM, Moritz, C & Mable, BK. 1996. Molecular Systematics, Sinaver Associates, Sunderland, USA.

Semester	Course Code					Title of the Course					Hours	Credits
III	21PBO3CC06					CORE-6: PLANT SYSTEMATICS					5	5
Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean score of COs	
CO1	3	3	2	2	2	3	3	3	2	2	2.5	
CO2	3	3	3	2	3	3	3	3	3	3	2.9	
CO3	3	3	3	2	3	3	3	3	3	3	2.9	
CO4	3	3	3	3	3	3	3	3	3	3	3.0	
CO5	3	3	3	2	2	3	3	3	3	3	2.8	
Mean Overall Score											2.82	
Result											High	

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBO3CP05	LABORATORY COURSE 5: PLANT SYSTEMATICS	4	3

PRACTICALS:

1. Exercise in key making.
2. Binomial identification using Flora.
3. Study and submission of digital description of the following families with reference to their South Indian representatives and minimum of one member each to be described, dissected and sketched to scale (classification based on APG IV, 2016):

BASAL ANGIOSPERM: Nymphaeales - Nymphaeaceae

MAGNOLIIDS: Peperales - Aristolochiaceae

MONOCOTS: Alismatales - Araceae, Hydrocharitaceae, **Commelinales –** Commelinaceae, **Poales -** Cyperaceae

EUDICOTS: Ranunculales - Menispermaceae

ROSIDS: Malpighiales - Passifloraceae, **Sapindales -** Meliaceae, **Brassicales -** Cleomaceae

SUPERASTERIDS: Santalales - Loranthaceae, **Caryophyllales -** Caryophyllaceae, Aizoaceae

ASTERIDS: Solanales - Convolvulaceae, **Lamiales -** Scrophulariaceae, Acanthaceae, Verbenaceae

4. Exercise in the important Articles of the Code.
5. Cladogram construction and analysis.
6. Submission of herbaria of any five plant species.
7. Field trip report.

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBO3CC07	CORE-7: RESEARCH METHODOLOGY	5	4

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	Obtain knowledge on basic concepts in Researchand in Biostatistics.	K1
CO-2	Acquire knowledge on sampling techniques, evaluate literature, collection of data and thesis writing..	K2
CO-3	Analyze the significance of databases and Citation Index.	K3
CO-4	Acquire skill in writing research articles and formatting the papers.	K4
CO-5	Solve and statistically analyse the data of variables	K5 & K6

Unit-I: (15Hours)

Research - types, objectives and approaches. Census method, Sample -types; Sampling techniques. Hypothesis: definition, characteristics, types,significance. Methods of collecting data: primary and Secondary- meritsand demerits, Code of research ethics. Literature collection: Books, Research articles and e-resources.

Unit- II (15Hours)

Structure of thesis & research article.Journals in Life Sciences, Impact factor of Journals, Ethical issues related to publishing, Plagiarism and Software. Manuscript for publication and proof correction. Structure and components of research proposal, National and International funding sources.

Unit-III: (15Hours)

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. Tailored Research and Retraction. Indian Patent Act.

Unit-IV: (15Hours)

Biostatistics: Introduction. Classification of data; Frequency Distribution: Discrete, Continuous and Cumulative Frequency Distributions;Tabulationof data; Diagrammatic and graphical representation of data:Bar Charts: Simple, Multiple & Sub divided, Histogram, Frequency polygon, Ogive curve, Pie diagram. Measures of Central values: Mean,Median and Mode. Measures of Dispersions: Range, Mean deviation and Standard deviation.

Unit-V: (15Hours)

Skewness and Kurtosis. Probability: Binomial, Poisson and Normaldistributions. Correlation: types, methods. Regression analysis, Large sample(Z), small sample testing: Test of Significance; 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 for Study

1. Kothari, C. R. 2014. Research Methodology-Methods & Techniques. WishwaPrakashan.
2. Misra, R. P, 2000. Research Methodology - A Handbook, Concept Pub. Company, NewDelhi.
3. Pillai and Bagavathi, 2008 Statistics, S. Chand& Company Ltd, NewDelhi.

Books for Reference

1. Gupta, SP. 1990. Statistical Methods, Sultan Chand & Sons, NewDelhi.
2. Nageswara Rao, G. 1983. Statistics for Agricultural Science Oxford & IBH, NewDelhi
3. Gupta, SC. 2013. Fundamentals of statistics, Himalaya Publishers,Mumbai.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
III	**21PBO3CC07**					**CORE-7: RESEARCH METHODOLOGY**					**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	2	3	2	2	3	2	2	3	2	2.4	
CO-2	2	3	2	3	2	3	2	3	2	1	2.3	
CO-3	2	2	3	2	1	3	3	2	3	1	2.2	
CO-4	3	3	2	3	2	3	3	2	3	2	2.6	
CO-5	2	2	3	2	1	3	2	3	2	1	2.1	
										Mean Overall Score	**2.4**	
										Result	**High**	

Semester	Course Code	Title of the Course	Hours	Credits
III	**21PBO3CC08**	**CORE-08: PHARMACOGNOSY**	**4**	**3**

CO. No.	CO- Statements	Cognitive Levels (K- levels)
After the successful completion of the course, student will be able to		
CO-1	acquire the knowledge about understanding of Principle and Treatment methods of various Traditional system of medicines.	**K1 & K2**
CO-2	learn the identification, pharmacological importance and processing of medicinal plants based on their classification and characterization.	**K3**
CO-3	analyze the suitable conservation method for medicinal plants using modern biotechnology tools to ensure the sustainable utilization.	**K4**
CO-4	evaluate the medicinal plants based drug efficacy and its various applications for different ailments	**K5**
CO-5	create new drug formulations using phytochemical compounds for the healthy life of society.	**K6**

Unit-I **(12 Hours)**

Traditional and alternative system of medicine-Principle, practice, short history and merits of herbal medicine- Siddha, Ayurveda, Homeopathy, Chinese medicine, Unani, Naturopathy, Aromatherapy and acupuncture. Status of Indian medicinal plant trade, medicinal plants prohibited from export, leading companies in India in trade of medicinal plants.

Unit-II **(12 Hours)**

Classification of crude drugs - alphabetical, taxonomical, morphological, chemical, pharmacological (therapeutical). Medicinal plants - Mass Cultivation methods for sustainable utilization, Collection and processing of herbal raw material for drugs Preparation-Post Harvesting care, Drying, Dressing, Packing and Storage. Conservation and mass propagation of important medicinal plants through *In vitro* propagation methods.

Unit-III **(12 Hours)**

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

Unit-IV **(12 Hours)**

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). Application of herbal formulations for the treatment of certain diseases- Jaundice, Fever, Cardiac, Infertility, Diabetics, Blood pressure, Skin care and Respiratory diseases.

Unit-V **(12 Hours)**

Pharmaceutical plant products- alkaloids, glycosides, terpenoids, tannins, flavonoids, lipids, proteins. Nutraceuticals, cosmeceuticals, pharmaceuticals - fibre, sutures, surgical dressings, adaptogens, rasayana. Drug adulteration and methods of evaluation-physical, chemical and microscopic. NMPB, CDRI, CIMAP, CIPLA; WHO regulation and Guidelines for quality control and trade of herbal medicine.

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, NiraliPrakashan.
5. Somasundara, S 1997. Maruththuva Thavaraiyal, Ilangovan Padhippagam, Palayamkottai
6. Cultivation of Medicinal and Aromatic crops by A.A. Farooqui and B.S. Sreeramu (2004)
7. Quality control and evaluation of Herbal Drugs by Pulok.K. Mukarjee (2019)

Online Resources

1. http://www.gallowglass.org/jadwiga/herbs/preparations.html
2. http://shawnacohen.tripod.com/thetribaltraditions/id51.html
   http://www.vasundharaorissa.org/Research%20Reports/Globalisation And
3. http://www.emea.europa.eu/docs/en_GB/document_library/Scientific_ guideline/2009/09/WC500003393.pdf

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBO3CC08	CORE-08: PHARMACOGNOSY	4	3

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean score of COs
CO-1	3	2	3	1	3	3	3	1	2	2	2.3
CO-2	2	2	3	1	2	1	3	3	2	3	2.2
CO-3	3	3	3	2	3	2	3	3	2	3	2.7
CO-4	3	1	3	2	3	2	3	1	2	2	2.2
CO-5	2	3	2	2	3	1	1	2	3	2	2.1
Mean Overall Score											2.30
Result											High

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBO3CP06	LABORATORY COURSE 6: RESEARCH METHODOLOGY	3	2

Research Methodology

1. Sampling
2. Collection of data
3. Classification of data
4. Diagrammatic representation of data
5. Measures of central value
6. Measures of dispersion
7. Test of significance
8. Bibliometrics
9. H-Index

Pharmacognosy

1. Chromatographic separation of amino acids (paper) and lipids (TLC).
2. Spectrophotometry: Standard graphs for proteins. (BSA), Glycine and Glucose.
3. Sampling
4. Classification of data.
5. Diagrammatic representation of data.
6. Measures of Central values.
7. Measures of dispersion.
8. Test of significance.
9. Identification and uses of locally available medicinal plants parts – Leaf: *Andrographis paniculata*, *Cardiospermum helicacabum* and *Cymbopogon citratus*. Rhizome: *Acorus calamus*, *Alphinia galanga* and *Curcuma longa*. Tubers: *Asparagus racemosus*, *Gloriosa superba* and *Withania somnifera*. Root: *Hemidesmus indicus*, *Vetiveria zizanioides* and *Achyranthus aspera*. Flower: *Syzygium aromaticum*, *Cassia auriculata* and *Hibiscus rosa-sinensis*. Bark: *Cinnamomum verum*, *Terminalia arjuna* and *Saraca asoca*. Seeds: *Ocimum basilicum*, *Trigonellafoenum-graecum*, and *Trachyspermum ammi*. Fruits: *Piper longum*, *Ficus racemosa* and *Garcinia gummi-gutta.*
10. Preparation of aqueous, methanolic and ethanolic leaf extracts of medicinal plants using soxhlet apparatus.
11. TLC separation of plant components.
12. Antimicrobial screening of bioactive principles of medicinal plants.
13. Preparation of ointment using plant materials.
14. Preparation of rejuvenating herbal foods.
15. Qualitative analysis of phytochemicals (Brinda *et al*., 1981).

Semester	Course Code	Title of the Course	Hours	Credits
III	**21PBO3ES03A**	**DSE-3: ORGANIC FARMING**	**5**	**4**

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	summarize the aims and objectives of organic farming and identify the regulations governing organic farming.	**K1 & K2**
CO-2	apply the acquire knowledge about organic Certification process and procedure.	**K3**
CO-3	integrate the skill to become an entrepreneur.	**K4**
CO-4	check the practices involved in maintaining soil fertility and plant productivity.	**K5**
CO-5	plan a proper pest management strategy for various crops.	**K6**

Unit- I **(15 Hours)**

Concepts and scope of organic farming, Requirements for organic farming, Farm components for an organic farm. Conversion to organic farming- Process, green card systems and subsidies. Fundamentals of Livestock farming, animal behavior, Poultry management.

Unit-II **(15 Hours)**

Types of Farming, Concept of different cropping systems in relation to Organic Farming (Inter cropping), nutrient uptake and balanced nutrient supply, organic manure, green and liquid manure, biofertilizers and their method of use, Compost: decomposition, manure – Types vermicompost: Scope and importance, use of vermi castings in organic farming, Potentials and constraints for vermiculture in India.

Unit-III **(15 Hours)**

Soil formation, types of soil according to composition, methods of increasing soil productivity and fertility, Cultivation of crops with organic inputs: field crops and leguminous crops. Plant protection measures: integrated pest and disease management, biopesticides, treatment methods, importance of neem in organic agriculture.

Unit-IV **(15 Hours)**

Organic crop production methods- sugarcane, mango, ginger, medicinal and ornamental crops. Green labels, Bio-fuel crops. Integrated Nutrient Management (INM) and Integrated Plant Nutrient Supply System (IPNS). Organic produce quality considerations, certification, accreditation process, marketing and Economics.

Unit-V **(15 Hours)**

National and international status of organic farming. Agencies and institutions related to organic farming. Organic Food Quality and Human Health. Entrepreneurship Development- Concept, characteristics and approaches. Income generation activities: Apiculture, Mushroom production, Organic milk production.

Books for Study

1. S.P. Palaniappan and K. Annadurai. 2007 Organic Farming – Theory and Practice. Scientific Publishers (India).
2. Lakshmi, Narasaiah M. 2010. Agriculture and Water Management. Discovery publishing House, New Delhi

Books for Reference

1. P.K. Gupta. 2012. Vermicomposting for sustainable Agriculture. Agrobios.
2. N. Kumar.2010. Introduction to Horticulture. Oxford &Ibh Publishing Co. Pvt. Ltd.
3. Kristensen, P., Taji, A. and Reganold, J. (2006). Organic Agriculture: A Global Perspective. CSIRO Press, Victoria, Australia.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
III	**21PBO3ES03A**					**DSE-3: ORGANIC FARMING**					**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	2	3	2	3	2	2	3	1	2	3	2.3	
CO-2	1	2	3	2	2	3	2	3	2	2	2.2	
CO-3	1	2	3	2	2	3	3	2	2	3	2.3	
CO-4	3	2	2	3	1	3	3	1	2	3	2.3	
CO-5	2	3	2	1	3	1	2	2	3	3	2.2	
Mean Overall Score											**2.3**	
Result											**High**	

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBO3ES03B	DSE-3: BIOINFORMATICS AND BIONANOTECHNOLOGY	5	4

CO No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	study the basic elements of interface, concepts between biology and nanotechnology.	K1
CO-2	outline the basics of sequence alignment and analysis.	K2
CO-3	classify different types of biological databases.	K3
CO-4	explain the synthesis approaches for nanomaterial and its characterization.	K4
CO-5	construct various types of nanomaterial for application and evaluate the impact on environment.	K5 & K6

Unit-I **(15 Hours)**

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. Biological Database Retrieval System - NCBI, PUBMED, EBI, EMBL, DDBJ and Gen- Bank.

Unit-II **(15 Hours)**

Database searches for homology using BLAST and FASTA. 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 **(15 Hours)**

Nanotechnology – definition, origin, scope and importance. 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 **(15 Hours)**

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 **(15 Hours)**

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.

Books for Study

1. Sharon, M. & Sharon, M 2012. Bio-Nanotechnology- Concepts and Applications, CRC Press.
2. Atkinson WI.2011. Nanotechnology. Jaico Book House, New Delhi.
3. Imtiaz Alam Khan. (2005). Elementary bioinformatics. Pharma Book Syndicate, Hyderabad.
4. Rastogi, S.C., Mediratta, N. and Rastogi. P. (2004). Bioinformatics, methods and applications, genomics, proteomics and drug discovery, Prentice hall of India, Pvt. Ltd., New Delhi.
5. Nalwa HS. 2005. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. American Scientific Publ.
6. Niemeyer CM &Mirkin CA. 2005. Nanobiotechnology. Wiley Interscience.
7. Introduction to Nanoscience, S.M. Lindsay, Oxford universal Press, First Edition, 2010 Nanotechnology: Understanding small system, Ben Rogers, Sumita Pennathur and Jesse Adams, CRC Press, Second edition, 2011.

Books for 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.

Web 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

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
III	**21PBO3ES03B**					**DSE-3: BIOINFORMATICS AND BIONANOTECHNOLOGY**					**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	3	2	1	2	2	3	2	1	2	2.1	
CO-2	2	3	2	2	2	2	3	2	2	3	2.3	
CO-3	2	2	3	2	1	2	2	3	2	2	2.1	
CO-4	1	2	2	3	2	2	3	2	3	2	2.2	
CO-5	1	2	2	3	2	2	3	2	1	3	2.1	
										Mean Overall Score	**2.2**	
										Result	**High**	

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBO3EG02	Generic Elective - 2 (BS): HORTICULTURE AND LANDSCAPING	4	3

CO No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	learn the brief history, divisions, classification and structure of horticultural and production of horticultural crops.	K1
CO-2	highlight the aesthetics of horticulture and post-harvest handling of techniques and marketing.	K2
CO-3	evaluate and analyse different landscaping and planting techniques.	K3 & K4
CO-4	develop practical skills in micro propagation techniques, bonsai, topiary techniques and wet and dry flower decorations.	K5
CO-5	design propagation methods and propagation through various specialized underground structures.	K6

Unit-I: **(12 Hours)**

Importance and scope of horticulture; divisions of horticulture; climate, soil and nutritional needs. Plant propagation methods - Cutting, Grafting, Budding and Layering. Natural horticultural gardening in India.

Unit-II: **(12 Hours)**

Indoor gardening - foliage, flowering plants and hanging basket. Terrarium, Bonsai and topiary plants. Floriculture –cultivation of commercial flower crops - rose, orchids and *Anthurium*. Flower decoration-dry and wet.

Unit-III: **(12 Hours)**

Fruit crops - induction of flowering, flower thinning, fruit setting and development. Cultivation of important fruit crops - Mango and Guava.

Unit-IV: **(12 Hours)**

Landscaping principles - planning design for house gardens, institutional and industrial gardens-bioaesthetic, avenue planting, railway planting- Avenue trees, shrubs, climbers, herbs and ground covers, pruning - tree transplantation.

Unit-V: **(12 Hours)**

Lawns: different grasses, maintenance of lawns and rockeries; special types of gardens - vertical garden, roof /terrace garden, bog garden, water garden, planning parks and public garden.

Books for Study

1. Arora JS. 1992. Introductory Ornamental Horticulture, Kalyani Publishers, New Delhi.
2. George Acquaah. 2002. Horticulture Principles and Practices, 2nd Edn. Pearson Edn, Delhi.

Books for 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	**Course Code**					**Title of the Course**					**Hours**	**Credits**
III	**21PBO3EG02**					**GENERIC ELECTIVE-2 (BS): HORTICULTURE AND LANDSCAPING**					**4**	**3**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	2	2	2	3	3	2	2	3	2	2.4	
CO-2	2	3	2	3	2	1	3	2	2	3	2.3	
CO-3	2	3	3	2	2	3	2	2	3	1	2.3	
CO-4	3	3	2	2	2	3	2	3	1	2	2.3	
CO-5	2	2	3	1	3	2	2	3	2	3	2.3	
Mean Overall Score											**2.3**	
Result											**High**	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBO4CC09	CORE-9: MICROBIOLOGY AND IMMUNOLOGY	5	5

CO No.	CO- Statements	Cognitive Levels (K- levels)
On successful completion of this course, students will be able to:		
CO-1	understand the various types of microbes in an environment and their importance.	K1
CO-2	demonstrate the role of microorganisms in food processing and spoilage, soil fertility and sewage disposal	K2
CO-3	assess role of microorganisms in industrial processing of microbial products	K3
CO-4	distinguish the structure and function of immune system in humans.	K4
CO-5	evaluate and justify the defence mechanism against infection in plants and humans.	K5 & K6

Unit-I: **(15 Hours)**

Scope, branches and history. Structure and organization of Bacteria, Actinomycetes. Brief study on Spirochetes, Rickettsias, Chlamydias and Mycoplasmas, Viruses – Structure, organization, replication. Brief account on Viroids, virusoids and prions. Culture of microorganisms: synchronous, batch and continuous culture. Chemostat and turbidostat, Methods of preservation of microbes.

Unit-II: **(15 Hours)**

Food, dairy and environmental microbiology. Source of Microbial contamination of food; food poisoning and food-borne infections. Methods of food preservation. Microbial contamination of milk, milk-borne diseases - preservation of milk and dairy products. Soil microbes and their role in biogeochemical cycling.

Unit-III: **(15 Hours)**

Industrial microbiology: selection of industrially useful microbes, fermentation processes, recovery of end products; production of alcohol, insulin, lactic acid, 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: **(15 Hours)**

Immunology: Role of genes in plant and animal immune system. Plant innate immunity: Role of Salicylic Acid, Jasmonate and Ethylene Signaling, Pre-existing-structural innate mechanisms: The wax layer and cuticle, Cytoskeleton, Hydathodes, Lenticles, Guard cells, Trichomes, Idioblasts. Pre-existing biochemical innate mechanisms: Anti-microbial compounds, Toxic inhibitors, Phytoanticipins and Phytohormones. Immune cells - haemetopoiesis -detailed study of T and B cells, MHC molecules and antigen processing and presentation. General structure of antibodies .Immunological role of Monoclonal antibodies.

Unit V: **(15 Hours)**

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 and their mode of action.

Books for Study

1. Sullia, S.B. and Shantharam, S. 1998. General Microbiology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi **Unit-II and Unit-III**
2. Pelczar, M.J., Reid, R.D. and Chan, E.C.S. 1983. Microbiology, Tata McGraw Hill Publishing Co., New Delhi. **Unit I**
3. Prescott et al., 2009 7e, Microbiology. Wm. C. Brown Publishers.
4. Kuby J, 2000, Immunology, 4thedition, WHFreeman.

Books for Reference

1. Reed, G. 1983. Prescott & Dunn's Industrial Microbiology. 4th ed. AVI Publishing Co., Connecticut, USA.
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. Roitt et al., 1998, Immunology 5thedition, Mosby International Ltd. London. UK.
5. GUIDO SESSA 2013. Molecular Plant Immunity. John Wiley & Sons, Inc. USA
6. František Baluška 2015. Signaling and Communication in Plants, Springer, New York.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
IV	**21PBO4CC09**					**CORE-9: MICROBIOLOGY AND IMMUNOLOGY**					**5**	**5**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	3	2	2	2	3	3	3	2	2	2.5	
CO-2	2	3	2	2	2	2	2	2	2	3	2.2	
CO-3	3	3	3	2	2	3	3	2	2	2	2.5	
CO-4	3	3	3	3	1	3	3	3	3	1	2.6	
CO-5	2	2	2	2	3	2	2	2	2	3	2.2	
										Mean Overall Score	**2.4**	
										Result	**High**	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBO4CC10	CORE-10: GENETIC ENGINEERING AND BIOTECHNOLOGY	5	5

CO No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, student will be able to		
CO-1	understand the principles of genetic engineering.	**K1**
CO-2	learn the types and application of cloning vectors.	**K2 & K3**
CO-3	study and analyse different types of gene transfer methods.	**K4**
CO-4	design protocol for plant tissue culture.	**K5**
CO-5	compile the principles and application of Intellectual Property Rights.	**K6**

Unit-I: **(15 Hours)**

Agrobacterium mediated gene transfer and Crown gall; **Nucleases:** Exonucleases and Endonucleases, **Restriction Enzymes:** (Type I - V), RNases and Eukaryotic (cDNA). **Methylases:** CpG Methylase, Dam Methylase, Dcm Methylase; Polymerases: DNA Pol I, Klenow Fragments, Reverse Transcriptase, Taq & Pfu Polymerases. **Ligases:** T4 DNA Ligase, E. coli DNA Ligase, T4 RNA Ligase **Topoisomerases:** Type I (A, B) & Type II (A, B) End Modifying Enzymes: Terminal Transferase, T4 Polynucleotide Kinase, Alkaline Phosphatases. Linkers and Homopolymers.

Unit-II: **(15 Hours)**

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

Unit-III: **(15 Hours)**

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: **(15 Hours)**

Technology protection systems (GURT) - terminator gene technology. 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 Bt-brinjal. Essentials of IPRs and patents.

Unit-V: **(15 Hours)**

Synthetic biology-scope and importance. Artificial DNA and synthetic genome. Contribution of JC Venter. Minimal genome, expanded gene pool. Creation of synthetic and commercially available products. Potentials and applications; ethical issues of synthetic organisms.

Books for Study

1. Old RN and Primrose S B. 2004, Principles of Gene Manipulation - Blackwell Sci., USA.

2. JD Watson, MGilman, JWitkowski and MZoller 1992. Recombinant DNA (12th Edition), WH Freeman Co., New York.

Books for Reference

1. Presidential Commission for the Study of Bioethical Issues, 2010. (www.bioethics.gov)
2. ETC Group, Canada, 2010. Extreme Genetic Engg - an introduction to synthetic biology.
3. Young, E and Alper, H, 2010. Synthetic Biology: A Review. Journal of Biomedicine and Biotechnology.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
IV	**21PBO4CC10**					**CORE-10: GENETIC ENGINEERING AND BIOTECHNOLOGY**					**5**	**5**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	2	3	2	2	3	3	2	3	2	2.5	
CO-2	2	3	2	3	2	2	3	2	2	3	2.4	
CO-3	2	2	3	2	3	3	3	2	3	1	2.4	
CO-4	3	3	3	3	1	3	3	3	3	1	2.6	
CO-5	2	2	2	2	3	2	2	2	2	3	2.2	
										Mean Overall Score	**2.42**	
										Result	**High**	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBO4CC11	CORE-11: CELL AND MOLECULAR BIOLOGY	4	3

CO. No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	recognize the structural, organization and function of different cell organelles.	K1
CO-2	explain the genetic code and its perpetuation.	K2
CO-3	differentiate the basic cellular and molecular events.	K3
CO-4	apply the knowledge acquired to interpret the molecular mechanisms.	K4 & K5
CO-5	critique the principles of gene regulation.	K6

Unit-I **(12 Hours)**

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 **(12 Hours)**

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 **(12 Hours)**

Transcription: RNA polymerases and their role. Transcription signals - promoters and terminators. Detailed account of transcription in *E. coli* and eukaryotes. Differences between the prokaryotic and the eukaryotic transcription, Post transcriptional modifications of mRNA (5'CAP formation, poly adenylation, spliciosome assembly, splicing editing). Organization of mRNA, RNA editing, mRNA export.

Unit-IV **(12 Hours)**

Translation: Genetic code – introduction, important features of the genetic code, exceptions to the standard code. Mechanism of translation in prokaryotes and eukaryotes. Differences between prokaryotic and eukaryotic protein synthesis. Protein sorting and translocation: Post-translational modification of proteins, Protein folding-self-assembly and role of chaperones.

Unit-V **(12 Hours)**

Gene regulation: Operon model - Inducible and repressible systems. Attenuation, positive and negative regulation. *lac* and *trp* operons of E. coli. Regulation of eukaryotic gene expression. Gene families and hormonal control in eukaryotes. Gene silencing: transcriptional and post transcriptional gene silencing.

Books for Study

Malacinski GM. 2015. Essentials of Molecular Biology. Jones and Bartlett, Boston, USA.

Books for Reference

1. Cooper M 2000. The Cell-a molecular biology approach. 2nd ed. Sinauer Associates, Massachusetts.
2. Lodish et al 2004.Molecular Cell Biology, COH freeman & Co. New York.
3. Watson JD et al. 2004.Molecular biology of the gene, Pearson education, Singapore.
4. Gardner et al. 2004. Principles of genetics. John Wiley & Sons Inc. Singapore.
5. Veer Bala Rastogi, 2016. Principles of Molecular Biology, Medtech publishers, New Delhi.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
IV	**21PBO4CC11**					**CORE-11: CELL AND MOLECULAR BIOLOGY**					**4**	**3**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	3	2	2	2	2	3	2	2	2	2	2.2	
CO-2	3	1	2	2	3	3	2	2	2	2	2.2	
CO-3	2	2	2	2	2	2	2	2	1	2	1.9	
CO-4	2	1	3	2	2	2	3	2	2	3	2.1	
CO-5	2	2	2	3	2	2	2	2	1	2	2.0	
										Mean Overall Score	**2.08**	
										Result	**Medium**	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBO4CP07	LABORATORY COURSE 7: MICROBIOLOGY, IMMUNOLOGY, GENETIC ENGINEERING AND BIOTECHNOLOGY	4	3

Experiments

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

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBO4ES04A	DSE-4: INTELLECTUAL PROPERTY RIGHTS	5	4

CO No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	understand the concept and procedure of IPR.	K1
CO-2	know the status of IPR in India.	K2
CO-3	evaluate the difference between patent, copy right and trademark.	K3 & K4
CO-4	analyse the benefits of patent, copy right and trademark.	K5
CO-5	prepare applications for patent, copy right and GI.	K6

Unit-I **(15 Hours)**

Intellectual Property Rights – Introduction, Concept and Theories, Kinds of Intellectual Property Rights, Need for intellectual property right, Advantages and Disadvantages of IPR. International Regime Relating to IPR – TRIPS, WIPO, WTO, GATTS. IPR in India genesis and development.

Unit-II **(15 Hours)**

Patent – introduction, Patent acts and its amendments. Patentable and Non patentable inventions. Process and product parent, double patent, patent of addition. Patent application process - Searching a patent, Drafting of a patent, filling of a patent, Types of patent applications-national, regional and international, patent document: specification and claims. Infringement.

Unit-III **(15 Hours)**

Copy right – concepts and principles. Historical background and development of copyright law – Copy right act, Berne Convention, Universal Copyright Convention, WIPO Phonograms and Performances treaty. Conditions for grant of copyright. Copyright in Literary, Dramatic and musical works, sound recording, cinematograph films and computer programme. Right of Broadcasting and performers. Copyright Board - Power and functioning.

Unit-IV **(15 Hours)**

Trademark – introduction, examples of well-known trademark. Historical development of the concept of trademark and trademark law-National and International. Kinds of trademarks. Procedure for registration of trademark. Infringement of trademark.

Unit-V **(15 Hours)**

Geographical Indication – introduction, types. GI laws. Indian GI act. Traditional knowledge and IPR. Public health and Intellectual Property Rights – case study. New plant varieties protection laws – need and benefits. Patenting of microorganism. IPR and Climate change. Patents and Biotechnology.

Books for Study

Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.

Books for Reference

1. Gopalakrishnan N.S. & T.G. Agitha, (2009), Principles of Intellectul Property, Eastern Book Company, Lucknow.
2. Ramakrishna B and Anil Kumar, HS. 2017. Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Notion Press, Chennai.
3. James Boyle, Jennifer Jenkins, 2018. Intellectual Property: Law & the Information Society—Cases and Materials, Create space Independent Pub. North Charleston, USA.
4. Damodar Reddy S.V. 2019. Intellectual Property Rights -- Law and Practice, Asia Law House, Hyderabad.

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
IV	**21PBO4ES04A**					**DSE-4: INTELLECTUAL PROPERTY RIGHTS**					**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	2	3	2	2	1	2	2	2	2	2	2.2	
CO-2	2	3	2	2	1	2	2	2	2	3	2.1	
CO-3	2	2	3	2	2	2	2	2	2	1	2.0	
CO-4	2	2	2	3	2	2	2	2	2	3	2.2	
CO-5	2	2	2	2	3	1	2	2	2	2	2.2	
Mean Overall Score											**2.1**	
Result											**Medium**	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBO4ES04B	DSE-4: GENETICS	5	4

CO No.	CO-Statements	Cognitive Levels (K-levels)
Upon completion of this course, graduates will		
CO-1	understand the principles of linkage, crossing over and the hereditary mechanisms.	K1 & K2
CO-2	examine the structure and functions of genetic materials.	K3
CO-3	explain the organization of prokaryotic and eukaryotic genomes.	K4
CO-4	justify and outline the mechanisms of DNA repair.	K5
CO-5	compose the dynamics of genetic variation and data interpretation.	K6

Unit-I **(15 Hours)**

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 **(15 Hours)**

Linkage and crossing over, 3-point cross and gene mapping methods. DNA is the genetic material: Griffith's experiment, Avery et al., and Hershy and Chase experiment; RNA as genetic material - Experiment of Fraenkel and Singer.

Unit-III **(15 Hours)**

Organization of eukaryotic and bacterial genomes- transformation, transduction (generalized and specialized), conjugation (F factor mediated, Hfr and Sexduction). Fine structure of the Gene: Cistron, muton and recon, 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 **(15 Hours)**

Molecular mechanisms of DNA repair (mismatch and proof reading, photo reactivation, excision, recombination and SOS repair). Mobile genetic elements- IS elements and transposons in maize and bacteria. Beneficial and harmful effects of mutations.

Unit-V **(15 Hours)**

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. Gene therapy with reference to Haemophilia, Stem cells-Definition, types & sources.

Books for Study

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

Books for References

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. Strickberger (2005). Genetics (III Edn).Prentice Hall of India Pvt. Ltd.
3. D Peter Snustad and Michael J Simmons (2010). Principles of Genetics. John Wiley & Sons

Semester	**Course Code**					**Title of the Course**					**Hours**	**Credits**
IV	**21PBO4ES04B**					**DSE-4: GENETICS**					**5**	**4**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean score of COs**	
CO-1	2	2	2	2	3	2	2	3	2	2	2.2	
CO-2	3	2	2	1	2	1	3	3	2	3	2.2	
CO-3	1	2	3	2	3	2	3	2	3	2	2.3	
CO-4	2	2	1	3	2	2	3	2	3	3	2.3	
CO-5	2	2	2	2	3	1	3	2	3	3	2.3	
Mean Overall Score											**2.3**	
Result											**High**	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBO4CE01	COMPREHENSIVE EXAMINATION	-	2

Unit I:

Classification, structure and reproduction of Algae, Fungi, Lichens, Bryophytes, Pteridophytes and Gymnosperms, Ecology and Evolutionary trends. Levels of organization of tissues, organs & systems. Nodal anatomy, stomatal types; Shoot and root development; floral meristems and floral development, microsporogenesis, endosperm, embryo development and apomixis.

Unit II:

Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle, structure & function of cytoskeleton, signaling through G-protein coupled receptors, signal transduction pathways; DNA replication, repair and recombination, Protein synthesis and gene expression; Methods of genetic transfers – transformation, conjugation, transduction, germinal verses somatic mutants, Structural and numerical alterations of chromosomes

Unit III:

Light harvesting complexes; mechanisms of electron transport, CO_2 fixation-C_3, C_4 and CAM pathways. Nitrogen metabolism, plant hormones- physiological effects, phytochromes, photoperiodism, Plant response to biotic and abiotic stress. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins), Principles of catalysis, enzyme kinetics and enzyme regulation, Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).

Unit IV:

Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants; Concept of habitat and niche, Ecosystem structure; ecosystem function; energy flow and mineral cycling, biogeographical zones of India. Rare, endangered species. Conservation strategies. Environmental pollution; global environmental change

Unit V:

Cells and molecules involved in innate and adaptive immunity, antigens, inflammation, hypersensitivity and autoimmunity; Microbial fermentation, Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for plants and animals. Bioremediation and phytoremediation, Biosensors, RFLP, RAPD and AFLP techniques; Measures of central tendency and dispersal, Levels of significance; Regression and Correlation; t-test.