

**SACRED HEART COLLEGE (AUTONOMOUS), THEVARA
KOCHI, KERALA, 682013**



CURRICULUM AND SYLLABI

**CHOICE BASED CREDIT AND SEMESTER SYSTEM
(CBCSS)**

**UNDERGRADUATE PROGRAMME IN BOTANY
(B.Sc. BOTANY - MODEL I)**

INTRODUCED FROM 2019 ADMISSION ONWARDS

BOARD OF STUDIES IN BOTANY
Sacred Heart College, Thevara, Kochi, Kerala

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FORWORD

Science is a study dealing with a body of facts or truths systematically and the base of all developments in the world is because of practical application of science, *i.e.* technology. The creation of a scientific thinking in society necessitates proper education and guidance. In order to achieve this, one must update the developments in every field of science. To achieve this goal, the curriculum of every programme in science should be revised frequently to incorporate the recent advances in science.

In line with the changes in higher education, the state of Kerala had introduced the autonomy in its 13 selected colleges in 2014. Exercising the opportune occasion of autonomy, the dept. of Botany had attempted to redraft the entire syllabus of UG in a different perspective and the rearrangement of the courses in a more systematic and learner friendly manner in 2015.

The Board of Studies in Botany has made a thorough evaluation of the present syllabus and decided to revise the curriculum in tune with the parent University and the University Grants Commission's model for Under Graduate Curriculum. In this process care has been taken to give emphasis to various aspects such as the creativity of students, knowledge of current developments in the discipline, awareness of environmental impacts due to the development of science and technology, the skills essential for handling equipment and instruments in laboratories and industries, employability and entrepreneur development. Later, consequent of the Hon'ble Supreme Court of India order and the subsequent UGC circular, the Academic Council of the college decided to incorporate Environmental Studies and Human Rights in the UG curriculum, as an additional core course.

Mahatma Gandhi University has revised the curriculum for the UG programs in 2017. In that they have included Environmental Studies and Human Rights in an impressive way. The BOS in Botany of this college decided to follow the syllabus of that course with appropriate modification as full course in Semester V.

The Academic Council of the college decided to implement the revised syllabus with effect from the academic year 2019-20.

The following are the major changes envisaged in the new draft.

1. Under graduate programme in Botany has 13 courses designed as per a well thought out draft scheme where care is given to the scientific coherence of progression subjects. The dissertation of the sixth semester is modified in such a way that the candidates shall opt for either conventional dissertation or any of the hands on training projects of the following types. The hands on training shall be streamlined in such a way that an MoU shall be signed with the outside professional agency, if any, with that of the department.

The following are the projects considered for hands on training:

- | | |
|--|---|
| 1. Mushroom cultivation | 2. Landscaping and garden designing |
| 3. Nursery Management | 4. Flower arrangement and Vegetable carving |
| 5. Topiary and Bonsai | 6. Poly-house farming & Precision farming |
| 7. Organic farming and Plantation management | 8. Plant tissue culture |
| 9. Cultivation of Medicinal plants | 10. Traditional post-harvest technology |
| 11. Natural fibre extraction and Handicrafts | 12. Natural dyes and Mural painting |
| 13. Vermi composting and Organic manure | 14. Bio-pesticides and Bio-insecticides |
| 15. Bio-fertilizers and Biological control | 16. Floriculture and Cut flower marketing |
| 17. Traditional and Natural food processing | 18. Home-made Chocolate Making |
| 19. Wood and Timber Processing | 20. Budding, Layering, Grafting |

Virtual Lab and Additional Credits

In tune with the new trends, ICT enabled teaching methods and to spread the message of non-invasive methods, Green Chemistry and protection of environments, virtual labs are offered in the new syllabus. Out of the 13 courses in Botany programme, 8 courses are appended with a minimum of 3 virtual lab experiments. During the tenure of the programme, students can choose at least 18 experiments from these without sparing a course completely for which they can earn an additional credit.

Thevara
August 15, 2018

Dr. (Fr.) Jose John
Chairman, BoS in Botany

Members of the Board of Studies in Botany

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CURRICULUM

1. TITLE

B. Sc. BOTANY PROGRAMME

Graduate Programme under Choice Based Credit Semester System, 2019.

2. SCOPE

Applicable to regular Under Graduate Programme B.Sc. Botany, conducted by the Sacred Heart College (Autonomous) with effect from 2019-20 admissions.

3. STUDENT ATTRIBUTES

To our knowledge, the Earth is the only planet where life exists. Chlorophyll bearing organisms assimilate the atmospheric CO₂ and release O₂, the vital component required for existence of life. Green plants are the only ultimate source of food for other living organisms. Plants and plant produce have been used as drug, cloth and shelter. Industrial revolution and its aftermath made a paradigm shift in the minds of the people around the world. The significance of ecosystem and natural environment with its natural products is accepted world over now. Botany programme envisages to unravel the significance of plants in the maintenance of life on planet earth.

Attributes:

1. Love and understanding of nature
2. Protection of natural habitats and biodiversity
3. Scientific character of observation and reasoning
4. Co-operation and team work
5. Practice of plant science knowledge in real life
6. Need based training in Botany of adequate quality at the undergraduate level
7. Use of Information Communication Technology to gather knowledge of current developments in plant sciences
8. Acquire skills essential for handling equipment and instruments in chemical laboratories
9. Enhance employability and an aptitude for entrepreneurship

4. DEFINITIONS

- 4.1 Programme** means a three year programme of study and examinations spread over six semesters, according to the regulations of the respective programme, the successful completion of which would lead to the award of a degree.
- 4.2 Semester** means a term consisting of a minimum of 450 contact hours distributed over 90 working days, inclusive of examination days, within 18 five-day academic weeks.
- 4.3 Academic Week** is a unit of five working days in which distribution of work is organized from day-one to day-five, with five contact hours of one hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.
- 4.4 Course** means a complete unit of learning which will be taught and evaluated within a semester.
- 4.5 Common Course I** means a course that comes under the category of courses for English and **Common Course II** means additional language, a selection of both is compulsory for all students undergoing undergraduate programmes.
- 4.6 Core course** means a course in the subject of specialization within a degree programme.
- 4.7 Complementary Course** means a course which would enrich the study of core courses.
- 4.8 Open course** means a course outside the field of his/her specialization, which can be opted by a student.
- 4.9 Choice based core course** means a compulsory course for all under graduate students (as per the UGC directive) to enrich their general awareness.
- 4.10 Credit** is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.
- 4.11 Additional credit or extra credit** is the numerical value assigned to Club activities, Social service, Internship etc. which is not added with the total academic credits of the students.
- 4.12 Grade** means a letter symbol (e.g., A, B, C, etc.), which indicates the broad level of performance of a student in a course/ semester/programme.
- 4.13 Grade point (GP)** is the numerical indicator of the percentage of marks awarded to a student in a course

4.14. Grace Marks shall be awarded to candidates as per the University Orders issued from time to time.

Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes.

5. DURATION OF THE PROGRAMME

The duration of U.G. programmes shall be 6 semesters. The duration of odd semesters shall be from June to October and that of even semesters from November to March. A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.

6. COURSE DESIGN

The UG programme in Botany consists of the following types of courses:

- a) Common courses.
- b) Core courses.
- c) Complementary courses.
- d) Open courses.
- e) Choice based courses.
- f) Project

The core course is in the discipline of Botany and two complementary courses, in Zoology and Chemistry. No course shall carry more than 4 credits. The student shall select any one open course in Semester V offered by other departments including Department of Physical Education.

A student can earn extra credits as detailed below:

- Service - Learning.
- Courses offered by talent clubs.
- Course in Virtual Lab Experiments.

7. PROGRAMME STRUCTURE

Programme Duration	6 Semesters
Total Credits required for the successful completion of the programme	120 Credits
Credits required from Common Course I (<i>English</i>)	22 Credits
Credits required from Common Course II (<i>Second Language</i>)	16 Credits
Credits required from Core Course, Complementary Courses and Project	79 Credits
Open Course	3 Credits
Minimum attendance required	75 %

7.1. Course-wise Distribution of Credits:

The B. Sc. Botany programme consists of common courses with 38 credits, core course, Choice based course and complementary courses with 79 credits and open course with 3 credits.

The number and credits of different types of courses of the programme are listed below.

Type of the Course	No. of Courses	No. of Credits
Common Course I (<i>English</i>)	6	22
Common Course II (<i>Additional Language</i>)	4	16
Total	10	38
Core Courses – <i>Theory</i>	12	34
Core Courses – <i>Practical</i>	6	12
Choice Based Course	1	3
Project & Viva – Voce	1	2
Total	20	51
Complementary Courses – <i>Theory</i>	8	20
Complementary Courses – <i>Practical</i>	2	8
Total	10	28
Open Course	1	3 3
Grand Total	41	120

7.2. Extra-Credit Courses:

The list of extra-credit courses and their corresponding credits are given below:

Course	No. of Credits
Service-Learning (<i>Mandatory</i>)	1
Courses offered by talent clubs	1
Virtual lab Experiments	1

7.3. Semester-wise Distribution of Credits and Instructional Hours:

	Sem I		Sem II		Sem III		Sem IV		Sem V		Sem VI	
	Credit	Hrs./Week	Credit	Hrs./Week	Credit	Hrs./Week	Credit	Hrs./Week	Credit	Hrs./Week	Credit	Hrs./Week
Common Course I (<i>English</i>)	7	9	7	9	4	5	4	5	-	-	-	-
Common Course II (<i>Second Language</i>)	4	4	4	4	4	5	4	5	-	-	-	-
Core Course - <i>Theory</i>	2	2	2	2	2	3	2	3	12	11	12	12
Core Course - <i>Practical</i>	1	2	2	2	1	2	2	2	4	8	4	10
Complementary Course – I <i>Zoology- Theory</i>	2	2	2	2	3	3	3	3	-	-	-	-
Complementary Course – I <i>Zoology- Practical</i>	-	2	2	2	-	2	2	2	-	-	-	-
Complementary Course – II <i>Chemistry - Theory</i>	2	2	2	2	3	3	3	3	-	-	-	-
Complementary Course – II <i>Chemistry – Practical</i>	-	2	2	2	-	2	2	2	-	-	-	-
Project	-	-	-	-	-	-	-	-	-	2	2	-
Open Course	-	-	-	-	-	-	-	-	3	4	-	-
Choice Based Core Course	-	-	-	-	-	-	-	-	-	-	3	3
Total	18	25	22	25	18	25	22	25	19	25	21	25

SEMESTER	No. of Credits	No. of Instructional Hours
I	20	25
II	20	25
III	20	25
IV	20	25
V	19	25
VI	21	25
<i>Total</i>	120	450

8. EXAMINATIONS

The evaluation of each course shall contain two parts:

- (i) CONTINUOUS INTERNAL ASSESSMENT (CIA)
- (ii) END-SEMESTER EXAMINATION (ESE)

The internal to external assessment ratio shall be 1:3, for both courses with or without practical. There shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation.

Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

8.1 Mark Distribution for all Core Theory Papers:

- | | | |
|--------------------------------------|---|-----------|
| a) Marks of End Semester Examination | : | 60 |
| b) Marks of Internal Evaluation | : | 20 |

Different components of theory paper internal evaluation is given below. All three components are mandatory.

Components of Theory – <i>Internal Evaluation</i>	Marks
Attendance	5
Assignment / Seminar/ Viva-Voce	5
Internal Assessment Tests (<i>Two</i>) ($2 \times 5 = 10$)	10
<i>Total</i>	20

Note: *Decimal are to be rounded to the next whole number*

8.1.1 Mark Distribution for Open course

- a) Marks of End Semester Examination : 75
 b) Marks of Internal Evaluation- Core Courses : 25

Different components for the open course internal evaluation is given below.

Components of Theory – Internal Evaluation	Marks
Attendance	5
Assignment	5
Seminar/ Viva-Voce	5
Internal Assessment Tests (Two) ($2 \times 5 = 10$)	10
Total	25

Note: Decimal are to be rounded to the next whole number

Assignment:

Assignments are to be done by the students from I, II, III and IV Semesters. At least one assignment should be done in each semester for all courses. Assignments shall be a field visit with report in a structured format, collection, preservation and presentation of botanical specimens, teacher monitored group discussions supported by report, museum enrichment, herbarium preparation, preparation of models, charts, posters, short report based on scientific papers or scripts on topics of respective semesters, small survey reports, written quiz, etc.

Seminar / Viva:

A student shall present a seminar in any one course in the V and VI semesters and shall appear for a Viva- voce for all the remaining courses.

Internal Assessment Tests (IAT):

Two internal assessment tests (IAT) are to be attended in each semester for each paper. The marks for the tests will be converted into a 5 mark scale for the test paper component of internal evaluation.

Hands on Training/ Research Project *Internal* Evaluation:

Components	Marks
Attendance & Punctuality	10
Commitment	10
Skill	10
Conduct	10
Group Involvement	10
TOTAL	50

The assignments include written assignments, preparation of models, charts, posters etc., field survey, field work.

Hands on Training/ Research Project *External* Evaluation:

Components	Marks
Project Report	25
Presentation	15
Viva voce	10
Total	50

8.2 Mark Distribution for all Practical Papers:

The practical end-semester examination is conducted only at the end of even semesters. Pattern and scheme of evaluation of the examination will be decided by the board of practical examination.

- a) Marks of End Semester Examination : **30**
- b) Marks of Internal Evaluation : **10**

Different components of practical paper internal evaluation is given below. All three components are mandatory.

Components of Practical – Internal Evaluation	Marks
Attendance and Lab Involvement	5
Record	5
Total	10

Note: Decimal are to be rounded to the next whole number

8.3 Attendance Evaluation for Both Theory and Practical Papers:

Mark distribution for attendance, rules regarding attendance and condonation of shortage of attendance are given below.

8.3.1 Mark Distribution for Attendance:

Percentage of Attendance	Marks
90 % and above	5
Between 85 and 90%	4
Between 80 and 85%	3
Between 75 and 80%	2
75%	1

8.3.2 Condonation of Shortage of Attendance:

Candidate can seek condonation of shortage of attendance only once in a 2 year course and twice in other courses of longer duration. Following are the rules regarding attendance requirement:-

- i.) Every candidate is to secure 75% attendance of the total duration of the course.
- ii.) A candidate having a shortage of 10% can apply for condonation of shortage in prescribed form on genuine grounds. Condonation of shortage of attendance if any should be obtained at least 7 days before the commencement of the concerned semester examination.
- iii.) It shall be the discretion of the Principal to consider such applications and condone the shortage on the merit of each case in consultation with the concerned course teacher and HoD.
- iv.) Unless the shortage of attendance is condoned, a candidate is not eligible to appear for the examination.

9. COMPUTATION OF GRADE AND GRADE POINTS

For all courses (theory & practical), grades are given on a 08-point scale based on the total percentage of marks (*CIA + ESE*) as given below:

% of Marks for a course	Grade	Grade Point
95% and above	O - Outstanding	10
85 to below 95%	A ⁺ - Excellent	9
75 to below 85%	A - Very Good	8
65 to below 75%	B ⁺ - Good	7
55 to below 65%	B - Satisfactory	6
45 to below 55%	C - Average	5
35 to below 45%	D - Pass	4
Below 35	F - Failure	0
	Ab – Absent	0

9.1.Computation of SGPA (*Semester Grade Point Average*)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses and the total number of credits of all the courses undergone by a student in a semester.

$$\text{SGPA } (S_i) = \frac{\sum(C_i \times G_i)}{\sum C_i}$$

Where, S_i is the SGPA of the i^{th} semester, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

The SGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for SGPA:

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit × Grade Point)
Course 1	3	B	6	3 × 6 = 18
Course 2	4	A	8	4 × 8 = 32
Course 3	3	A ⁺	9	3 × 9 = 27
Course 4	3	B ⁺	7	3 × 7 = 21
Course 5	3	C	5	3 × 5 = 15
Course 6	4	O	10	4 × 10 = 40
	Σ C_i = 20			Σ (C_i × G_i) = 153

$$\text{SGPA } (S_i) = \frac{\sum(C_i \times G_i)}{\sum C_i} = \frac{153}{20} = 7.65$$

9.2 Computation of CGPA (Cumulative Grade Point Average)

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, *i.e.*

$$\text{CGPA} = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

Where, S_i is the SGPA of the i^{th} semester and C_i is the number of credits in that semester.

Note: The CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for CGPA:

Semester	SGPA (S_i)	Credits (C_i)	$S_i \times C_i$
I	9.69	18	174.42
II	9.12	22	200.64
III	8.50	18	153.00
IV	8.75	22	192.50
V	9.13	15	136.95
VI	9.50	25	237.50
		$\Sigma C_i = 120$	$\Sigma (S_i \times C_i) = 1095.01$

$$\text{CGPA} = \frac{\sum(S_i \times C_i)}{\sum C_i} = \frac{1095.01}{120} = 9.13$$

Grades for the different semesters and overall programme are given based on the corresponding SGPA/ CGPA as shown below:

SGPA /CGPA	Grade
9.50 to 10.00	<i>O - Outstanding</i>
8.50 to 9.49	<i>A+ - Excellent</i>
7.50 to 8.49	<i>A - Very Good</i>
6.50 to 7.49	<i>B+ – Good</i>
5.50 to 6.49	<i>B – Satisfactory</i>
4.50 to 5.49	<i>C – Adequate</i>
3.5 to 4.49	<i>D - Pass</i>
Below 3.5	<i>F – Failure</i>

Note: A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course.

For a pass in a programme, a separate minimum of Grade **D** is required for all the individual courses. If a candidate secures **F** Grade for any one of the courses offered in a Semester / Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this to **D** grade or above within the permitted period. Candidate secure **D** grade and above will be eligible for higher studies.

10. SCHEME OF CORE AND COMPLEMENTARY COURSES

10.1 SCHEME OF BOTANY CORE COURSES (Semester-wise Distribution)

Course Code	Course Title	Credits	Hours / Week	Hour / Sem.	Examination		
					ESE Duration	ESE Max. Marks	CIA Max. Marks
SEMESTER I							
19U1CRBOT1	Microbiology and Phycology *Practical 1	2	2 2	72	3 Hrs.	60 15	20 05
SEMESTER II							
19U2CRBOT2	Mycology, Lichenology and Plant Pathology *Practical 2	2	2 2	72	3 Hrs.	60 15	20 05
19U2PRBOT1	Practical 1 and Practical 2 combined	2			3 Hrs.	30	10
SEMESTER III							
19U3CRBOT3	Bryology, Pteridology, Gymnosperms and Paleobotany *Practical 3	3	3 2	90	3 Hrs.	60 15	20 05
SEMESTER IV							
19U4CRBOT4	Anatomy, Microtechnique and Angiosperm Morphology *Practical 4	3	3 2	90	3 Hrs.	60 15	20 05
19U2PRBOT2	Practical 3 and Practical 4 combined	2			3 Hrs.	30	10
SEMESTER V							
19U5CRBOT5	Angiosperm Systematics and Economic Botany *Practical 5	2	3 2	90	3 Hrs.	60 15	20 05
19U5CRBOT6	Environmental Science and Ecotourism *Practical 6	3	3 2	90	3 Hrs.	60 15	20 05
19U5CRBOT7	Genetics and Plant Breeding	3	3	90	3 Hrs.	60	20

	*Practical 7		2			15	05
19U5CRBOT8	Cell and Molecular Biology and Evolution *Practical 8	3	3 2	90	3 Hrs.	60 15	20 05
19U5OCBOT1	Agribased Microenterprises (Open Course)	3	4	72	3 Hrs.	75	25
SEMESTER VI							
19U6CRBOT9	Plant Physiology and Biochemistry *Practical 9	2	3 2	90	3 Hrs.	60 15	20 05
19U6CRBOT10	Perspectives of Science, Methodology and General Informatics *Practical 10	3	3 2	90	3 Hrs.	60 15	20 05
19U6CRBOT11	Biotechnology and Bioinformatics *Practical 11	3	3 2	90	3 Hrs.	60 15	20 05
19U6CRBOT12	Horticulture, Nursery Management, Embryology and Reproductive Biology *Practical 12	3	3 2	90	3 Hrs.	60 15	20 05
19U6CRBOT13 EL	Phytochemistry and Pharmacognosy (Elective Course)	3	4	54	3 Hrs.	75	25
19U6PJBOT1	Hand on Training Cum Project*	2	1	36	-	50	50
19U2PRBOT3	Practical 5 and Practical 6 combined	2			3 Hrs.	30	10
19U2PRBOT4	Practical 7 and Practical 8 combined	2			3 Hrs.	30	10
19U2PRBOT5	Practical 9 and Practical 10 combined	3			3 Hrs.	30	10
19U2PRBOT6	Practical 11 and Practical 12 combined	2			3 Hrs.	30	10

10.2 SCHEME OF BOTANY COMPLEMENTARY COURSES (Semester-wise Distribution)
(For students who have opted for Zoology as Core)

Course Code	Course Title	Credits	Hours / Week	Hour / Sem.	Examination		
					ESE Duration	ESE Max. Marks	CIA Max. Marks
SEMESTER I							
19U1CPBOT1	Cryptogams, Gymnosperms and Plant Pathology Practical 1	2	2	72	3 Hrs.	60	20
		1	2			15	05
SEMESTER II							
19U2CPBOT2	Plant Physiology Practical 2	2 1	2 2	72	3 Hrs.	60 15	20 05
19U2PCBOT1	Practical 1 and Practical 2 combined	2			3 Hrs.	30	10
SEMESTER III							

19U3CPBOT3	Angiosperm Taxonomy and Economic Botany Practical 3	3 1	3 2	90	3 Hrs.	60 15	20 05
SEMESTER IV							
19U4CPBOT4	Anatomy and Applied Botany *Practical 4	3 1	3 2	90	3 Hrs.	60 15	20 05
19U2PCBOT2	Practical 3 and Practical 4 combined	2			3 Hrs.	30	10

11. B. Sc. BOTANY PROGRAMME - CONSOLIDATED SCHEME

The programme structure with detailed semester-wise distribution of common courses, core courses, complementary courses, open course, choice based course and project are listed below.

Sl. No.	Type of Course	Course Title	Credits	Hrs./ Week	Hrs./ Sem.
SEMESTER I					
1.	Common	English - I	4	5	90
2.	Common	English Common Course - I	3	4	72
3.	Common	Second Language - I (<i>Mal / Hin / San / Fre</i>)	4	4	72
4.	Core	Botany Core - I	2	2	54
5.	Core	Botany Core I - Practicals	1	2	36
6.	Complementary	Zoology - I	2	2	72
7.	Complementary	Zoology Practicals - I	1	2	36
8.	Complementary	Chemistry - I	2	2	72
9.	Complementary	Chemistry Practicals - I	1	2	36
Total			20	25	450
SEMESTER II					
1.	Common	English - II	4	5	90
2.	Common	English Common Course - II	3	4	72
3.	Common	Second Language - II (<i>Mal / Hin / San / Fre</i>)	4	4	72
4.	Core	Botany Core - II	2	2	36
5.	Core	Botany Core II - Practicals	1	2	36
6.	Complementary	Zoology - II	2	2	36
7.	Complementary	Zoology Practicals – II	1	2	36
8.	Complementary	Chemistry – II	2	2	36
9.	Complementary	Chemistry – Practical II	1	2	36
Total			20	25	450

SEMESTER III					
1.	Common	English - III	4	5	90
2.	Common	Second Language - III (<i>Mal / Hin / San / Fre</i>)	4	5	90
3.	Core	Botany Core - III	3	3	54
4.	Core	Botany Core III - Practicals	1	2	36
5.	Complementary	Zoology - III	3	3	54
6.	Complementary	Zoology Practicals – III	1	2	36
7.	Complementary	Chemistry – III	3	3	36
9.	Complementary	Chemistry – Practical III	1	2	36
Total			20	25	450
SEMESTER IV					
1.	Common	English - IV	4	5	90
2.	Common	Second Language - IV (<i>Mal / Hin / San / Fre</i>)	4	5	90
3.	Core	Botany Core - IV	3	3	54
4.	Core	Botany Core IV - Practicals	1	2	36
5.	Complementary	Zoology - IV	3	3	54
6.	Complementary	Zoology Practicals – IV	1	2	36
7.	Complementary	Chemistry – IV	3	3	54
8.	Complementary	Chemistry Practicals – IV	1	2	36
Total			20	25	450
SEMESTER V					
1.	Core	Angiosperm Systematics and Economic Botany *Practical 5	4	5	90
2.	Core	Environmental Science and Ecotourism *Practical 6	4	5	90
3.	Core	Genetics and Plant Breeding *Practical 7	4	5	90
4.	Core	Cell and Molecular Biology and Evolution *Practical 8	4	5	90
5.	Open	Agribased Microenterprises (<i>Open Course</i>)	3	4	72
6.	Core	Hand on Training Cum Project*	2	1	18
Total			19	25	450
SEMESTER VI					
1.	Core	Plant Physiology and Biochemistry *Practical 9	4	5	90

2.	Core	Perspectives of Science, Methodology and General Informatics *Practical 10	4	5	90
3.	Core	Biotechnology and Bioinformatics *Practical 11	4	5	90
4.	Core	Horticulture, Nursery Management, Embryology and Reproductive Biology *Practical 12	4	5	90
5.	Choice Based	Phytochemistry and Pharmacognosy (<i>Elective Course</i>)	3	4	72
6.	Core	Hand on Training / Research Project*	2	1	18
Total			21	25	450

**RESTRUCTURED CURRICULUM FOR B. Sc. DEGREE IN BOTANY
PROGRAMME
COURSE STRUCTURE**

Total Credits 120
Total Instructional hours 150

Semester 1

No	Course Title	Hrs/ week	Credit
1	Common Course English -1	5	4
2	Common Course English -2	4	3
3	Common Course Sec. language -1	4	4
4	Core Course -1 Microbiology and Phycology + Practical	4	3
5	1 st Complementary – Zoology- 1	2	2
6	1 st Complementary – Zoology- 1 Practical	2	1
7	2 nd Complementary- Chemistry -1	2	2
8	2 nd Complementary- Chemistry - 1 Practical	2	1
Total		25	20

Semester 2

No	Course Title	Hrs/ week	Credit
1	Common Course -English -3	5	4
2	Common Course -English -4	4	3
3	Common Course - Sec. language -2	4	4
4	Core Course -2 Mycology, Lichenology and Plant Pathology + practical	4	3
5	1 st Complementary - Zoology - 2	2	2
6	1 st Complementary - Zoology - 2 practical	2	1
7	2 nd Complementary -Chemistry -2 + Practical	4	3
Total		25	20

Semester 3

No	Course Title	Hrs/week	Credit
1	Common Course English -5	5	4
2	Common Course Sec. language -3	5	4
3	Core Course -3 Bryology, Pteridology, Gymnosperms and PaleoBotany + practical	5	4
4	1 st Complementary - Zoology - 3	3	3
5	1 st Complementary - Zoology - 3 practical	2	1
6	2 nd Complementary - Chemistry -3	3	3
7	2 nd Complementary - Chemistry – 3 practical	2	1
	Total	25	20

Semester 4

No	Course Title	Hrs/Week	Credit
1	Common Course - English - 6	5	4
2	Common Course Sec. language -4	5	4
3	Core Course - 4 Anatomy, Microtechnique and Angiosperm Morphology + practical	5	4
4	1 st Complementary - Zoology - 4	3	3
5	1 st Complementary - Zoology - 4 practical	2	1
6	2 nd Complementary - Chemistry - 4	3	3
7	2 nd Complementary - Chemistry – 4 practical	2	1
	Total	25	20

Semester 5

No	Course Title	Hrs/Week	Credit
1	Core Course - 5 Angiosperm Systematics, Floral Morphology and Economic Botany + Two Practical including practicals of project	6	4
2	Core Course - 6 Environmental Science and Ecotourism + Practical	5	4
3	Core Course -7 Genetics and Plant Breeding + Practical	5	4
4	Core Course - 8 Cell and Molecular Biology and Evolution + Practical	5	4
5	Open Course : Agri. Based Microenterprises	4	3
	Total	25	19

Semester 6

No	Course Title	Hrs/Week	Credit
1	Core Course -9 Plant Physiology and Biochemistry + Practical	5	4
2	Core Course -10 Perspectives of Science, Methodology and General Informatics + Practical	5	4
3	Core Course -11 Biotechnology and Bioinformatics + practical	5	4

4	Core Course -12 Horticulture, Nursery Management, Embryology and Reproductive Biology + Practical	5	4
5	Core Choice Based – 13 Phytochemistry and Pharmacognosy	3	3
6	Hands on Training/ Research Project	2	2
	Total	25	21

Grievance Redressal Mechanism

In order to address the grievance of students regarding Continuous internal assessment (CIA) a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1:

At the level of the concerned course teacher

Level 2:

At the level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

Level 3:

A committee with the Principal as Chairman, Dean of concerned Faculty, HOD of concerned department and one member of the Academic council nominated by the principal every year as members.

B.Sc. BOTANY
Programme Outcomes (POs)

PO1	Critical Thinking & Deep Domain Knowledge
PO2	Effective Communication
PO3	Contribute to Nation Building
PO4	Care for the Environment
PO5	Ethical Values
PO6	Global Perspective
PROGRAMME SPECIFIC OUTCOMES (PSOs)	
PSO 1	Understand the functional and theoretical concepts of the biological world and their relative roles in the sustainability of natural habitats and biodiversity. (PO1, PO2, PO3, PO4, PO5, PO6)
PSO 2	Possess knowledge of the evolutionary relationships among plants. (PO1, PO4, PO6)
PSO 3	Understand the applications of plant biology in various disciplines. (PO1, PO3, PO4, PO5)
PSO 4	Perform laboratory procedures as per ethics and following standard protocols. (PO1, PO2, PO5)
PSO 5	Synthesize the scientific character of observation, reasoning and apply the knowledge in designing experiments. (PO1, PO2, PO3, PO5, PO6)

Syllabi

MODEL I B.Sc. Programme in BOTANY Semester I

Course 1

19U1CRBOT1 MICROBIOLOGY AND PHYCOLOGY
(Theory: 48 hours; Practical: 24) (Theory Credit 2, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO 1	Understand the world of microbial diversity
CO 2	Understand the reproductive behaviour in Algae and microbes
CO 3	Understand ecological significance of the lower groups of plants and protists
CO 4	Understand economic significance of the lower groups of plants and protists
CO 5	Collect various algal forms and classify them in the laboratory
CO 6	Compare various algal forms on the basis of their thallus structure

MICROBIOLOGY (Theory: 16 hours; Practical: 6 hours)

Module 1 **1 hr**
Introduction, Scope of Microbiology

Module 2 **8 hrs**
Bacteria: Fine structure - cell wall - Peptidoglycan- cytoplasm - Nucleoid, Flagella
Reproduction- Binary fission
Genetic recombination - Conjugation, transformation & transduction
Three Domains of Life. Mycoplasma - general characters

Module 3 **4 hrs**
Virus - General morphology and structure.
Plant viruses – architecture of TMV
RNA viruses, DNA viruses (Examples only)
Brief account of virus replication.

Module 4 Applied Microbiology

3 hrs

1. Biofertilizers & Biopesticides
2. Biogas production.
3. Reconversion of waste products.
4. Bioremediation.
5. Antibiotics.
6. Production of single cell protein and Probiotics.

Practical

6 hrs

Students are expected to do the following practical

1. Preparation of bacterial smear.
2. Grams staining.
3. Isolation of microbes from soil (Streaking method).

Additional Credit – Virtual Lab Experiments:

1. Gram Staining
2. Streak plate method
3. Isolation and identification of two bacterial unknowns

PHYCOLOGY (Theory: 32 hours; Practical: 18 hours)

Module 1 : Introduction to Phycology and Classification of Algae

7 hrs

Introduction: general characters, habitat diversity, range of thallus structure and pigments in algae; Different types of life cycle and alternation of generations in algae.

Classification: by Fritsch (1945); brief introduction to the modern classification by Lee (2009) [up to divisions].

Module 2

18 hrs

General characters of the following major groups with special reference to the structure, reproduction and life cycles of the following types.

- a. Cyanophyceae: *Nostoc*
- b. Chlorophyceae: *Volvox*, *Oedogonium*, *Cladophora*, *Chara*
- c. Xanthophyceae: *Vaucheria*
- d. Bacillariophyceae: *Pinnularia*
- e. Phaeophyceae : *Sargassum*
- f. Rhodophyceae : *Polysiphonia*

Module 3

4 hrs

Economic importance

- a. Algae as pollution indicator and in waste water treatment
- b. Commercial products: Agar, Alginates, Carrageenin, Diatomaceous earth
- c. Algae in soil fertility, Fertilizer, Nitrogen fixation, minerals, soil algae and symbiosis
- d. Sources of food & medicine
- e. Diatoms and nanotechnology

- f. As a source of Hydrogen as fuel
- g. Toxic algae – Algal blooms, red tides & fish poisoning
- h. Algae as primary producers – Oxygen liberators
- i. Cyanobacteria as a source of restriction endonuclease
- j. Role of algae in aquaculture.

Module 4

3 hrs

Algal culture: isolation, cultivation and preservation of micro- and macro-algae. (Brief account only)

Practical

18 hrs

1. Conduct a field visit to any one of the ecosystems rich in Algae to experience algal diversity. Submit a report of the visit with photographs.
2. Make micro preparation of vegetative and reproductive structures of the types mentioned in the syllabus and make labelled sketches of the specimens observed.
3. Identify the algal specimens up to the generic level by noting their key characters.
4. Algal Culturing: isolation and cultivation of microalgae and macro algae using suitable growth media [Demonstration only].
5. Familiarize the technique of algal collection and preservation and submit at least five algal specimens.

References:

1. Agarwal S.K, 2008. *Foundation course in Biology*, Ane Books Pvt. Ltd., New Delhi.
2. Anand N, 1989. *Culturing and cultivation of BGA*. Handbook of Blue Green Algae.
3. Aneja K. R, 1996. *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation*. Wishwa Prakasan, Delhi.
4. Bilgrama K. S & Saha L. C, 1996. *Text Book Of Algae*, C B S Publishers & Distributors
5. Carpenter P. L, 1967. *Microbiology.*, W. B Saunder & Co, Philadelphia
6. Chapman, V. J, 1962. *The Algae.*: Macmillan & co. Ltd, London
7. Christian Hoek, 1995. *Algae: An Introduction to Phycology*, Cambridge University Press.
8. Dube H.C, 2008. *Fungi, Bacteria and Viruses*, Agrobios, Meerut.
9. Frazier W C & Westhoff D.C, 1978. *Food Microbiology*. TMH Edn.
10. Fritsch F. E, 1945. *Structure and Reproduction of Algae*. Vol.1: Cambridge University Press, London.
11. Hans G Schlegel, 1995. *General Microbiology*. Cambridge University Press, London.
12. John J & Francis M.S, 2013. *An Illustrated Algal Flora of Kerala*, Vol.I: GCS Books, Cochin.
13. Kanika Sharma, 2005. *Manual of Microbiology tools & Techniques*. Ane books, Ansari road, New Delhi.
14. Karthick B, Hamilton P.B and Kociolek J.P, 2013. *An Illustrated Guide on Common Freshwater Diatoms of Peninsular India*. Gubbi Labs, Gubbi.
15. Lee Robert Edward, 2009. *Phycology*. 4th Edn. Cambridge University Press, New Delhi.
16. Mamatha Rao, 2009. *Microbes and Non flowering plants- impact and application* Ane Books P.Ltd.

17. Parihar L, 2008. *Advances in Applied Microbiology*, Agrobios, Meerut.
18. Pelczar M.J Reid and Chan E.C.S, 1977. *Microbiology*. Tata McGraw-Hill publishing Co., New Delhi.
19. Prescott S.C, 2009. *Industrial Microbiology*, Agrobios, Meerut.
20. Sharma O.P, 2004. *Text Book of Algae*, Tata Mc. Graw Hill Co.
21. Sharma P. D, 2005. *Microbiology and Plant Pathology* Rastogi publication Meerut.
22. Vasishta B R, Sinha A.K, Singh V.P, 2004. *Botany for Degree Students. Algae*. S. Chand & Co. Ltd. New Delhi.

Websites

<http://www.phycology.net/>

<http://www.algaebase.org/>

<http://www.seaweed.ie/>

<http://www.brphycsoc.org/> (British Phycological Society)

<http://www.intphycsoc.org/> (International Phycological Society)

<http://www.isaseaweed.org/> (International Seaweed Association)

<http://botany.si.edu/projects/algae/>

<http://botany.si.edu/projects/algae/> (Smithsonian National Museum of Natural History)

Semester II

Course 2

19U2CRBOT2 MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

(Theory: 36 hours; Practical: 36 hours)

(Theory Credit 2, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the diversity of fungi and Lichens
CO2	Understand the reproductive behaviour in fungi and lichen
CO3	Understand the biotechnological application of fungi
CO4	Understand ecological significance of fungi and lichens
CO5	Know the economic significance of the fungal world
CO6	Carry out the mushroom cultivation in at a small scale industry level
CO7	Identify the plant diseases and it's control measures

I. MYCOLOGY (Theory 26 hours; Practical: 26 hours)

Module 1

18 hrs

1. Introduction, structure, reproduction, life cycle, evolutionary trends.
Classification based on Ainsworth (1973)
2. Distinguishing characters of different classes of fungi with special reference to reproductive structures and life history of the genera mentioned in each group
 - a) Myxomycotina - General Characters
 - b) Mastigomycotina - *Albugo*
 - c) Zygomycotina - *Rhizopus*
 - d) Ascomycotina
 - Hemiascomycetes - *Saccharomyces*
 - Plectomycetes - *Pencillium*
 - Pyrenomycetes - *Xylaria*
 - Discomycetes - *Peziza*
 - e) Basidiomycotina
 - Teliomycetes - *Puccinia*
 - Hymenomycetes - *Agaricus*
 - f) Deuteromycotina - *Fusarium*

Module 2 **8 hrs**

1. Economic importance of Fungi – useful and harmful aspects.
2. Fungi of Agricultural importance – mycoherbicides, myconematicides, mycoparasites, Mycorrhiza – diversity, function and significance.
3. Fungal biotechnology- Fundamental principles.
Mushrooms- edible and poisonous types.
cultivation technique-Spawn production .
Cultivation of Oyster mushroom.

Practical **24 hrs**

1. Students are expected to identify the following types by making suitable micropreparations and make labeled sketches *Albugo*, *Rhizopus*, *Saccharomyces*, *Pencillium*, *Xylaria*, *Peziza*, *Puccinia*, *Fusarium* and *Parmelia*.
2. Isolation and culture of Oyster mushroom mycelium.
3. Preparation of bed for mushroom cultivation.
4. Staining of endomycorrhiza or fungus using Trypan Blue.

Additonal Credit : Virtual Lab Experiments

1. Aseptic techniques and transfer of micro-organisms.
2. Selective and differential media for identifying micro-organisms.
3. Slide culture technique for fungi.

II. LICHENOLOGY **2 hrs**

Module 1

General account , economic and ecological importance of lichen
Structure, reproduction and life cycle of *Parmelia*.

III. PLANT PATHOLOGY (Theory 10 hours; Practical: 10 hours)

Module 1 **2 hrs**

History of plant pathology, Classification of plant diseases on the basis of causative organism and symptoms, Host parasite interaction, Defense mechanism in host, Mechanism of infection, transmission and dissemination of diseases.

Module 2 **1 hr**

Control of plant diseases –
Prophylaxis-quarantine measures, seed certification
Therapeutic – physical therapy, chemotherapy.
Biological control.

Module 3 **7 hrs**

Study of following diseases with emphasis on symptoms, cause, disease cycle and control:
Bunchy top of Banana, Bacterial blight of Paddy, Root wilt of Coconut,
Abnormal leaf fall of Rubber, Leaf mosaic disease of Tapioca, Citrus canker.
Fungicides - Bordeaux mixture, Tobacco Neem decoction, preparation. (Brief account only)

Practical**10 hrs**

Students are expected to:

1. Identify the diseases mentioned in the syllabus with respect to causal organisms and symptoms
2. Submit herbarium preparations of various stages (3stages) of any one of the diseases mentioned.
3. Students should be trained to prepare the fungicide – Bordeaux mixture, Tobacco decoction.

Suggested Additional Topics

Fungal ecology - details of fungal decomposition of organic matter, coprophilous fungi, cellulolytic fungi, lignin degrading fungi, details of wood decay, soil fungi, Plant diseases, Role of enzymes in pathogenesis.

References :

1. Ahamadjian Vernon and Hale M.E (eds) 1973. *The Lichens* , Academic press, New Delhi.
2. Ainsworth G.C ., Sparrow K.F & Sussman A.S (eds) 1973. *The Fungi an advanced Treatise*, Vol. 4 a & 4b, a Taxonomic review with keys , academic press New York.
3. Alexopoulos C.J, Mims, C.W & C.W Blackwell,M 1996 *Introductory Mycology* .John Willy and sons, INC . New York.
4. Bilgrami K.S and Dube H.C 1976 *A Text book of Modern Plant pathology* ,: Vikas
5. Campbell R 1987 *Plant Microbiology* , ELBS Edward Arnold , London .
6. George N. Agrios 1988. *Plant Pathology*, Academic Press Ltd., London.
7. Greth Jones,D 1989 *Plant Pathology –Principles and Practice* , Aditya books, New Delhi.
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9. Hale M.E 1983 *The Biology of Lichen*,3rd edition Edward Arnold, London.
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12. Krishnamurthy K.V. 2004. *An Advanced Text Book on Biodiversity Principles and practice*. Oxford and IBH Publishing Co. Pvt. Ltd.
13. Malhotra & Aggarwal Ashok 2003 *Plant Pathology*, Tata Mc Graw Hill Publishing Co
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18. Sharma P.D 2004 , *The Fungi* , 2nd Edition , Rasthogi publication
19. Singh, Pande Jain 2007, *Diversity of Microbes and Cryptogam*, Rastogi Publications.
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21. Vasishta B.R !990 *Botany for Degree Students* , Fungi S. Chand &Co, NewDelhi.

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<http://www.fungibank.csiro.au/>

<http://www.in2.dk/fungi/imageintroTxt.htm>

<http://www.fungi4schools.org/>

<http://www.fungiphoto.com/>

<http://www.britmycolsoc.org.uk/> (British mycological society)

<http://www.mycology.com/>

<http://www.bgbm.fu-berlin.de/sipman/keys/default.htm> (lichen)

<http://www.bspp.org.uk/>

<http://www.fs.fed.us/r6/nr/fid/coolpath.shtml>

<http://fruit.wsu.edu/>

<http://www.apsnet.org>

Semester III

Course 3

19U3CRBOT3 BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS & PALAEOBOTANY

(Theory: 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the morphological diversity of bryophytes, pteridophyte, and gymnosperms
CO2	Understand the reproductive behaviour in bryophytes, pteridophyte, and gymnosperms
CO3	Know the evolutionary trends in bryophytes, pteridophyte, and gymnosperms
CO4	Understand ecological significance of bryophytes, pteridophyte, and gymnosperms
CO5	Know the economic significance of bryophytes, pteridophyte, and gymnosperms
CO6	Understand the habitat variation in bryophytes, pteridophyte, and gymnosperms
CO7	Understand the diversity and distributions of prehistoric flora

BRYOLOGY (Theory: 16 hours; Practical: 9 hours)

Module 1

Introduction, general characters, classification, Evolution of Bryophytes.

2 hrs

Module 2

Morphology, anatomy and reproduction in *Riccia*, *Marchantia*, *Anthoceros* and *Funaria*. Evolution of sporophyte and gametophyte (Development of sex organs not necessary).

12 hrs

Module 3

Importance of Bryophytes, Prevention of soil erosion, pollution monitoring and control, Antibiotics, Horticultural importance.

2 hrs

Practical **15 hrs**
 Make micro preparations of the types mentioned. Study vegetative and reproductive structures.

PTERIDOLOGY (Theory:16 hours; Practical :24 hours)

Module 1 **2 hrs**
 Introduction, general characters, classification and evolution of Pteridophytes.

Module 2 **14 hrs**
 Structural organization of sporophyte and gametophyte (development of sex organs not necessary) of the following types with special reference to stelar structure, heterospory and seed habit.

1. *Psilotum*
2. *Lycopodium*
3. *Selaginella*
4. *Equisetum*
5. *Pteris*
6. *Marsilea*

Practical **18 hrs**
 Make micropreparations to study stelar structure and sporangia of the mentioned types. Identify at sight, noting the morphology.

GYMNOSPERMS (Theory: 14 hours ; Practical :12 hours)

Module 1 **2 hrs**
 Introduction, general characters, classification, origin and evolutionary significance

Module 2 **12 hrs**
 Study of morphology, anatomy and reproductive features of *Cycas*, *Pinus* and *Gnetum*.

Practical **12 hrs**
 Study of the morphology, anatomy and reproductive structures of the types mentioned.

PALAEOBOTANY (Theory: 8 hours)

Module 1 **3 hrs**
 Introduction, study of geological time scale, formation of fossil, fossil types & technique of study, fossil as a fuel.

Module 2 **4 hrs**
 Detailed study of

- Fossil Pteridophyte : *Rhynia*
- Fossil Gymnosperm: *Williamsonia*
- Fossil Angiosperm : *Palmoxylon*

Indian contribution to Palaeobotany **1 hr**

Reference

1. Arnold H.N, 1967. *Introduction to Paleobotany*, Tata Mc Graw- Hill, New Delhi
2. Biswas & John B .M, 2004. *Gymnosperms*, Naresa Publishing house.
3. Bower F.O, 1935. *Primitive Land Plants*. Cambridge, London.
4. Chopra R.N and Kumar P. K, 1988. *Biology of Bryophytes*, Wiley Eastern Ltd, New Delhi.
5. Coutler J.M & Chamberlain C. J, 1958. *Morphology of Gymnosperms*. Central Book Depot Allahabad.
6. Dutta S.C, 1991, *An Introduction To Gymnosperms*, Kalyan Publishing Co. New Delhi.
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9. Rasheed A. 2000, *An Introduction To Bryophyta*, Vikas Publishing House, New Delhi.
10. Singh, Pande Jain 2007, *Diversity of Microbes and Cryptogam*, Rastogi Publications
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12. Vashista B. R, 1993. *Gymnosperms*, S Chand & Co., New Delhi.
13. Vashista B. R, 1993. *Pteridophyta*, S Chand & Co., New Delhi

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<http://www.artdata.slu.se/guest/SSCBryo/SSCBryo.html>
<http://www.northernontarioflora.ca/links.cfm?val=bryophytes>
<http://bryophytes.plant.siu.edu/>
<http://worldofmosses.com/>
<http://www.unomaha.edu/~abls/>
<http://www.anbg.gov.au/bryophyte/index.html>
<http://www.bryoecol.mtu.edu/>
<http://www.mobot.org/MOBOT/tropicos/most/Glossary/glosefr.html>
http://www.fairhavenbryology.com/Master_Page.html
<http://www.mygarden.ws/fernlinks.htm>
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<http://www.bioimages.org.uk/HTML/T77.HTM>
http://botany.csd.tamu.edu/FLORA/gallery/gallery_query.htm
<http://homepages.caverock.net.nz/~bj/fern/>
<http://www.home.aone.net.au/~byzantium/ferns/>
<http://www.northernontarioflora.ca/links.cfm?val=pteridophytes>
http://www.fiu.edu/~chusb001/giant_equisetum.html
<http://www.mygarden.ws/fernlinks.htm>
http://www.nrm.se/en/menu/researchandcollections/departments/cryptogamicbotany/collections/pteridophytes.652_en.html
<http://www.amerfernsoc.org/>
<http://www.gymnosperms.org/>
<http://www.plantapalm.com/vce/toc.htm>
<http://www.cycad.org/conservation.htm>
http://allwebhunt.com/cgi.cfm/Top/Science/Biology/Flora_and_Fauna/Plantae/Cycadophyta/Cycadopsida/Cycadaceae/Cycas
<http://www.forestgiants.com/>
<http://www.azpalmandcycad.org/>

Semester IV

Course 4

19U4CRBOT4 ANATOMY, MICROTECHNIQUE AND ANGIOSPERM MORPHOLOGY

(Theory: 54 hours; Practical: 36 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (Cos)	
CO1	Understand the plant cell structure in a detailed manner
CO2	Understand the tissue level organization in plant system
CO3	Understand the morphological features of angiosperms
CO4	Know and carry out the plant anatomical specimen preparations
CO5	Understand the details of wood anatomy
CO6	Understand different inflorescence and fruit types in plant kingdom

ANATOMY (Theory: 36 hours, Practical: 18 hours)

Module 1: Structure and composition of plant cells

8 hrs

Cell wall: structure of cell wall; sub-microscopic structure - cellulose, micelle, micro fibril and macro fibril; structure and function of plasmodesmata, simple and bordered pits; different types of cell wall thickening in treachery elements; extra cell wall thickening materials. Growth of cell wall - apposition, intussusception. Non-living inclusions in plant cells: food products, secretory products, excretory (waste) products - nitrogenous and non-nitrogenous.

Module 2: Organization of tissues

9 hrs

Tissues: meristematic tissue – characteristic features, functions and classification. Theories on apical organization - apical cell theory, histogen theory, tunica-cortex theory. Permanent tissues - structure and function of simple and complex tissues. Secretory tissues: external secretory tissue - glands and nectaries; internal secretory tissues - laticifers.

Tissue systems: epidermal tissue system - epidermis, cuticle, trichome; stomata – structure, types; bulliform cells. Ground tissue system - cortex, endodermis, pericycle, pith and pith rays. Vascular tissue system - structure of xylem and phloem, different types of vascular bundles and their arrangement in root and stem.

Module 3: Plant body structure

6 hrs

Primary structure of stem, root and leaf (dicot and monocot). Normal secondary growth in dicot stem -and root. Periderm: structure and development - phellum, phellogen, phelloderm, bark, and lenticels. Anomalous secondary thickening: *Bignonia* stem, and *Dracaena* stem.

Module 4: Wood anatomy

4 hrs Basic

structure of wood - heart wood, sap wood; hard wood, soft wood; growth rings and dendrochronology; porous and non-porous wood; ring porous and diffuse porous wood, tyloses. Reaction wood: tension wood and compression wood.

Practical

18 hrs

1. Cell types and tissues.
2. Non-living inclusions – starch grains, cystolith, raphides, aleurone grains.
3. Primary structure of stem, root and leaf - Dicots and Monocots.
4. Stomatal types: - anomocytic, anisocytic, paracytic, diacytic and grass type.
5. Secondary structure of dicot stem and root.
6. Anomalous secondary structure of *Bignonia* stem and *Dracaena* stem.
7. Maceration of wood elements

MICROTECHNIQUE (Theory 9 hrs; Practical 9 hrs)

Preservation of plant specimens, sectioning and mounting

9 hrs

Introduction to microtechnique: killing and fixing - purpose. Dehydration - purpose, agents used - ethyl alcohol. Sectioning: hand sections, serial section; Microtome - rotary, sledge (application only).

Staining technique: principle of staining; stains - hematoxylin, fast green, acetocarmine; vital stains - neutral red, Evans blue; mordants - purpose with examples. Types of staining - single staining, double staining. Mounting and mounting media – purpose, mounting media - glycerine, DPX, Canada balsam. Use of permanent whole mounts; permanent sections; maceration, smear and squash preparation.

Practical

9 hrs

1. Familiarize preparation and use of stains, fixatives and mounting media.
2. Preparation of smears and squash.
3. Demonstration of microtome sectioning.
5. Preparation of single stained hand sections (Permanent – demonstration only).

ANGIOSPERM MORPHOLOGY (Theory 9 hours; Practical: 9 hours)

Unit 1: Plant habit- Herbs, Ephemerals, Shrubs, Trees, Climbers (vines and lianas)

Unit 2: Leaf Morphology - types, venation, phyllotaxy

Unit 3: Morphology of flower - Parts of a flower- description of flower and its parts in technical terms.

Unit 4: Inflorescence:

- (a) Racemose types-Simple Raceme, Corymb, Panicle, Umbel, Spike, Spadix, Head and Capitulum.
- (b) Cymose types-Simple Cyme, Monochasial- Scorpoid and Helicoid, Dichasial
- (c) Special type- Cyathium, Hypanthodium, Verticillaster, Thyrses

Unit 4 Fruits: Simple-Fleshy, Dry- dehiscent, indehiscent, Aggregate, Multiple (Sorosis and Syconus)

Practical

1. Based on the theory topics.

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Semester V

Course 5

19U5CRBOT5 ANGIOSPERM SYSTEMATICS AND ECONOMIC BOTANY

(Theory 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit1)

COURSE OUTCOMES (COs)	
CO1	Know about the natural order in plant kingdom
CO2	Understand the various classification systems and its scope in plant systematics
CO3	Understand the morphological and molecular features of angiosperms in a systematic way
CO4	Gain knowledge about various plants and plant products
CO5	Understand the role of plants in human welfare
CO6	Know about field exploration and plant specimen handling in botanical studies

Module 1: Floral Morphology

6 hrs

- Ovary position and types of flowers: Superior, Inferior and Half-inferior; Hypogyny, Perigyny, Epigyny, Epihypogynous and Epiperigynous
- Floral symmetry- Actinomorphic, Biradial, Zygomorphic and Asymmetric.
- Aestivation types- Imbricate, Twisted, Valvate, Imbricate-alternate, Quincuncial and Involute.
- Placentation types- Axile, Apical, Apical-axile, Basal, Basal-axile, Marginal, Free-central, Laminal, Parietal, Parietal-axile and Parietal-septate.
- Floral Diagram and Floral Formula.

Module 2: Systematic Botany

8 hrs

- Types of Classification- Artificial System- Linnaeus System, Natural system- Bentham and Hooker's System, and Phylogenetic System-APG (Brief account).
- Binomial Nomenclature, ICN and its Principles
- Cytotaxonomy, Chemotaxonomy and Molecular Systematics
- Herbarium technique- steps involved in the preparation of herbarium and its significance.
- Brief study on Flora, Revision and Monographs.

Module 3: Angiosperm Families

30 hrs

Study the following families of Bentham and Hooker's System with special reference to their morphological and floral characters. Special attention should be given to common and economically important plants (Binomial, family and Morphology of useful parts) within the families.

- | | | | |
|-------------------|----------------------|------------------------|----------------------|
| (1) Annonaceae, | (2) Capparidaceae, | (3) Malvaceae, | (4) Rutaceae, |
| (5) Fabaceae, | (6) Caesalpiniaceae, | (7) Mimosaceae | (8) Combretaceae, |
| (9) Myrtaceae, | (10) Cucurbitaceae, | (11) Apiaceae, | (12) Rubiaceae, |
| (13) Asteraceae, | (14) Sapotaceae, | (15) Apocynaceae, | (16) Asclepiadaceae, |
| (17) Solanaceae, | (18) Convolvulaceae, | (19) Scrophulariaceae, | (20) Acanthaceae, |
| (21) Verbenaceae, | (22) Lamiaceae, | (23) Euphorbiaceae, | (24) Orchidaceae, |
| (25) Arecaceae, | (26) Poaceae. | | |

Module 4: Economic Botany

7 hrs

Study of the following groups of plants based on their uses with special reference to the botanical name, family and morphology of the useful part

- | | |
|--------------------------------|--|
| a) Cereals | - Rice, Wheat |
| b) Millets | - Ragi |
| c) Pulses | - Green gram, Bengal gram, Black gram |
| d) Sugar yielding plants | - Sugarcane |
| e) Fruits | - Apple, Pineapple, Orange, Mango and Banana |
| f) Vegetables | - Bitter Gourd, Ladies finger, Carrot and Cabbage. |
| g) Timber yielding plants | - Teak wood and Jack wood |
| h) Beverages | - Tea, Coffee |
| i) Fibre yielding plants | - Coir, Jute, Cotton |
| j) Oil yielding plants | - Ground nut, Gingelly |
| k) Rubber yielding plants | - Para rubber |
| l) Gums and Resins | - White damer, Gum Arabic, Asafoetida |
| m) Spices | - Cardamom, Pepper, Cloves , Ginger |
| n) Insecticide yielding Plants | - Tobacco and Neem |

Module 5: Ethnobotany

3 hrs

Study of the following plants used in daily life by ethnic people and village folks for food, shelter and medicine.

- | | |
|--------------|--|
| a) Food- | <i>Artocarpus, Corypha, Phoenix</i> (wild dates) |
| b) Shelter- | <i>Bambusa, Ochlandra and Calamus</i> |
| c) Medicine- | <i>Curcuma, Trichopus zeylanicus and Alpinia galanga</i> |

Practical

45 hrs

1. Identification of aestivation and placentation types.
2. Identify the families mentioned in the syllabus by noting their key, vegetative and floral characters. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.
3. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
4. Identify and describe the ethnobotanical uses of the items mentioned in the syllabus.
5. Prepare and submit herbarium of 25 plants with duly certified field book.
6. Conduct field work for a minimum of 5 days under the guidance of a teacher

Suggested additional topics

1. Interdisciplinary approach in Taxonomy, Molecular taxonomy, Numerical taxonomy, Barcoding for species identification and Taxonomy for biodiversity characterization.
2. Binomial nomenclature- Historical account, ICBN, Principles and major rules in – Type concept, priority, valid publication, author citation.

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Semester V
Course 6

19U5CRBOT6 ENVIRONMENTAL SCIENCE AND ECOTOURISM
(Theory: 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Know about the significance of environmental science
CO2	Create responsible citizens on conservation of nature and natural resources
CO3	Design novel mechanism for the sustainable utilization of natural resources
CO4	Understand the ecological interactions in various ecosystems
CO5	Understand various environmental laws in India
CO6	Understand the current environmental issues and its global impacts
CO7	Analyze various ecosystems for its impact in human life

ENVIRONMENTAL SCIENCE **48 hrs**

Module 1 Environmental science and its multidisciplinary nature **1 hr**
Introduction, relevance and scope, public awareness

Module 2 Natural Resources **2 hrs**
Types of resources - renewable and non-renewable
Types based on utility -Forest resources, Water resources, Food resources, Energy resources, Land resources
Conservation of Biodiversity, ecological footprints, umbrella species and keystone species conservation.

Module 3 Ecosystems **10 hrs**
Structure and function of ecosystem: Ecosystem components- abiotic and biotic, Productivity – primary and secondary-gross and net productivity. Decomposition in nature, homeostasis in ecosystem
Ecological energetics: energy flow, trophic levels, food chain and food web, ecological pyramids
Nutrient cycles: Biogeochemical cycles of C, N and S.

Module 4 Community ecology **4 hrs**
 Population: size, density, natality, mortality.
 Community characteristics: Species diversity and species richness, dominance, growth forms and structure, trophic structure.
 Association of communities: plant association, ecotypes, ecotone, edge effect, ecological indicators.
 Ecological succession: types of succession, process – migration, ecesis, colonization, stabilization and climax community; hydrosere, xerosere, lithosere.

Module 5 Plants and environment **4 hrs**
 Ecological complexes and factors affecting plants growth and response:
 Climatic factors: temperature and pressure; water - precipitation, humidity, soil water holding capacity; light - global radiation.
 Topographic factors: altitude and aspects
 Edaphic factors - profile and physical and chemical properties of soil
 Biotic factors: interactions – positive and negative.
 Species – ecosystem interaction: Habitat, ecological niche, microclimate
 Adaptation of plants to environment: To Water- Xerophytes, Hydrophytes; Temperature – thermo periodicity, vernalization; light – photoperiodism, heliophytes, sciophytes; salinity – halophytes, mangroves.

Module 6 Environmental pollution and Management **12 hrs**
 Definition and general introduction
Air pollution: Causes and sources, types of pollutants-particulates-aerosol, mist, dust, smoke, fume, plume, fog, smog. Effect of air pollution on plants and animals, Bhopal Gas Tragedy.
Water pollution: Sources and types of pollutants. Water quality standards, water quality assessment. Ground water pollution-blue baby syndrome. Cycling of heavy metals, hydrocarbons. Eutrophication, BOD, Minamata disease.
Soil pollution: Causes and sources-waste dumps, municipal wastes, agrochemicals, mining, solid waste management-vermi composting.
Noise pollution: Sources, standards and measurements, effect on health, control techniques.
Thermal pollution: Sources and effects, management
Nuclear hazards: Sources and impacts, management, Chernobyl incident
EIA: Environmental Impact Assessment in polluted areas

Module 7 Social issues and the environment **2 hrs**
 Climate change, global warming and greenhouse gases, IPCC, Acid rain, Ozone layer depletion, nuclear accidents and nuclear holocaust.
 Significance of EIA (Environmental Impact Assessment)

Module 8 Environmental legislation and laws **1 hr**
 Environment (protection) Act, 1986, (2) Air (Prevention and control of pollution) Act, 1981, (3) Water (Prevention and control of pollution) Act, 1974, (4) Wildlife (protection) Act, 1972, (5) Forest (Conservation) Act, 1980, (6) Biological Diversity Act (2002) (briefly).

Module 9 Biodiversity and Conservation biology **6 hrs**
 Biodiversity – definition; Endemism: Definition-types-factors. Hotspot of endemism-hotspots in India. IUCN-threat categories, RET. Red Data Book, Western Ghats as the hottest spot and its conservations.
 Biodiversity loss: Causes and rate of biodiversity loss, extinction-causes. Alien species, negative and positive impacts
 Conservation efforts: Rio Earth Summit, Agenda 21, Kyoto protocol, COP 15(15th Conference of the Parties under the U N Framework Convention on Climate Change), IPCC (Inter

Governmental Panel for Climate Change) and its contribution. Conservation strategies and efforts in India and Kerala, *In situ* and *ex situ* conservation methods. Applications of remote sensing and GIS (brief account). Role of NGOs in biological conservation

Module 10 Organizations, movements and contributors of Ecological studies **2 hrs**

Organizations: BNHS, WWF, CSE, NEERI, MoEF, Green Peace, Chipko

Famous contributors of Ecology in India: Salim Ali, M.S. Swaminathan, Madhav Gadgil, M.C. Mehta, Anil Agarwal, Medha Patkar, John C. Jacob, Sunderlal Bahuguna.

Module 11 Environment and human rights **4 hrs**

Environment and human rights: right to clean environment and public safety; issues of industrial pollution; Conservation of natural resources and human rights (briefly). Conservation issues of the Western Ghats – Madhav Gadgil committee report (brief study only).

ECOTOURISM **6 hrs**

Definition, concept, introduction, history, relevance and scope. Components of ecotourism. Forms and types of ecotourism in India and Kerala, ecotourism resources- biological, historical, cultural, and geographical. Ecotourism centers in Kerala. Positive and negative impacts of ecotourism.

Practical **45 hrs**

1. Estimation of CO₂, Cl₂, and salinity of water samples (Titremetry)
2. Determination of pH of soil and water
3. Assessment of diversity, abundance, and frequency of plant species by quadrat method (Grasslands, forests)
4. Study of the most probable number (MPN) of coliform bacteria in water samples
5. EIA studies in degraded areas (Sampling – line transect, Quadrat)
6. Visit to any forests types including grasslands and preparation of the list of Rare and threatened (R&T) plants (no collection of specimens)
7. Collection, identification and preparation of the list of exotic species in the locality.
8. Identification of pollutant to respective pollution types.
9. Study of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic, Halophytic).
10. Collection and recording of rain data by using simple rain gauge.

Additional Credits: Virtual Lab Experiments

1. Biological Oxygen Demand
2. Chemical Oxygen Demand of waste water
3. Case studies on Ecology

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Semester V

Course 7

19U5CRBOT7 GENETICS AND PLANT BREEDING

(Theory 54 hours; Practical 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the science of plant breeding and genetics
CO2	Understand the branch of plant breeding for the survival and success of human civilizations
CO3	Understand the techniques for the production of new superior crop varieties
CO4	Understand the modern strategies applied in genetics and plant breeding for human welfare
CO5	Understand the inheritance and variation of genetic characters
CO6	Understand the background of genetic disorders
CO7	Analyze and predict the occurrence of genetic traits and its impact in human life

GENETICS (Theory 40 hrs)

Module 1: Origin and development of Genetics

3 hrs

Genetics as a science: origin - experiments of Mendel with *Pisum sativum*, general terminology used in genetics. Principles of inheritance, Mendelian laws - monohybrid and dihybrid cross, test cross and backcross.

Module 2: Exceptions to Mendelism

15 hrs

Modification of Mendelian ratios: incomplete dominance - *Mirabilis*; Co-dominance - MN blood group in man; Lethal genes – pigmentation in Snapdragon.
Geneic interaction: Epistasis, (a) Dominant Epistasis - fruit colour in summer squashes (b) Recessive Epistasis - coat colour in mice; Complementary genes - flower colour in sweet pea. Non-epistasis - comb pattern in Fowls. Multiple alleles – ABO blood groups in man; self sterility in *Nicotiana*.

Module 3: Linkage of genes

5 hrs

Linkage and crossing over: chromosome theory of linkage; crossing over - types of crossing over, mechanism of crossing over. Linkage map - 2 point cross, interference and coincidence.

Module 4: Determination of sex **7 hrs**
 Sex determination: sex chromosomes and autosomes; chromosomal basis of sex determination; XX-XY, XX-XO mechanism; sex determination in higher plants (*Melandrium album*). Sex linked inheritance: X-linked - Morgan's experiment e.g. eye colour in *Drosophila*, Haemophilia in man; Y-linked inheritance; sex limited and sex influenced inheritance. Pedigree analysis.

Module 5: Quantitative inheritance **3 hrs**
 Quantitative characters: polygenic inheritance, continuous variation - kernel color in wheat, ear size in maize.

Module 6: Extra-chromosomal inheritance **5 hrs**
 Extra chromosomal inheritance: chloroplast mutation - variegation in 4O'clock plant; mitochondrial mutations in yeast. Maternal effects - Streptomycin resistance in *Chlamydomonas*; infective heredity - kappa particles in *Paramecium*.

Module 7: Population genetics **2 hrs**
 Concept of population, gene pool, Hardy-Weinberg principle (brief).

Practical **36 hrs**

a. Students are expected to work out and record the problems in:

1. Monohybrid, dihybrid cross and back crosses.
2. All types of modified Mendelian ratios mentioned in the syllabus.

b. Study of human karyotype and study of characteristic karyotypes and symptoms of the syndromes mentioned in the syllabus and record it.

PLANT BREEDING (Theory: 18 hours)

Module 1 **1 hour**
 An Introduction to and objectives of plant breeding.

Module 2 **1 hr**
 Plant introduction- procedure of plant introduction, quarantine regulations, acclimatization-agencies of plant introduction in India, major achievements.

Module 3 **2 hrs**
 Selection- mass, pure-line, clonal- genetic basis of selection- some achievements – semi dwarf wheat and Rice.

Module 4 **5 hrs**
 Hybridization- Introduction, history, objectives and procedure- choice of parents, evaluation of parents, emasculation procedures such as hand method, succession method, hot water method, alcohol method and cold treatment methods- intergeneric, interspecific and intervarietal hybridization with examples- composite and synthetic varieties- heterosis in plant breeding, inbreeding depression; genetics of heterosis and inbreeding depression; single cross, pedigree method, bulk population method, multiple cross, back cross, male sterility in plant breeding. Use of apomixis in plant breeding.

Module 5 **2 hrs**
Mutation breeding and polyploidy breeding - methods- achievements in India; breeding for pest, disease and stress resistance

Module 6 **2 hrs**
Modern tools for plant breeding; Genetic Engineering and products of genetically modified crops. Certification process for plant breeders; process, agencies and their significances

Practical **9 hrs**

1. Emasculation and bagging
2. Comparison of percentage of seed germination and the effect of any one chemical on the rate of elongation of radicle in any three crop seeds

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Semester V

Course 8

19U5CRBOT8 CELL MOLECULAR BIOLOGY AND EVOLUTION

(Theory: 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

	COURSE OUTCOMES (COs)
CO1	Understand the molecular biology of a cell and its implications
CO2	Differentiate the ultrastructure of prokaryotic and a eukaryotic cell
CO3	Understand the chromosomes and the aberrations in its number and structure
CO4	Understand the stages of cell cycle and carry out mitosis and meiosis
CO5	Understand the genetic variation due to mutation and its significance
CO6	Understand the molecular structure of nucleic acids
CO7	Know about the gene expression and its control
CO8	Know the genetic basis of cancer
CO9	Understand the concept of evolution as the basis of biodiversity

CELL BIOLOGY (Theory: 28 hrs)

Unit 1. Historical account of cell Biology, Cell theory, Protoplasm theory **1 hr**

Unit 2. Cell **8 hrs**

The physio-chemical nature of plasma membrane and cytoplasm Eukaryotic, Prokaryotic cell. The ultra structure of plant cell with brief description and function of the following organelles- Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosome, Microbodies, lysosomes. Vacuole and cell sap, Nucleus - ultra structure, nucleolus structure and function.

Unit 3. Chromosomes **15 hrs**

Morphology - fine structure Dupraw model - Nucleosome model – chemical organization of nucleosome – nucleoproteins, karyotype and idiogram; Special type of chromosomes - salivary gland, Lampbrush and B chromosome. Cell cycle, mitosis, meiosis: significance of mitosis and meiosis. Change in number of chromosomes -Aneuploidy and Euploidy
Change in the structure of chromosomes - Chromosomal aberrations deletion, duplication, inversions and translocations. Meiotic behaviour of chromosomes. Lagging of chromosomes and Chromosome Bridge

Unit 4. Mutations **2 hrs**

Spontaneous and induced. Mutagens- Physical and Chemical mutagens.
Chromosomal and point mutations. Molecular mechanism of mutation - Transition, Transvesion and Substitution.

Unit 5. Stem cells; definition, sources and applications. **2 hrs**

MOLECULAR BIOLOGY (Theory: 17 hrs)

Unit1. Nucleic acids - structure of DNA and RNA - basic features, alternate forms of DNA - types and structure of RNA **3 hrs**

Unit2. Replication of DNA - Meselson-Stahl experiment - details of semiconservative replication of DNA **3 hrs**

Unit3. Gene expression - concept of gene, definitions - the central dogma - details of transcription in procaryotes and eucaryotes - RNA processing.details of translation - genetic cod features **6 hrs**

Unit4. Control of gene expression - positive and negative control - operon model - lac operon, trp operon -attenuation **3 hrs**

Unit5. Genetic basis of cancer - oncogenes - tumor suppressor genes - metastasis **2 hrs**

Practical

Problems based on DNA, RNA and Proteins **9 hrs**

EVOLUTION (Theory: 9 hrs)

Unit 1. Introduction, Origin of life – biochemical origina of life, Progressive, Retrogressive, Parallel and Convergent evolution. Theories of evolution - Lamark’s, Darwin’s, Weisman’s and De Vries. **4 hrs**

Unit 2 Neo Darwinism **5 hrs**
Reproductive isolation, Mutation, Genetic drift, Speciation. Variation and evolution, hybridization and evolution, Polyploidy and evolution. Mutation and evolution.

Practical (36 hrs)

1. Make acetocarmine squash preparation of onion root tip to identify mitotic stages.
2. Study the Mitotic Index of onion root tip cells
3. Study of meioses in any flower bud by smear preparation of PMC’s

4. Identification of Barr body
5. Identification of salivary gland chromosome.
6. Identify and study photographs and diagrams of cell division anomalies like lagging chromosomes, chromosome bridge, aneuploidy, polyploidy. Study the chromosomal patterns/ Karyotype in auto-, allo-, and aneuploids

Additional Credits: Virtual Lab Experiments

1. Lignin staining
2. Preparation of Buffer Stocks
3. Plasmid isolation

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Semester V
Open Course
BO5D01U AGRIBASED MICROENTERPRISES
(72 Hours) Theory Credits 3

COURSE OUTCOMES (COs)	
CO1	Know the plausibleness of entrepreneurial aspects in plant science
CO2	Know about the basics of organic farming in agriculture
CO3	Compare sustainable agricultural practices
CO4	Know the importance of floriculture and cut flower industry
CO5	Understand the nursery management and it's industrial significance
CO6	Design the mushroom cultivation techniques
CO7	Understand the basics of plant tissue culture

Module 1 Organic Farming and Composting Techniques**9 hrs**

Organic manures and fertilizers. Composition of fertilizers – NPK content of various fertilizers. Common organic manures – bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost – aerobic and anaerobic- advantages of both; vermicompost – preparation, vermiwash. Biofertilizers – definition, types – *Trichoderma*, *Rhizobium*, PGPR. Biopesticides – Tobacco and Neem decoction. Biological control. Sustainable agriculture.

Module 2 Horticulture and Nursery management**20 hrs**

Soil components. Preparation of potting mixture. Common Garden tools and implements. Methods of plant propagation – by seeds – advantages and disadvantages. Vegetative propagation – advantages and disadvantages. Natural methods of vegetative propagation. Artificial methods – cutting, grafting, budding and layering. Use of growth regulators for rooting. Micropropagation by tissue culture. Gardening – Types of garden – ornamental, indoor garden, kitchen garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing – garden components – flower beds, borders, hedges, edges, drives and paths, garden adornments. Lawn - preparation by seeds, by transplanting seedling and by turfing. Bonsai preparation. Pruning of plants. Types of Nurseries – Management aspects and Maintenance. Irrigation Methods: surface, drip and mist chamber. Plant growth structures – advantages of green house, polyshed, fernery and orchidarium. Packaging of fruits, vegetables, nursery products and flowers.

Module 3 Floriculture and Flower Arrangement**7 hrs**

Prospects and problems of floriculture in Kerala, Scope of floriculture, especially anthurium, orchids and jasmine in Kerala, Common cut flowers- Rose, Gerbera, Gladiolus, Aster,

Chrysanthemum, Carnation, Anthurium, Liliium, Orchids; Common leaves in flower arrangement – Cyprus, Podocarpus, Asparagus, palms, cycads, ferns; Flower arrangement types – western, eastern (Japanese), modern, wases, flower holders, floral foam, dry flower arrangement.

Module 4 Mushroom Cultivation and Spawn Production **9 hrs**

Significance of Mushrooms, General outline of life cycle. Types of mushrooms - button mushroom, oyster mushroom and milky mushroom, poisonous mushroom – methods of identification. Spawn – isolation and preparation. Cultivation of oyster and milky mushrooms – using paddy straw and saw dust by polybag. Farm design and control of pests and diseases. Value added products from mushroom – pickles, candies, dried mushrooms.

Module 5 Plant Tissue Culture and Micropropagation **9 hrs**

Protoplasm - basic structure of plant cell; Concept of totipotency - differentiation and dedifferentiation. Infra-structure of a tissue culture laboratory. Solid and liquid media-composition. Sterilization - dry, wet and filter sterilization. Explant- inoculation and incubation techniques. Callus induction- organogenesis and embryogenesis. Transplanting, hardening, package and transportation of tissue cultured plantlets.

Module 6 Self Employment Opportunities **3 hrs**

Funding Agencies and self-employment schemes, Procedure to get financial support, special scheme for women empowerment.

Hands on Training **15 hrs**

1. Prepare a chart showing the NPK composition of minimum 6 manures and fertilizers.
2. Identification and familiarization of the following organic manures- cow dung (Dry), Coconut cake, Vermicompost, neem cake, Organic mixture, Bone meal.
3. Preparation of potting mixture.
4. Make a Vermicompost pit /pot in the campus/ house of the student.
5. Familiarization of common garden tools and implements.
6. Estimation of germination percentage of seeds
7. Demonstrate the effect of a rooting hormone on stem cutting.
8. Demonstration of T budding, epicotyle grafting and air layering on live plants
9. Familiarization of garden components from photographs
10. Familiarization of different mushrooms and preparation of a polybag of *Pleurotus* using straw/sawdust
11. Visit to a well established tissue culture lab, nursery and mushroom cultivation unit.
12. Familiarization of common cut flowers in Kerala
13. Fresh cut flower arrangement
14. Preparation and arrangement of dry flowers
15. Interaction with funding agencies

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Semester VI**Course 9****19U6CRBOT9 PLANT PHYSIOLOGY AND BIOCHEMISTRY****(Theory 54: hours; Practical: 45 hours) (Theory Credit 2, Practical Credit 2)**

	COURSE OUTCOMES (COs)
CO1	Understand the relationship of plant with its habitat
CO2	Differentiate mineral nutrition and mechanism of absorption
CO3	Understand the mechanism of photosynthesis
CO4	Know the transport mechanism happening in plant system
CO5	Understand the respiration mechanism in plants
CO6	Know the plant responses to environment
CO7	Understand the physiology of growth and development in plants
CO8	Understand the biochemical nature of plant cell
CO9	Know the chemical nature of biomolecules
CO10	Understand the general features of enzymes
CO11	Identify the osmotic pressure, stomatal index, and pigment variations in plant system

PLANT PHYSIOLOGY (Theory: 36 hours; Practical: 33 hours)**Module 1 Water relations****6 hrs**

A. Physical aspects of absorption-Diffusion, imbibition, osmosis, OP, DPD, TP, WP, Concept of Water potential- osmotic/solute potential, gravity potential, matric potential, pressure potential.

B. Absorption of water-active & passive, radial pathway of water movement – apoplastic, symplastic & transmembrane pathway, Ascent of sap-cohesion tension theory, Transpiration-types-mechanism-theories- (starch-sugar inter conversion hypothesis, Active K⁺ ion exchange)-significance – anti-transpirants, Guttation.

Module 2 Mineral Nutrition and mechanism of absorption**3 hrs**

Essential and non essential elements- macro& micro- role- deficiency symptoms. Absorption of minerals– active & passive- carrier concept, ion exchange.

Module 3 Photosynthesis**10 hrs**

History – PAR, Photosynthetic pigments, photo excitation- Fluorescence, Phosphorescence - Absorption and action spectra, Red drop and Emerson enhancement effect, Concept of photo

systems, Cyclic & Non Cyclic photophosphorylation, Carbon assimilation pathways-C₃, C₄, CAM- Photorespiration –factors affecting photosynthesis- Blackmann’s law of limiting factors.

Module 4 Translocation of solutes **2 hrs**

Pathway-phloem transport-mechanism-pressure flow-phloem loading and unloading.

Module 5 Respiration **8 hrs**

Aerobic and Anaerobic, Glycolysis, Krebs cycle, Electron transport system & Oxidative phosphorylation. ATPases - chemi osmotic hypothesis-RQ –significance-factors affecting respiration.

Module 6 Plant responses to environment **1 hr**

Allelochemicals- herbivory

Module 7 Physiology of growth and development **4 hrs**

A. Physiological effects and practical applications of hormones- Auxins, Giberillins, Cytokinins, ABA, ethylene.

B. Physiology of flowering–phytochrome-photoperiodism-vernalization

Module 8 Stress physiology **2 hrs**

Abiotic - concept of plant responses to water, salt and temperature stresses; Biotic- pathogens

Practical **(33 hours)**

Core Experiments

1. Determination of osmotic pressure of plant cell sap by plasmolytic method.
2. Compare the stomatal indices of hydrophytes, xerophytes and mesophytes.
3. Separation of plant pigments by thin layer chromatography (TLC) and paper chromatography.
4. Measurement of photosynthesis by Willmott’s bubbler/ Hydrilla plant experiment/ any suitable method.
5. Estimation of plant pigments by colorimeter.

Practical Experiments –Only demonstration.

1. Papaya petiole osmoscope.
2. Demonstration of tissue tension.
3. Relation between transpiration and absorption.
4. Necessity of chlorophyll, light and CO₂ in photosynthesis.
5. Simple respiroscope
6. Respirometer and measurement of R.Q.
7. Fermentation.
8. Measurement of transpiration rate using Ganong’s photometer/ Farmer’s Potometer.

BIOCHEMISTRY (Theory 18: hours; Practical: 12 hours)

Module 1 Water, Solutions & pH **2 hrs**

Physical and chemical properties of water, Acid and bases, pH definition, significance, measurement, pH indicators, buffer action, pH and lif .

Module 2 Chemistry of biological molecules

10 hrs

Carbohydrates- structure and role of mono-di & poly-saccharides-common sugars seen in plants
Proteins-peptide bond-essential and non-essential amino acids- structural levels of proteins - primary, secondary, tertiary and quaternary-physiologically important proteins. Lipids - general features and their roles - fatty acid types and structure - fatty acid derivatives- fats and oils, structure and functions - compound lipids

Module 3 Enzymes

6 hrs

Nomenclature, characteristics mechanism and regulation of enzyme action, enzyme kinetics, factors affecting enzyme action.

Practical

(12 hours)

1. General test for carbohydrates- Molisch's test, Benedict's tests, Fehling's test.
2. Colour test for starch – Iodine test.
3. Colour tests for proteins in solution. Biuret test, Million's test, Ninhydrin test.
4. Detect the presence of any three major organic compounds in the given food stuff/material viz. reducing /non-reducing sugar/fat proteins/starch/sucrose.
5. Action of various enzymes in plant tissues: peroxidases, dehydrogenase.
6. Estimation of protein using colorimeter.

Additional Credits: Virtual Lab Experiments

1. Isolation of plant pigments by column chromatography
2. Construction of protein standard curve using Folin's Lowry method
3. Effect of substrate concentration on enzyme kinetics

Suggested additional topics

1. Mycorrhizae
2. Chelating agents
3. Photosynthetic rates, efficiencies and crop production.
4. Pentose phosphate pathway.
5. Nitrogen fixation.
6. Plant protective coats –cutins, waxes and suberin.
7. Senescence and abscission.
8. Circadian rhythms.

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Semester VI

Course 10

19U6CRBOT10 PERSPECTIVES OF SCIENCE, METHODOLOGY AND GENERAL INFORMATICS

(Theory 54 hours, Practical 36 hours)

(Theory Credit 3, Practical credit 1)

COURSE OUTCOMES (COs)	
CO1	Introduce the perspective of science
CO2	Understands the steps in scientific methods
CO3	Understand the steps in research methodology in plant science
CO4	Understand the uses and applications of general informatics
CO5	Understand the basis of computer in education
CO6	Understand and perform chromatography and other techniques in botany
CO7	Understand the statistical terms and its relevance in plant science

PERSPECTIVES OF SCIENCE (Theory 12 hours; Practical 4 hours)

Module 1 Introduction to science and scientific methods

4 hrs

- Introduction to science
- Steps in scientific methods
 - observation and thoughts
 - formulation of a hypothesis
 - designing of experiments
 - testing of hypothesis
 - formulation of theories

Module 2 Experimentation in science

8 hrs

- Selection of a problem
- Searching the literature
- Selection of variables, study area, and a suitable design
- Necessity of units and dimensions
 - Units of length, volume, area, concentration, temperature, pressure
- Setting of hypothesis, Null- hypothesis and alternative hypothesis
- Need of control, treatments and replication
- Analysis, presentation and interpretation of data

- Testing of hypothesis, need of statistical tools
- Examples of great experiments in life sciences
 - An example of moving from a question to hypothesis and then to an experimental design
 - Contributions and the great experiments of Louis Pasteur, and Robert Koch
- Ethics in science

Practical

4 hrs

1. Prepare $\text{CuSO}_4 \cdot \text{H}_2\text{O}$ solution of different molarity using a stock solution
2. Determination of the area of different types of leaves using graph paper.

METHODOLOGIES OF PLANT SCIENCE (Theory 24 hours, Practical 18 hours)

Module 1 Biophysics

8 hrs

- Principles and applications of colorimeter, spectrophotometer and centrifuge, Beer-Lambert's Law,
- Separation methods :- chromatography; thin layer, paper, column (principle and applications only), electrophoresis; PAGE, Agarose gel electrophoresis (Principle and applications only)
- pH:- concept of pH, methods to measure pH ; pH paper and pH meter,
- Buffers:- definition, functions of buffers in biological systems, use of buffers in biological research, examples of commonly used buffers

Practical

10 hrs

1. Preparation of 0.1M sodium phosphate buffer (pH 6 and 7)
2. Measurement of pH using pH meter
3. Paper chromatography of plant pigments (demonstration)
4. Electrophoresis of nucleic acids (demonstration)
5. Column chromatography of plant pigments (demonstration)
6. Determination of the concentration of a given solution of CuSO_4 using colorimetry

Additional Credits: Vitual Lab

1. Western Blotting
2. Haemocytometer
3. PAGE

Module 2 Biostatistics

12 hrs

- Introduction, statistical terms and symbols
- Sample:- concept of sample, sampling methods,
- Collection and representation of data, graphic representation of data(Line graph, bar diagram, Pie diagram & Histogram)
- Measures of central tendency:- mean, mode, median
- Measures of dispersion:- standard deviation, standard error
- Distribution patterns:- normal distribution, binomial distribution
- t-test :- introduction, uses, procedure
- chi-square test:- introduction, uses, procedure

Practical **8 hrs**

Collect numerical data and find out the central tendencies and prepare different types of graph mentioned in the syllabus

1. Familiarize with situations requiring t-test, chi-square test

Module 4 Research Methodology **5 hrs**

- Need for research
- Types of research
- Scientific literature, Books, Research Journals, Reputed National and International journals in life sciences, Research paper
- INSDOC services
- Laboratory Etiquette
- Laboratory Hygiene
-

GENERAL INFORMATICS (Theory 18 hours, Practical 12 hours)

Module 1 Overview of the Information Technology **3 hrs**

- Features of the modern personal computers and peripherals.
- Internet as a knowledge repository, e-mail, search engines (Google,), study of educational sites related to life sciences (DNAi, Scitable), academic search techniques, (Science direct and INFLIBNET)
- Introduction to the use of information technology in teaching and learning.

Module 2. Use of Computers **15 hrs**

- DOS – The basic concept of operating systems (Study of commands not required)
- MS-WINDOWS:- logging to windows, organizing files and folders, copying, moving, deleting and saving documents, installing software, installing hardware
- MS-WORD:- word processing using WORD, editing tools (cut , copy, paste,) formatting tools (font, paragraph) use of spell check, inserting tables (draw), inserting graphs and pictures
- MS-EXCEL:- Creating a worksheet, data entry, sorting (ascending and descending), use of statistical tools in EXCEL (SUM, MEAN, MODE, MEDIAN), preparation of graphs (bar diagram, pie chart and line graph)
- MS-POWERPOINT:- Creating a presentation, Inserting tables, charts and pictures into slides, Use of animation tools

Practical **12 hrs**

1. Gather information and pictures on a given topic using the internet. Make a list of the sites visited for the purpose
2. Prepare a project report using MS-WORD based on the information and pictures gathered from the internet.
3. Prepare a worksheet using a set of data collected and find out the SUM, MEAN, MEDIAN and MODE using EXCEL
4. Prepare suitable tables/ charts/graphs based on the data using EXCEL
5. Prepare a powerpoint presentation based on the 1 & 2 exercises

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Semester VI

Course 11

19U6CRBOT11 BIOTECHNOLOGY AND BIOINFORMATICS (Theory 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Know about all the basic aspects of plant tissue culture
CO2	Understands the fundamentals of recombinant DNA technology, gene cloning strategies
CO3	Know the social and ethical issues in the field of biotechnology
CO4	Understand the scope and relevance of genome, transcriptome and proteome
CO5	Check the usefulness of biological databases
CO6	Understand the genome sequencing and sequence assembly
CO7	Know about the protein sequencing method and basics of protein structure prediction and modeling
CO8	Know the molecular phylogeny and phylogenetic trees
CO9	Outline the molecular visualization tool in proteomics

BIOTECHNOLOGY (Theory 36 hours; Practical 32 hours)

Module 1: Plant tissue culture

20 hrs

1. Introduction: Definition of biotechnology, land marks, definition of tissue culture.
2. Principles of tissue culture: Cellular totipotency, callus induction, organogenesis and somatic embryogenesis.
3. Tissue culture medium: Basic components in tissue culture medium, MS medium, Preparation medium
4. Aseptic techniques in tissue culture: sterilization of instruments and glass wares, medium, explants; working principle of laminar air flow and autoclave.
5. Micropropagation: definition, different stages of micropropagation, advantages and disadvantages.
6. Somaclonal variation: Reasons, advantages and disadvantages, applications
7. Applications of tissue culture: Shoot tip and meristem culture, Synthetic seed production, embryo rescue culture, Protoplast culture, Somatic cell hybridization, *in vitro* secondary metabolite production, *in vitro* production of haploids – androgenesis and gynogenesis, triploid plant production, Cryopreservation.

- Module 2** **8 hrs**
1. Recombinant DNA Technology
 2. Gene cloning strategies – recombinant DNA construction – cloning vectors – plasmids pBR322, bacteriophage based vectors, Ti plasmids. Restriction endonucleases and ligases – Ligation techniques, transformation and selection of transformants – using antibiotic resistances markers, southern blotting; PCR.
 3. Different methods of gene transfer – chemically stimulated DNA uptake by protoplast, transduction, electroporation, microinjection, microprojectiles, *Agrobacterium* mediated gene transfer gene library, gene banks.

- Module 3** **6 hrs**
1. Important achievements in Biotechnology:
 2. Production of human insulin, Bt Brinjal and Bt cotton, Golden rice, Flavr Savr tomato, Shikonin pigments
 3. Current trends in Biotechnology:
 4. Tissue Engineering, Stem cell culture, Nanobiotechnology
 5. Strategic Applications of Biotechnology:
 6. Production of disease/ stress resistant plants, Gene therapy, DNA fingerprinting

- Module 4** **2 hrs**
- Social and ethical issues, biosafety, biowar, patenting and IPR issues.

- Practical** **32 hrs**
1. Preparation of nutrient medium – Murashige and Skoog medium, sterilization, preparation of explants, inoculation.
 2. Extraction of DNA from plant tissue.
 3. Immobilization of whole cells or tissues in sodium alginate.
 4. Determination of appropriate flower bud containing uninucleate pollen for anther culture using cytological techniques
 5. Study of genetic engineering tools and techniques using photographs/diagram (Southern blotting, DNA finger printing, PCR)
 6. Visit a well-equipped biotechnology lab and submit a report along with the practical record.

Additional Credits: Virtual Lab Experiments

1. PCR
2. Transformation of host cells
3. 16s RNA Sequencing

BIOINFORMATICS (Theory: 18 hours; Practical: 10 hours)

- Module 1** **7 hrs**
1. Introduction to Bioinformatics, scope and relevance, genome, transcriptome, proteome.
 2. Biological data bases –
Nucleotide sequence database – EMBL, Gen Bank, DDBJ.
Protein sequence database – PDB, SWISS PROT
Organismal database – *Saccharomyces* genome database
Biodiversity database – Species 2000

3. Information retrieval from Biological database, sequence alignment types and tools: pair wise sequence alignment multiple sequence alignment, use of BLAST, FASTA.

Module 2 **6 hrs**

1. Genomics : DNA sequencing Sangers procedure-automation of DNA sequencing, genome sequence assembly, Genome projects – Major findings of the following genome projects – Human, *Arabidopsis thaliana*, Rice, *Haemophilus influenza*, Application of genome projects.
2. Proteomics : Protein sequencing- Edman degradation method, automation of sequencing, protein structure prediction and modelling (Brief account only)

Module 3 **5 hrs**

A brief account on

1. Molecular phylogeny and phylogenetic trees.
2. Molecular visualization – use of Rasmol.
3. Molecular docking and computer aided drug design.

Practical **13 hrs**

1. Familiarizing with the different data bank mentioned in the syllabus.
2. Molecular visualization using Rasmol.
3. Blast search.

Additional Credits: Virtual Lab Experiments

1. Retrieving sequence data from Entrez
2. Pair wise alignment of data using FASTA
3. Visualizing secondary structure of a protein
4. Designing a primer

Suggested additional topics

Tissue culture and crop improvement, Genetic transformation and transgenics, Advances in crop biotechnology molecular markers-molecular biology tools in plant breeding, Gene and genome library, Terminator technology, Advances in microbial biotechnology, enzyme technology, Advances in animal biotechnology-stem cell research. Micro array Bioinformatics.

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Semester VI

Course 12

19U6CRBOT12 HORTICULTURE, NURSERY MANAGEMENT, EMBRYOLOGY AND REPRODUCTIVE BIOLOGY

(Theory 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the basics of horticulture and nursery management
CO2	Understand and execute propagation of horticultural plants
CO3	Understand to set a classical outdoor garden
CO4	Understand the structure and development of reproductive structures in Plant
CO5	Know about organic farming and composting techniques
CO6	Understand the aspects of organic manures and fertilizers
CO7	Understand the prospects and problems of floriculture
CO8	Awareness on self employment opportunities in horticulture

HORTICULTURE (Theory 14 hours; Practical 18 hours)

Module 1

2 hrs

Introduction to horticulture - definition, history, classification of horticultural plants, disciplines of horticulture; Garden tools and implements. Irrigation methods- surface, sub, drip and spray irrigations, mist chambers - advantages and disadvantages

Module 2

6 hrs

Propagation of horticultural plants- by seeds- Seed viability, seed dormancy, seed testing and certification, seed bed preparation, seedling transplanting, hardening of seedling; advantages and disadvantages of seed propagation. Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation.

Module 3

6 hrs

Gardening- ornamental gardens, indoor gardens, home gardens- terrestrial and aquatic gardens- garden adornments; garden designing- garden components- lawns, preparation of lawns by seeds, seedling, turfing. Shrubs and trees, borders, hedges, edges, walks, drives- famous gardens of India;

Landscape architecture- home landscape design, parks. Physical control of plant growth- training and pruning; repotting; disease and pest control selection of plant for bonsai, bonsai containers and method of bonsai formation; Orchid cultivation.

Practical **18 hrs**

1. Tongue grafting, budding ('T' and patch) and air layering
2. Identification of different garden tools and their uses
3. List out the garden components in the photograph of the garden given
4. Preparation of potting mixture in the given proportion.

REPRODUCTIVE BIOLOGY (Theory 20 hrs; Practical 12 hrs)

Module 1 Introduction **2 hrs**

General account and interdisciplinary relevance of embryology, embryology in relation to taxonomy; experimental embryology.

Module 2 **4 hrs**

Structure and development of anther, microsporogenesis, development of male gametophyte, anthesis and anther dehiscence, structure of pollen, pollen germination, pollen tube growth and pollen viability.

Module 3 **4 hrs**

Structure and development of ovule, megasporogenesis, embryosacs-monosporic (polygonum type), bisporic (Allium type) and tetrasporic (Peperomia type). Structure of mature embryo sac.

Module 4 **4 hrs**

Breeding/Reproductive systems and pollination syndromes (with examples for each syndrome) in angiosperms; pollen stigma interaction; self-compatibility and incompatibility; syngamy and fusion; apomixis.

Module 5 **3 hrs**

Development of endosperm and embryo in Dicots and Monocots; Poly-embryony; Development and general structure of fruits (dry and fleshy) and seed.

Module 6 **3 hrs**

Any Indian example from a reputed journal to study the pollination mechanisms and methods (eg. *Adathoda vasica*, *Strobilanthes kunthianus*)

Practical **12 hrs**

1. Identification of C.S. of anther, embryo sac and embryo.
2. Identification of various anther types-monothealous, dithealous
3. Identification of placentation types.
4. Observation of pollen and locating pollen pore
5. Pollen germination study

NURSERY MANAGEMENT (Theory 20 hours; Practical 15 hrs)**Module 1 Introduction 4 hrs**

Preparation of potting mixtures, polybags. Plant Growth structures – green houses, shaded houses, polyshed, mist chamber, sprinkling system, drip irrigation. Modern strategies in propagation by root initiation of cutting, layering technique, budding and grafting technique – Micropropagation; Planting, Transplanting and Hardening of seedlings, After care of seedlings. Packing and transporting of seedlings.

Module 2 Organic farming and Composting Techniques 6 hrs

Organic manures and fertilizers, Composition of fertilizers. NPK content of various fertilizers and preparation of fertilizer mixtures. Common organic manures – bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost – aerobic and anaerobic – advantages and limitations. Vermicompost – preparation - Vermiwash. – preparation. Biofertilizers – Definition and preparation of different types – Trichoderma, Rhizobium, PGPR, PSB, mycorrhiza. Application of Biofertilizers. Biopesticides – Tobacco and Neem decoction. Biological control of disease and pests.

Module 3 Cultivation of Vegetables, Fruits and Medicinal Plants 3 hrs

Types of Home gardening, Market gardening and Truck gardening. Packing and Transporting of Vegetables. Organic farming of fruit crops – Packing and Transporting of fruits. Induction of flowering and weed control. Cultivation of Medicinal and Aromatic plants of common use and great demand. Traditional production techniques and Post-harvest techniques.

Module 4 Floriculture and Flower arrangement 4 hrs

Problems and prospects of Floriculture in Kerala.
Scope of growing Anthurium, Orchids and Jasmine in Kerala.
Common cut flowers – Rose, Gerbera, Gladiolus, Aster, *Chrysanthemum*, Daisies, Carnation, Golden rod, Anthurium, Orchids, Liliium and Limolium.
Common leaves used in flower arrangement – *Cyprus*, *Podocarpus*, *Asparagus*, Palms, Cycads, Ferns and *Eucalyptus*.
Floral arrangement: Types - Western, Eastern (Japanese/ Ikebana) and Modern. Wases, Flower Holders and Floral Foam. Wase life of flowers and leaves. After care of flower arrangements – Bouquets. Packing and Maintenance of flowers and leaves.

Module 5 Self Employment Opportunities 3 hrs

Funding Agencies and self-employment schemes, Procedure to get financial support, special scheme for women empowerment.

Practical 15 hrs

1. Preparation of potting mixture
2. Preparation of Tobacco/ Neem decoction
3. Familiarization of common fertilizers and manures

4. Familiarization of common cut flowers and leaves used in flower arrangements
5. Different flower arrangement types (demonstration)

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Websites

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Semester VI

Core Course Choice Based

19U6CRBOT13 PHYTOCHEMISTRY AND PHARMACOGNOSY (54 Hours) Theory Credits 3

COURSE OUTCOMES (COs)	
CO1	Understand the morphological, organoleptic, microscopic approach to study drug and aromatic plants
CO2	Understand the extraction and characterization techniques in studying the secondary metabolites in plants
CO3	Identify the occurrence, structure, classification, functions and pharmacological uses of plant derived drugs
CO4	Identify the Phytochemical properties of common plant of Kerala
CO5	Understand the volatile oil extraction methods for aromatic plants
CO6	Know the methods in pharmacognosy
CO7	Understand the traditional plant medicines and its scope in modern drug discovery

Module 1 Introduction

2 hrs

Introduction to phytochemical approaches –morphological-organoleptic-microscopic- to study drug and aromatic plants

Module 2 Extraction and characterization techniques hrs

4

Cold extraction- hot extraction—soxhlet apparatus, cleverger apparatus; Solvents - petroleum ether, chloroform, ethanol, methanol, water. Separation technique-TLC, Column, HPLC. Characterization technique-GC/MS, HPTLC, UV Spectra, IR Spectra.

Module 3 Study of the drug plants and their active principles

10 hrs

- A. Alkaloids – introduction, properties, occurrence, structure, classification, functions, and pharmacological uses.
- B. Triterpenoids. Introduction, properties, occurrence, classification, functions and pharmacological uses.
- C. Phenolics. Quinines- benzoquinones, naphthoquinones, anthraquinone, and coumarins.

Module 4 Study of the following plants with special reference to 20 hrs

- (1) Habit, habitat and systematic position and morphology of the useful part.
- (2) Organoleptic, anatomical and chemical evaluation of the officinal part.
- (3) Phytochemistry and major pharmacological action of plant drugs.
- (4) Ayurvedic formulations using the plant

<i>Tinospora cordifolia,</i>	<i>Papaver somniferum,</i>	<i>Aegle marmelos ,</i>
<i>Punica granatum,</i>	<i>Plumbago rosea,</i>	<i>Adhatoda vasica,</i>
<i>Withania somnifera,</i>	<i>Achyranthes aspera,</i>	<i>Asparagus racemosus,</i>
<i>Kaempferia galanga,</i>	<i>Sida acuta,</i>	<i>Carica papaya,</i>
<i>Azadirachta indica,</i>	<i>Glycirrhiza glabra,</i>	<i>Phyllanthus neruri,</i>
<i>Datura stramonium,</i>	<i>Hemidesmus indicus,</i>	<i>Aloe veera,</i>
<i>Tylophora indica,</i>	<i>Acorus calamus.</i>	

Module 5 Study of the following aromatic plants - volatile oils and methods of extraction

10 hrs

Vetiveria zizanioides, Cinnamomum zeylanica, Syzygium aromaticum, Santalum album, Eucalyptus, Ocimum bacilicum, Rosa, Mentha piperita, Cymopogon, Cananga, Pelargonium.

Module 6 Pharmacognosy

4 hrs

Introduction, tools for identifying adulteration; methods in pharmacognosy- microscopy, phytochemical methods- study of starch grains of maize, wheat, rice, potato, curcuma

Ethnomedicine

4 hrs

Traditional plant medicines as a source of new drugs – The process of modern drug discovery using ethnopharmacology – Taxol, Artemisinin, Galathamine and Flavopyridole as examples of drug discovery based on ethanopharmacological approach; Jeevani-Pushpangadan model of benefit sharing.

Suggested additional topics

1. Basic principles in spectroscopy - UV, NMR, IR etc
2. Use of secondary metabolites for protection against pathogens, herbivores

Additional Credits: Virtual Lab Experiments

1. Estimation of saponification value of fats/ oils
2. Estimation of Iodine value of fats and oils
3. Extraction of caffeine from Tea

References

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10.2 SCHEME OF CHEMISTRY COMPLEMENTARY COURSES (Semester-wise Distribution)

Course Code	Course Title	Credits	Hours / Week	Hour / Sem.	Examination		
					ESE Duration	ESE Max. Marks	CIA Max. Marks
SEMESTER I (Common for students who have opted for Physics, Botany & Zoology as Core)							
19U1CPCHE1	General Chemistry	2	2	36	3 Hrs.	60	20
19U2PCCHE1	Volumetric Analysis	-	2	36	Examination at the end of Sem II		
SEMESTER II (Common for students who have opted for Physics, Botany & Zoology as Core)							
19U2CPCHE2	Basic Organic Chemistry	2	2	36	3 Hrs.	60	20
19U2PCCHE1	Volumetric Analysis	2	2	36	3 Hrs.	30	10
SEMESTER III (for students who have opted for Physics as Core)							
19U3CPCHE3.1	Advanced Physical Chemistry – I	3	3	54	3 Hrs.	60	20
19U4PCCHE2.1	Physical Chemistry Practicals	-	2	36	Examination at the end of Sem IV		
<i>(for students who have opted for Botany & Zoology as Core)</i>							
19U3CPCHE3.2	Bio-inorganic and Heterocyclic Chemistry	3	3	54	3 Hrs.	60	20
19U4PCCHE2.2	Organic Chemistry Practicals	2	2	36	Examination at the end of Sem IV		
SEMESTER IV (for students who have opted for Physics as Core)							
19U4CPCHE4.1	Advanced Physical Chemistry – II	4	4	72	3 Hrs.	60	20
19U4PCCHE2.1	Physical Chemistry Practicals	-	2	36	3 Hrs.	30	10
<i>(for students who have opted for Botany & Zoology as Core)</i>							
19U4CPCHE4.2	Advanced Bio-Organic Chemistry	3	3	54	3 Hrs.	60	20
19U4PCCHE2.2	Organic Chemistry Practicals	3	3	54	3 Hrs.	30	10

11. B. Sc. CHEMISTRY PROGRAMME - CONSOLIDATED SCHEME

**SYLLABUS FOR
COMPLEMENTARY CHEMISTRY
COURSES**

SEMESTER I

COURSE CODE	19U1PCHE1
COURSE TITLE	GENERAL CHEMISTRY
NO. OF CREDITS	2
NO. OF CONTACT HOURS	36

(Common to Physical sciences and Life sciences)

	Course Outcomes	POs / PSOs	CL	KC	Class Sessions
CO 1	<i>Describe different models of atomic structure.</i>	PO 1, PSO 1	U	C	9
CO 2	<i>Define acids and bases and explain the concept of equilibrium.</i>	PO 1, PSO 1	U	C	5
CO 3	<i>Understand the concept of solubility and its applications in various fields.</i>	PO 1, PSO 1	U	C	3
CO 4	<i>Explain the fundamentals of nuclear chemistry.</i>	PO 1, PSO 1	U	C	2
CO 5	<i>Generate a basic idea on applications of nuclear energy in various fields and the possible hazards.</i>	PO 1, PSO 1	U	C	4
CO 6	<i>Explain the fundamentals of analytical chemistry.</i>	PO 1, PSO 1	U	C	5
CO 7	<i>Understand the basics of thermodynamics.</i>	PO 1, PSO 1	U	C	8

Unit 1: Atomic Structure (9 Hrs.)

Introduction: Atoms, Planck's quantum Theory, Photoelectric effect, Postulates of Bohr's theory, Energy levels in atom and origin of hydrogen spectrum (*qualitative treatment only*). Sommerfeld's extension of Bohr's Theory, Shortcomings of Bohr Theory, Dual nature of matter and radiation. Derivation of de Broglie equation, Wave nature of electron and quantisation of angular momentum, Heisenberg's uncertainty principle, Concept of orbital, Quantum numbers, shapes of orbitals (*s, p, d*), Electronic configuration of atoms - Aufbau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle.

Unit 2: Concept of Equilibrium (8 Hrs.)

Acids and bases – Arrhenius, Lowry-Bronsted and Lewis Concepts, ionic product of water, introductory idea of pH, pOH. Strengths of acids and bases, K_a and K_b , pK_a and pK_b , buffer solution Henderson equation (*elementary idea only*), hydrolysis of salt, solubility, solubility product, application. Common ion effect, application.

Unit 3: Nuclear Chemistry (6 Hrs.)

Stability of Nucleus:- binding energy, magic number, packing fraction, n/p ratio.

Radioactivity: natural radioactivity, induced radioactivity, fertile and fissile isotopes, units of radioactivity.

Nuclear Reactions: fission and fusion, chain reactions, disposal of nuclear wastes.

Applications: Reactors – conventional and breeder, energy generation, radiocarbon dating, medical, agricultural and industrial applications.

Unit 4: Analytical Chemistry- Basic principles (5 Hrs.)

Concentration terms- molality, molarity, normality, weight percentage, ppm, and millimoles. Titrimetric method of analysis: General principle, types of titrations, requirements for titrimetric analysis. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions.

Evaluation of analytical data: Accuracy, precision, absolute error, relative error, types of error. Methods of elimination or minimization of errors.

Unit 5: Laws of Thermodynamics (8 Hrs.)

System and Surrounding. First law of Thermodynamics: Internal energy, Significance of internal energy change, enthalpy, Second law of Thermodynamics: free energy, Entropy and Spontaneity, Statement of second law based on entropy, Entropy change in Phase transitions (*No derivation required*) - entropy of fusion, entropy of vaporization, entropy of sublimation.

The concept of Gibbs's free energy- Physical significance of free energy, conditions for equilibrium & spontaneity based on ΔG values. Effect of temperature on spontaneity of Reaction. Third law of thermodynamics.

References:

1. B. R. Puri, L. R. Sharma, Kalia, *Principles of Inorganic Chemistry*, 31st edn. Milstone (2010).
2. Manas Chanda, *Atomic Structure and Molecular Spectroscopy*.
3. P. L. Soni, *Inorganic Chemistry*.
4. C. N. R. Rao, *University General Chemistry*, Macmillan.
5. R. A. Day Junior, A.L. Underwood, *Quantitative Analysis*, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988.
6. Vogel's *Text Book of Quantitative Chemical Analysis*, J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, 6th edn. Pearson Education (2003).
7. R. Gopalan, *Analytical Chemistry*, S. Chand and Co., New Delhi.
8. B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements of Physical Chemistry*, 3rd edn. Vishal Pub. CO., 2008.

SEMESTER II

COURSE CODE	19U2CPCHE2
COURSE TITLE	BASIC ORGANIC CHEMISTRY
NO. OF CREDITS	2
NO. OF CONTACT HOURS	36

(Common to Physical sciences and Life sciences)

	Course Outcomes	POs / PSOs	CL	KC	Class Sessions
CO 1	<i>Understand the basics of organic chemistry.</i>	PO 1, PSO 1	U	C	1
CO 2	<i>Understand various purification techniques like solvent extraction, distillation and crystallization.</i>	PO 1, PSO 1	U	C	3
CO 3	<i>Develop an idea on stereochemistry of organic compounds</i>	PO 1, PSO 1	U	C	10
CO 4	<i>Explain the basics of organic reaction mechanism.</i>	PO 1, PSO 1	U	C	15
CO 5	<i>Discuss the classification and synthesis of polymers.</i>	PO 1, PSO 1	U	C	5
CO 6	<i>Discuss the hazards of synthetic polymers/ plastics.</i>	PO 1, PSO 1	U	C	1
CO 7	<i>Understand the concept of biodegradable alternatives for plastics.</i>	PO 1, PSO 1	U	C	1

Unit 1: Purification of Organic Compounds (3 Hrs.)

Purification techniques: Recrystallisation, sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure. Solvent extraction.

Unit 2: Stereochemistry of Organic Compounds (11 Hrs.)

Geometrical isomerism- *cis* and *trans* configuration, 2-butene, maleic and fumaric acid, determination of configuration of cis-trans isomers, E and Z configuration.

Optical isomerism- D and L configuration. Optical activity, Chirality, Stereogenic Centre, Enantiomers and diastereomers – optical isomerism in lactic acid and tartaric acid, Racemisation.

Conformation- Newman projection, Saw-horse projection, Conformations of Ethane, n - butane and Cyclohexane.

Unit 3: Mechanisms of Organic Reactions (15 Hrs)

Hybridization and shape of molecules - sp^3 , sp^2 and sp , (ethane, ethene, ethyne). Types of reagents - electrophiles, nucleophiles.

Types of electron displacement in organic molecules- Inductive, electromeric, mesomeric, and hyper conjugative effects. Explanation of the strength of carboxylic and halogen substituted acids, base strength of primary, secondary and tertiary amines.

Types of bond fission- homolytic and heterolytic fission.

Reactive intermediates- carbocations, carbanions and free radicals. Their formation and stability.

Types of organic reactions – Substitution reactions: Nucleophilic substitution of alkyl halides- S_N1 and S_N2 mechanisms. Factors affecting rate of Substitution reaction of alkyl halide. Nature of alkyl halide, Effect of solvent. Stereochemistry of S_N1 and S_N2 reactions.

Electrophilic substitution in benzene-reaction mechanism. Halogenation, Nitration and Sulphonation.

Addition reactions: electrophilic addition. Addition of Bromine and Hydrogen halides to ethane, propene and ethyne-the Markwonikoff's rule, Peroxide effect.

Elimination reactions: E1 and E2 mechanisms. Saytzeff and Hofmann elimination.(Detailed mechanism is not expected.)

Unit 4: Natural and Synthetic Polymers (7 Hrs.)

Classification of polymers: Natural, synthetic; linear, cross-linked and network; plastics, elastomers, fibres; homopolymers and copolymers. Polymerization reactions, Addition Polymerization, Condensation polymerization, typical examples- polyethene, polypropylene, PVC, phenol-formaldehyde resins, polyamides (nylons) and polyester. Natural rubber: structure, vulcanization. Synthetic rubbers- SBR, nitrile rubber, neoprene. Biodegradable polymers, environmental hazards caused by polymers, Health problem due to burning plastics.

References

1. I. L. Finar, *Organic Chemistry*, Vol. I, 6th edn. Pearson.
2. S. M. Mukherji, S. P Singh, R. P Kapoor, *Organic Chemistry*, Vol.1, New Age International (P) Ltd, 2006.
3. P.S Kalsi, *Stereochemistry Conformation and Mechanism*, New Age International Publishers, 2004.
4. Peter Sykes, *A Guide Book to Mechanism in Organic Chemistry*, 6th edn. Orient Longman, 1988.
5. S. M. Mukherji, S.P Singh, *Reaction Mechanism in Organic Chemistry*, Macmillan, 3rd Edn., 2003.
6. V. R. Gowariker, *Polymer Science*, Wiley Eastern.
7. K.S Tewari, N K Vishnoi, *Text book of Organic Chemistry*, Vikas Publishing House Pvt. Ltd.2007.

**SEMESTER I AND II
PRACTICAL I**

COURSE CODE	19U2PCCHE01
COURSE TITLE	VOLUMETRIC ANALYSIS
NO. OF CREDITS	2
NO. OF CONTACT HOURS	72

(Common to Physical Sciences and Life Sciences)

	Course Outcomes	POs / PSOs	CL	KC	Class Sessions
CO 1	Perform the estimation the amount of substance in a given solution by volumetric analysis.	PO 1, PSO 2	U	P	36
CO 2	Apply microscale procedures like two-burette titration in acidimetry and alkalimetry.	PO 1, PSO 2	U	P	36

Standard solution must be prepared by the student.

Laboratory operations (*Non-evaluative*): Use of different glass wares like pipette, burette, standard measuring flask, distillation apparatus; heating methods, filtration techniques, weighing principle in chemical balance, weighing in electronic balance-general idea.

Micro-scale Chemistry: The volumetric analysis may be done by two-burette titration procedure.

I. Acidimetry and Alkalimetry

1. Standardization of HCl with standard Na₂CO₃ solution
2. Standardization of NaOH with standard oxalic acid solution
3. Estimation of any acid using standard NaOH
4. Estimation of any alkali using standard HCl.

II. Permanganometry

1. Standardization of KMnO₄ using (i) oxalic acid (ii) Mohr's salt
2. Estimation of Fe²⁺ in Mohr's salt and crystalline Ferrous Sulphate using standard KMnO₄.
3. Estimation of oxalic acid using standard KMnO₄.

III. Dichrometry

1. Estimation of Ferrous ions (external indicator)
2. Estimation of Ferrous ions (internal indicator)

References

1. D. A. Skoog, D. M. West, and S. R. Crouch, *Fundamentals of Analytical Chemistry*, 8th edn, Brooks/Cole Nelson.
2. Vogel's *Textbook of Quantitative Chemical Analysis* 6th edn, Pearsons Education Ltd.
3. G. D. Christian, *Analytical Chemistry*, JohnWiley and Sons.

SEMESTER III

COURSE CODE	19U3CPCHE03.2
COURSE TITLE	BIO-INORGANIC AND HETEROCYCLIC CHEMISTRY
NO. OF CREDITS	3
NO. OF CONTACT HOURS	54

(For students who have opted Botany and Zoology as main)

	Course Outcomes	POs / PSOs	CL	KC	Class Sessions
CO 1	Understand the basics of heterocyclic chemistry and bioinorganic chemistry.	PO 1, PSO 1	U	C	26
CO 2	Know the structure and properties of enzymes and nucleic acids.	PO 1, PSO 1	U	C	16
CO 3	Explain various application of chemistry in agriculture.	PO 1, PSO 1	U	C	12

Unit 1: Heterocyclic Compounds (10 Hrs.)

Aromaticity – Huckel rule, preparation (*any one method*), properties, structure and aromaticity of furan, pyrrole, pyridine, indole. Pyrimidines and purines.

Unit 2: Bioinorganic Chemistry (16 Hrs.)

Thermodynamics of Living cell- Exergonic and endergonic reactions, coupled reactions, biological oxidation reactions (*general idea*).

Oxygen Carriers: Oxygen transport in biological system-Hemoglobin and myoglobin, Structure and function. Oxygen transport mechanism, cooperativity of hemoglobin, Perutz mechanism, Bohr effect. Hemocyanin, Hemerythrin (*Structure and function only*).

Electron carriers: Ferredoxine, cytochromes (*Structure and function only*).

Photosynthesis: Photosynthetic pigments, Chlorophyll, Structure, Different types of chlorophyll. Photosystem-I, photosystem-II, Z- Scheme, photophosphorylation (*Elementary idea only*).

Unit 3: Enzymes and Nucleic acids (16 Hrs.)

Enzymes: Nomenclature, Classification, Metalloenzymes, prosthetic group, coenzyme, cofactors, characteristics of enzyme action, mechanism of enzyme action (*elementary idea only*).

Lock and key model, Induced fit model. Factors affecting enzyme action. Enzyme inhibition.

Structure and function of some important enzymes: peroxidase, catalase, cytochrome P-450. Carbonic anhydrase, Carboxy peptidase. Cytochrome oxidase. Vitamin B₁₂.

Na⁺/K⁺ ATPase-Sodium Potassium pump (*Detailed mechanism is not expected*).

Energy rich molecules: elementary structure of ATP and ADP.

Nucleic acids: Chemical composition, structures of nucleosides and nucleotides. Structure of DNA & RNA. Biological Functions:-replication and protein synthesis.

Unit 4: Chemistry and Agriculture (12 Hrs.)

Plant nutrients- Non Mineral nutrients. Mineral nutrients-Macro nutrients- Primary and Secondary macro nutrients. Micronutrients. Their role in plant growth.

Fertilizers- NPK value, superphosphates, triple super phosphate, uses of mixed fertilizers, Bio-fertilizers. Plant growth hormones.

Pesticides- classifications with simple examples, mention of bio pesticides. Insecticides – stomach poisons, contact insecticides, fumigants. Examples. Method of preparation of DDT, BHC, pyrethrin.

Herbicides- structure and function of 2,4-D and 2,4,5 –T.

Fungicides- inorganic and organic- Bordeaux mixture, dithiocarbamates, Excessive use of pesticides – environmental hazards.

References:

1. I. L Finar, *Organic Chemistry*, Vol 1 & 2, 6th Edition, Pearson.
2. K. S. Tewari, N. K. Vishnoi, *A Text Book of Organic Chemistry*, 3rd edition, Vikas publishing House Pvt. Ltd, 2006.
3. J. D. Lee, *Concise Inorganic Chemistry* 5th edn. Wiley India Pvt. Ltd.2008.
4. R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry*, 31st Milestone Publishers, New Delhi, 2010.
5. G.L. Meissler, D.A Tarr, *Inorganic Chemistry*, 3rd Edn. Pearson Education, 2004.
6. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, *Inorganic Chemistry*, Pearson 2006.
7. A.C. Deb, *Fundamentals of Biochemistry*, 9th Edn. New Central Book Agency, 2001.
8. Rastogi, *Biochemistry*, Tata Mc Graw –Hill Publication, 1996.
9. http://en.wikipedia.org/wiki/Plant_nutrition.

SEMESTER IV

COURSE CODE	19U4CPCHE04.2
COURSE TITLE	ADVANCED BIO-ORGANIC CHEMISTRY
NO. OF CREDITS	3
NO. OF CONTACT HOURS	54

(For students who have opted Botany and Zoology as main)

	Course Outcomes	POs / PSOs	CL	KC	Class Sessions
CO 1	Explain the structure and properties of amino acids, proteins, carbohydrates, vitamins, steroids, hormones and lipids.	PO 1, PSO 1	U	C	34
CO 2	Understand the applications of chemistry in medicine.	PO 1, PSO 1	U	C	9
CO 3	Understand the basics of chromatography.	PO 1, PSO 1	U	C	5
CO 4	Explain the structure and properties of alkaloids and terpenoids.	PO 1, PSO 1	U	C	6

Unit 1: Amino Acids and Proteins (12 Hrs.)

Classification of amino acids, zwitter ion, general chemical properties of - amino acids, separation of amino acids, synthesis of glycine, alanine, phenyl alanine (*any one method*). Peptides – peptide bond, polypeptides. Proteins- amino acids as building block of proteins, classifications, prosthetic group, properties, denaturation. Structure of proteins- primary, secondary and tertiary structure.

Unit 2: Carbohydrates (10 Hrs.)

Classification of carbohydrates, preparation and properties of glucose, fructose and sucrose. Haworth configuration of α -D glucose and β -D glucose, α -D fructose, β -D fructose, maltose and cellobiose (*ring size determination not expected*). Mutarotation. Conversion of glucose to fructose and vice-versa. Structure of starch and cellulose. Industrial applications of cellulose.

Unit 3: Vitamins, Steroids, Hormones and Lipids (12 Hrs.)

Structure and biological activity of vitamin A, B and C.

Steroids- general introduction, cholesterol and bile acids.

Hormones (structure not required) - Introduction, steroid hormones peptide hormones, amine hormones, artificial hormones (general idea).

Simple lipids and complex lipids- isolation- properties. Analysis of oils and fats- acid value, saponification value, iodine value, Role of MUFA and PUFA in preventing heart diseases.

Unit 4: Chemistry in Medicine (9 Hrs.)

Essential and trace elements in biological system. Metal deficiency and disease- Iron, Zinc Copper. Metal toxicity- Toxicity due to Plutonium and mercury. Treatment for excess mercury and plutonium.

Classification of drugs. Structure, therapeutic uses and mode of action (synthesis not required) of *Antibiotics*: Ampicillin and Chloramphenicol, Sulpha drugs: Sulphanilamide and sulphapyridine, *Antipyretics and Analgesics*: Paracetamol, Aspirin. *Antacids*: Ranitidine. *Antimalarials*: Chloroquine and *Anti-cancer drugs*: Chlorambucil, Cis-platin.

Psychotropic drugs: Tranquilizers, antidepressants and stimulants with examples.

Drug addiction and abuse: Prevention and treatment.

Unit 5: Natural Products (5 Hrs.)

Terpenoids: Essential oils- isolation, isoprene rule. Elementary study of citral, geraniol and natural rubber.

Alkaloids: Classification, source, isolation, general properties and structure of coniine, nicotine, piperine. Structure elucidation: coniine, nicotine.

Unit 6: Chromatographic Techniques (6 Hrs.)

Classification of chromatographic methods. Basic principle and uses of Column chromatography, Thin layer chromatography (TLC), Paper chromatography (PC), R_f value, Gas chromatography (GC), High Performance Liquid chromatography (HPLC), Ion Exchange chromatography (IEC).

References

1. I. L. Finar, *Organic Chemistry*, Vol 1 & 2, 6th edition, Pearson.
2. K. S. Tewari, N. K. Vishnoi, *A Text Book of Organic Chemistry*, 3rd edition, Vikas publishing House Pvt. Ltd, 2006.
3. Rastogi, *Biochemistry*, Tata McGraw –Hill Publication, 1996.
4. Dr. A.C. Deb, *Fundamentals of Biochemistry*.
5. C. N. R. Rao, *University General Chemistry*, Macmillan.
6. G. T. Austin, *Shreve's Chemical process Industries*, 5th edition, McGraw Hill, 1984.
7. G. R. Chatwal, *Synthetic Drugs*, Himalaya Publishing House, Bombay, 1995.
8. J. Ghosh, *A Textbook of Pharmaceutical Chemistry*, S. Chand & Co Ltd., 1997.
9. Bhat S.V., Nagasampagi, B.A. & Sivakumar M., *Chemistry of Natural Products*, Narosa, 2005.
10. R. A. Day Junior, A.L. Underwood, *Quantitative Analysis*, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988.
11. Vogel's *Text Book of Quantitative Chemical Analysis*, J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, 6th edn. Pearson Education (2003).

SEMESTER III & IV
PRACTICAL 2

COURSE CODE	19U4PCCHE02.2
COURSE TITLE	ORGANIC CHEMISTRY PRACTICALS
NO. OF CREDITS	2
NO. OF CONTACT HOURS	72

(For students who have opted Botany and Zoology as main)

	Course Outcomes	POs / PSOs	CL	KC	Class Sessions
CO 1	<i>Identify and distinguish various organic compounds.</i>	PO 1, PSO 2	U	P	54
CO 2	<i>Understand the preparation of organic compounds.</i>	PO 1, PSO 2	U	P	18

1. Tests for elements: Nitrogen, Halogen and Sulphur.
 2. Study of reactions of common functional groups.
 3. Qualitative analysis with a view to characterization of functional groups and identification of the following compounds: Naphthalene, chlorobenzene, benzyl chloride, benzyl alcohol, phenol, o-, m- and p- cresols, resorcinol, benzaldehyde, acetophenone, benzophenone, benzoic acid, phthalic acid, cinnamic acid, salicylic acid, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, nitrobenzene, m-dinitrobenzene and glucose.
- Organic preparation involving halogenation, nitration, oxidation, reduction, acetylation, benzylation, hydrolysis, diazotization.
 - Isolation of an organic compound from a natural source.

References:

1. A. I. Vogel, *A Text Book of Practical Organic Chemistry*, Longman.
2. F. G. Mann and B. C. Saunders, '*Practical Organic Chemistry*' Fourth Edition, Pearson Education.
3. V. K. Ahluwalia and S. Dhingra, *Comprehensive Practical Organic Chemistry*, Universities Press.

Syllabus for extra credit course
List of Virtual Lab Experiments in Chemistry
Additional Credit Course in Chemistry

1. Calculation of Thermodynamic Quantities in Physical Chemistry
2. Quantum Chemistry Calculations
3. Practices and Concepts in statistical Thermodynamics
4. EMF measurements in Physical Chemistry
5. Structure and Properties of Organic Compounds
6. Detection of elements : Lassaigne's Test
7. Detection of Functional Groups using spectroscopic Measurements
8. Calculation of λ_{\max} of Organic Compounds using Woodward Fieser Rules
9. Acid Base Titrations
10. Calculation in Group Theory.

OPEN COURSE FOR OTHER STREAMS							
19U5OCZOO01	Human Genetics, Nutrition, Community health and Sanitation	3	4	72	3 Hrs.	75	25
SEMESTER VI							
19U6CRZOO09	Reproductive and Developmental Biology	3	3	54	3 Hrs.	60	20
19U6CRZOO10	Genetics and Biotechnology	3	3	54	3 Hrs.	60	20
19U6CRZOO11	Microbiology and Immunology	3	3	54	3 Hrs.	60	20
19U6CRZOO12	General Informatics, Bioinformatics, Biostatistics and Research Methodology	3	3	54	3 Hrs.	60	20
19U6CRZOO13	Ecotourism and Ecotourism Entrepreneurship (<i>Elective Course</i>)	3	4	72	3 Hrs.	75	25
19U6PRZOO05	Reproductive and Developmental Biology + Genetics and Biotechnology	2	2	36	3 Hrs.	30	10
19U6PRZOO06	Microbiology and Immunology + General Informatics, Bioinformatics, Biostatistics and Research Methodology	2	2	36	3 Hrs.	30	10
19U6PJZOO01	Project and Viva (6th Semester) Visit to research institutes (6th Semester) Study tour/Field study , Group activity (5th Semester)	2	1	18	<i>Project evaluation and viva-voce at the end of Sem VI</i>		

10.2 SCHEME OF ZOOLOGY COMPLEMENTARY COURSES FOR B.Sc. BOTANY (*Semester-wise Distribution*)

Course Code	Course Title	Credits	Hours / Week	Hour / Sem.	Examination		
					ESE Duration	ESE Max. Marks	CIA Max. Marks
SEMESTER I							
19U1CPZOO01	Animal Diversity – Non-Chordata	2	2	36	3 Hrs.	60	20
19U2PCZOO01	Practical 1 - Animal Diversity – Non-Chordata + Chordata	-	2	36	<i>Examination at the end of Sem II</i>		
SEMESTER II							
19U2CPZOO02	Animal Diversity – Chordata	2	2	36	3 Hrs.	60	20
19U2PCZOO01	Practical 1 - Animal Diversity – Non-Chordata + Chordata	2	2	36	3 Hrs.	30	10
SEMESTER III							
19U3CPZOO03	Human Physiology and Immunology	3	3	54	3 Hrs.	60	20
19U4PCZOO02	Practical 2 - Human Physiology and Immunology + Applied Zoology	-	2	36	<i>Examination at the end of Sem IV</i>		

SEMESTER IV							
19U4CPZOO04	Applied Zoology	3	3	54	3 Hrs.	60	20
19U4PCZOO02	Practical 2 - Human Physiology and Immunology + Applied Zoology	-	2	36	3 Hrs.	30	10

11. B. Sc. ZOOLOGY PROGRAMME - CONSOLIDATED SCHEME

The programme structure with detailed semester-wise distribution of common courses, core courses, complementary courses, open course, choice based course and project are listed below.

Sl. No.	Type of Course	Course Title	Credits	Hrs./ Week	Hrs./ Sem.
SEMESTER I					
1.	Common	English - I	4	5	90
2.	Common	English Common Course - I	3	4	72
3.	Common	Second Language - I (<i>Mal / Hin / San / Fre</i>)	4	4	72
4.	Core	Animal Diversity – Non-Chordata I	2	2	36
5.	Core	Practicals 1	-	2	36
6.	Complementary	Chemistry - I	2	2	36
7.	Complementary	Chemistry Practicals - I	-	2	36
8.	Complementary	Botany - I	2	2	36
9.	Complementary	Botany Practicals - I	-	2	36
Total			17	25	450
SEMESTER II					
1.	Common	English - II	4	5	90
2.	Common	English Common Course - II	3	4	72
3.	Common	Second Language - II (<i>Mal / Hin / San / Fre</i>)	4	4	72
4.	Core	Animal Diversity – Non-Chordata II	2	2	36
5.	Core	Practicals 1	2	2	36
6.	Complementary	Chemistry - 2	2	2	36
7.	Complementary	Chemistry Practicals - I	2	2	36
8.	Complementary	Botany - 2	2	2	36
9.	Complementary	Botany Practicals - I	2	2	36
Total			23	25	450

SYLLABUS OF ZOOLOGY FOR COMPLEMENTARY COURSE (B.Sc. BOTANY PROGRAMME)

SEMESTER I

19U1CPZOO1: Animal Diversity – Non Chordata

2 hrs/week

36/hrs

Credit – 2

Course Code	19U1CPZOO1
Title of the course	Animal Diversity - Non Chordata
Semester in which the course is to be taught	1
No. of credits	2
No. of contact hours	36

Objectives

1. To acquire knowledge on the taxonomic status of various Invertebrate animals and animal groups.
2. To familiarize the students with the diverse group of organisms around us.
3. To develop an aptitude for understanding nature and its rich bio-diversity.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the basic concepts and principles of invertebrate taxonomy	PO1,PO4 PSO1	U	C	2

CO2	Understand salient features and taxonomy up to phylum of Kingdom Protista	PO1,PO4 PSO1	U	C	7
CO3	Understand the salient features and taxonomy of mesozoa and parazoa.	PO1,PO4 PSO1	U	C	2
CO4	Differentiate the coral reefs and the rich biodiversity of coelenterates	PO1,PO4 PSO1	U	C	3
CO5	Understand the pathogenicity of round worms and flat worms.	PO1,PO4 PSO1	U	C	4
CO6	Understand the salient features and taxonomy of segmented, jointed and shelled invertebrates.	PO1,PO4 PSO1	U	C	5
CO7	Understand the morphological aspects, structural and functional facets of <i>Panaeus</i> .	PO1,PO4 PSO1	U	C	8
CO8	Understand the pests of paddy, coconut and stored grains.	PO1,PO4 PSO1	U	C	5

Module 1

General Introduction

1 hr

5 Kingdom classification, Classification in general

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1.
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications. Zoological Society of Kerala.

Animal Diversity (2002). Published by Zoological Society of Kerala.

Module 2

Kingdom Protista

7 hrs

Salient features and classification up to phyla

1. Phylum Rhizopoda : Amoeba
2. Phylum Actinopoda : Actinophrys
3. Phylum Dinoflagellata : Noctiluca
4. Phylum Parabasalia : Trychonympha
5. Phylum Metamonada : Giardia
6. Phylum Kinetoplasta : Trypanosoma
7. Phylum Euglenophyta : Euglena
8. Phylum Cryptophyta : Cryptomonas
9. Phylum Opalinata : Opalina
10. Phylum Bacillariophyta : Diatoms
11. Phylum Chlorophyta : Volvox
12. Phylum Choanoflagellata : Proterospongia
13. Phylum Ciliophora : Paramecium
14. Phylum Sporozoa : Plasmodium
15. Phylum Microsporidia : Nosema
16. Phylum Rhodophyta : Red Alga

(Mention any five general characters for each phylum. Detailed accounts of examples are not necessary.)

Pathogenic protista – Plasmodium, Entamoeba.

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1.
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

Zoological Society of Kerala. Animal Diversity (2002). Published by
Zoological Society of Kerala.

Module 3

Mesozoa – eg.Rhopalura (mention 5 salient features)

2 hrs

Parazoa

Phylum Porifera – egLeucosolenia

Phylum Placozoa –e g. Trycoplaxadherens.

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1.
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

Zoological Society of Kerala. Animal Diversity (2002). Published by
Zoological Society of Kerala.

Module 4

Phylum : Coelenterata

3hrs

Salient features, Classification up to classes

1. Hydrozoa – Physalia
2. Scyphozoa – Aurelia
3. Anthozoa – Adamsia

Corals and coral reefs.

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1.
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

Zoological Society of Kerala. Animal Diversity (2002). Published by Zoological Society of Kerala.

Module 5

Phylum - Platyhelminthes

2 hrs

Salient features, classification upto classes

1. Turbellaria – Planaria
2. Trematoda – Fasciola
3. Cestoda – Taenia solium

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

Zoological Society of Kerala. Animal Diversity (2002). Published by Zoological Society of Kerala.

Module 6

Phylum Nematoda

2 hrs

Salient features, classification up to classes

1. Phasmidia - Wuchereria
2. Aphasmidia – Trichinella

Module 7

Phylum - Annelida

2 hrs

Salient features, classification upto classes

1. Polychaeta, - Nereis
2. Oligochaeta – Earthworm – Pheretima
3. Hirudinomorpha – Hirudinaria

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

Zoological Society of Kerala. Animal Diversity (2002). Published by Zoological Society of Kerala.

Module 8

Phylum Arthropoda

10 hrs

Salient features

Type - Prawn - Penaeus

Classification upto classes

Subphylum Chelicerata

Class 1. Merostoma – Limulus

2. Arachnida – Spider

3. Pycnogonida – Nymphon

Subphylum Mandibulata

Class 1. Crustacea – Daphnia

2. Chilopoda - Centepede

3. Symphyla - Scutigereilla

4. Diplopoda - Millipede

5. Pauropoda - Pauropus

6. Insecta - Butterfly

(Detailed account of examples are not necessary)

Phylum Onychophora – eg. Peripatus (Mention its affinities)

Insect pests

1. Pests of coconut – *Oryctes rhinoceros*,
Rhynchophorus ferrugineus, *Nephantisserinopa*, *Eriophid mite*
2. Pests of paddy – *Leptocorisa acuta*, *Spodoptera mauritius*
3. Pests of stored grains - *Trogoderma granarium*,
Tribolium castaneum, *Sitophilus oryzae*

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1.
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

Zoological Society of Kerala. Animal Diversity (2002). Published by
Zoological Society of Kerala.

Module: - 9

Phylum – Mollusca

3 hrs

Salient features and classification upto classes

1. Aplousobranchia – Neomenia
2. Monoplacophora – Neopalina
3. Bivalvia – Perna
4. Polyplacophora – Chiton
5. Gastropoda – Xancus
6. Cephalopoda – Sepia
7. Scaphopoda – Dentalium

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1.
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

Zoological Society of Kerala. Animal Diversity (2002). Published by
Zoological Society of Kerala.

Module 10

Phylum - Echinodermata

3 hrs

Salient features , classification upto classes

Class 1. Asterozoa – Astropecten

2. Ophiurozoa - Ophiothrix
3. Echinozoa – Echinus

4. Holothuroidea – Cucumaria

5. Crinoidea – Antedon

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1.
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications. Zoological Society of Kerala.

Animal Diversity (2002). Published by Zoological Society of Kerala.

Module 11

Phylum Hemichordata

1 hr

Salient features eg: Balanoglossus

Core Readings

EkambaranathaAyyer M (1990) A Manual of Zoology, Volume 1.
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)

Protista & Animal Diversity Academica Publications.

Zoological Society of Kerala. Animal Diversity (2002). Published by
Zoological Society of Kerala.

Selected Further Readings

Barnes, R.D. , 1987. Invertebrate Zoology (W.B. Saunders, New York).

Barrington, E.J.W., 1967. Invertebrate Structure and function (ELBS and Nelson , London).

Dhami, P.S. and Dhami, J.K. 1979. Invertebrate Zoology (R. Chand and Co. New Delhi).

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Invertebrate Part I and Part
II S. Viswanathan Printers & Publishers Pvt. Ltd.

Groove, A.J. and Newell, G.E. 1974. Animal Biology – Indian Reprint (University Book Stall,
New Delhi).

Hyman, L.H. The Invertebrate vols. (McGraw-Hill) 1942. Comparative vertebrate Anatomy
(The University of Chicago Press).

- James R.D. (1987). Invertebrate Zoology, W.B. Saunders, New York.
- Kapoor V.C. (1994). Theory and Practice of Animal Taxonomy.
- Kapoor, V.C. 1994. Theory and Practice of Animal Taxonomy (Oxford and IBH Publishing Co., New Delhi.)
- Kotpal R.L. Agarwal S.K. and R.P. Khetharpal (2002). Modern Text Book of Zoology.
- Parker T.J and Haswell W.A. (1962). Text Book of Zoology Vol. I. Invertebrate (ELBS & Macmillan, London).
- Marshall, A.J. and Williams, W.D. 1972. Text Book of Zoology Vol. Invertebrates (ELBS and Macmillan, London).
- Mayer, E. 1980. Principles of Systematic Zoology (Tata McGraw Hill Publishing Co., New Delhi.)
- Nair, K.K. Ananthkrishnan, T.N. David, B.V. 1976. General and Applied Entomology (T.M.H. New Delhi).

Practicals

19U2PCZOO1: ANIMAL DIVERSITY – NON CHORDATA

2 hr/week,
36 hrs
Credit – 1

CO	CO Statement	POs/PS Os	CL	KC	Class sessions
CO1	Application of scientific principles in drawing invertebrates	PO1 PSO4	A	P	8
CO2	Application of taxonomic principles in identification of invertebrates.	PO1,PO4 PSO4	A	P	5
CO3	Analyse Prawn Nervous system.	PO1 PSO4	An	P	6
CO4	Analyse Cockroach Nervous system.	PO1 PSO4	An	P	6
CO5	Analyse Prawn appendages	PO1 PSO4	An	P	4
CO6	Analyse mouthparts of cockroach.	PO1 PSO4	An	P	4
CO7	Application of histological principles in invertebrate systematics.	PO1 PSO4	A	P	3

1. Scientific drawing - 5 specimens
2. Simple identification – 25 invertebrates (Out of which 15 by their scientific names)
3. T.S - Earthworm, T.S Fasciola
4. Dissection - Prawn Nervous system
5. Dissection - Cockroach Nervous system
6. Mounting – Prawn Appendages
7. Mounting – Cockroach Mouth parts

SEMESTER II

19U2CPZ002 - ANIMAL DIVERSITY – CHORDATA

36 hrs
Credits 2

Course Code	19U2CPZ002
Title of the course	Animal Diversity - Chordata
Semester in which the course is to be taught	2
No. of credits	2
No. of contact hours	36

Objectives

1. To acquire knowledge on the taxonomic status of the various vertebrate animals and animal groups.
2. To familiarise the students with the diverse groups of organisms around us.
3. To develop an aptitude for understanding nature and its rich biodiversity.

CO	CO Statement	POs/PS Os	CL	KC	Class sessions
CO1	Understand taxonomy of Phylum Chordata, sub phyla Urochordata and Cephalochordata their classes and specific examples.	PO1 PSO1	U	C	5
CO2	Understand the taxonomy and salient features of Sub phylum Vertebrata, divisions Agnatha and Gnathostomata, super class Pisces and its various classes with typical examples	PO1 PSO1	U	C	3
CO3	Understand the accessory respiratory organs in fish.	PO1 and PO4 PSO1	U	C	2
CO4	Understand the morphological aspects, structural and functional characteristics of frog.	PO1 PSO1	U	C	16
CO5	Understand salient features of class Reptilia, its various subclasses with examples, identifying poisonous and nonpoisonous snakes.	PO1 and PO4 PSO1	U	C	4
CO6	Understand Avian characteristics, its taxonomy and flight adaptations.	PO1 and PO4 PSO1	U	C	3
CO7	Understand the general characteristics of Class Mammalia and its classification.	PO1 PSO1	U	C	2
CO8	Understand adaptations in aquatic mammals.	PO1 and PO4 PSO1	U	C	1

Module I

7hrs

Phylum Chordata

General characters of the Phylum Chordata

Classification upto classes

Sub phylum I Urochordata

General characters

Class 1 Larvaceaeg . Oikopleura

2. Ascidiaceaeg. Ascidia

3. Thaliaceaeg.Salpa

Subphylum II Cephalochordata

General characters eg.Brachiostoma

Subphylum III Vertebrata

General characters

Division I Agnatha

General characters

Class 1 Cyclostomataeg.Petromyzon

Class 2 Ostracodermieg.Cephalapis

Division 2 Gnathostomata

General characters

Super class Pisces and Super class Tetrapoda

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module II

3 hrs

Super class Pisces

General characters

Class 1. Chondrichthyes eg. Narcine

Class 2. Osteichthyes eg. Latimeria

Accessory respiratory organs in fishes.

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module III

16 hrs

Super Class Tetrapoda

General characters

Class : Amphibia General characters

Type : *Rana hexadactyla*

Order I. Urodelaeg. Amblystoma

II. Anuraeg. Bufo

III . Apodaeg. Ichthyophis

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module IV Class Reptilia

4 hrs

General characters

Sub class I: Anapsida Eg. Chelone

Sub class II Diapsida Eg. Chameleon

Subclass III Parapsida Eg. Ichthyosaurus

Poisonous and non-poisonous snakes of India

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module V Class Aves

3 hrs

General characters

Sub class I : Archeornithes Eg: Archaeopteryx

Sub class II. Neornithes Eg: Struthio

Flight adaptations of birds

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (Oxford University Press).

Module VI Class – Mammalia

3 hrs

General characters

Sub class I Prototheria eg. Echidna

Sub Class II Metatheria eg. Macropus

Sub class III Eutheriaeg. Elephas

Aquatic mammals

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Selected Further Readings

Deoras, P.J. 1981. Snakes of India (National Book Trust of India.)

EkamberanathaAyyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.

Groove, A.J. and Newell, G.E. 1974. Animal Biology - Indian Reprint Universal Book Stall, New Delhi.

Induchoodan, 1986, KweralthilePakshikal (Kerala Sahitya Academy, Trichur).

Kapoor, V.C. 1994, Theory and Practice of Animal Taxonomy (Oxford and IBM Publishing Co. New Delhi.

Lagler, K.F. , Bardach, J.E. , Miller, R.R. Passino, D.R.M. 1977 Ichthyology (John Wiley and Sons).

Mayer, E. 1980. Principles of Systematic Zoology (Tata McGraw Hill Publishing Co. New Delhi.

- Newman, H.H. 1939. Phylum Chordata, (Macmillan Pub. Co. New York)
- Nigam H.C. 1978 , Zoology of Chordata (S. Chand and Co. New Delhi).
- Parker, T.J. and Haswell W.A. 1962. Text Book of Zoology Col. II Vertebrates (ELBS and Macmillan , London).
- Parter S.H. 1971. The Book of Indian Animals (Bombay Natural History Society).
- Salim Ali, 1969. Birds of Kerala (Oxford University Press).
- Sinha A.K. , Adhikari S. Ganguly, B.B. 1988. Biology of Animals Vol. II (New Central Book Agency, Calcutta.)
- Whitaker, R. 1978 Common Indian Snakes – A field Guide Macmillan and Co. of India Ltd.)
- Young J.Z. 1981. The life of Vertebrates (Oxford University Press).
- Young J.Z. Life of mammals) Oxford University Press).

Practicals

19U2PCZOO1 - ANIMAL DIVERSITY – CHORDATA

2 hrs/week

36 hrs

1. Morphology

Scientific drawing – 5 specimens of chordates

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Apply taxonomic principles and identify animals belonging to various phyla and classes by their scientific names	PO1 PSO4	U	C	5
CO2	Apply scientific principles and draw vertebrate specimens belonging to different classes	PO1 PSO4	A	P	10
CO3	Analyse the viscera, digestive system, arterial system, sciatic plexus and brain of frog	PO1 and PO4 PSO4	U	C	5
CO4	Analyse placoid scales in fish.	PO1 PSO4	A	P	5
CO5	Analyse and examine the vertebrae and girdles of frog	PO1 and PO4 PSO4	A	C	5
CO6	Apply taxonomic principles to identify snakes	PO1 and PO4 PSO4	A	P	6

2. Simple identification of 10 chordates (Out of which 5 by their scientific names)

3. Osteology – Vertebrae and girdles of Frog

4. Snake identification - 3 poisonous and
3 non poisonous with key

5. Mounting of placoid scales of shark

6. Dissections:

Frog: Photographs/Diagrams/one dissected & preserved specimen each/ models may be used for the study.

1. Frog – Viscera
2. Frog – Digestive System
3. Frog – Arterial System
4. Frog – Sciatic plexus
5. Frog – Brain

SEMESTER III

19U3CPZOO3- HUMAN PHYSIOLOGY AND IMMUNOLOGY

3 hrs/week

54 hrs

Credits 3

Course Code	19U3CPZOO3
Title of the course	Human Physiology and Immunology
Semester in which the course is to be taught	3
No. of credits	3
No. of contact hours	54

Objectives

- To inspire the students in learning the frontier areas of biological sciences
- To appreciate the correlation between structure and function of organisms
- To make them aware of the health related problems, their origin and treatment.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand nutrition and deficiency disorders	PO1 PSO3	U	C	3
CO2	Understand the functional aspects of respiration and respiratory disorders	PO1 PSO3	U	C	5
CO3	Understand functional aspects of cardiovascular circulation, disorders and clinical aspects.	PO1 PSO3	U	C	7

C04	Understand structure and function of human nitrogenous excretory organ and renal disorders.	PO1 PSO3	U	C	6
C05	Understand structural and functional features of neuromuscular system and its disorders.	PO1 PSO3	U	C	10
C06	Understand functional characteristics of hormonal glands and its disorders.	PO1 PSO3	U	C	5
C07	Understand the basics of immunology, antigens and antibodies, antigen antibody reactions and its clinical applications.	PO1 PSO3	U	C	13
C08	Understand the applications, new developments and recent trends in immune research.	PO1 PSO3	U	C	5

Part I HUMAN PHYSIOLOGY

36 hrs

Module 1 : Nutrition

3 hrs

Malnutrition disorders, Vitamin deficiencies, and mineral deficiencies (Iron, Calcium and Iodine)

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.718-833

Prosser & Brown 2006 : Comparative Animal Physiology

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 2: Respiration

5 hrs

Transport of O₂ and CO₂ in blood, respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp432-509 Zoological

Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 3: Circulation

7 hrs

Blood – Composition and function, Brief account of mechanism of blood clotting; Disorders of blood clotting – Haemophilia, cerebral and pulmonary thrombosis, Cerebral haemorrhage, Blood pressure and factors controlling it; electrocardiogram, Cardiovascular disorders – Arteriosclerosis, Myocardial infraction, Angiogram and Angioplasty.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.144-262, 382-429, 711-715.

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 4 Excretion

6 hrs

Structure of human nephron, composition of urine – normal and abnormal constituents, urine formation (ultra filtration , selective reabsorption, tubular secretion and counter current mechanism); Hormonal control of renal function, Kidney disorders – myeleonephritis, glomerular nephritis, nephrotic syndrome, Dialysis

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.264-379

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 5 Neurophysiology

6 hrs

Structure of typical neuron, myelinated and non myelinated nerve fibres; Nerve impulse – initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters, Brian waves, Electroencephalogram, Neural disorders – Parkinson’s disease, Epilepsy,

Alzheimer's syndrome, Dyslexia.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.512-715

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 6 Muscle Physiology

4 hrs

Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, Fatigue, O₂ dept, Rigor mortis.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.52-86

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 7 Endocrinology

5 hrs

Endocrine glands and their hormones, mode of action (in brief) , Hypothalamus, Pituitary , Thyroid, Parathyroid, Thymus , Islets of Langerhans, Adrenal, Testis and ovary , Hormonal disorders.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Part II IMMUNOLOGY

18 hrs

Module 8

3 hrs

Introduction to immunology

Types of immunity, innate immunity , acquired, passive , active

Mechanism of innate immunity (eg. Barriers , phagocytosis , inflammation)

Complement System, biological effects of complements.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 9

5 hrs

Antigens and antibodies

Types of antigens , haptens, antigenic determinants.

Basic structure of immunoglobulins , Different classes of immunoglobulins and functions.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 10

5 hrs

Antigen antibody reactions

Precipitation test, agglutination test ,

Clinical applications of antigen antibody reaction, Widal, VDRL, HIV test (ELISA), Complement Fixation Test, and Coombs test.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material; Zoological Society of Kerala

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 11

5 hrs

(Brief accounts of the followings)

Immune response system

Primary and secondary lymphoid organs,

Cells of Immune system – Leucocytes, lymphocytes, T&B cells, Macrophages, Plasma cells , Memory cells, MHC, Antibody synthesis, Monoclonal antibodies, Hybridoma technology

Immune disorders – hypersensitivity, Auto immunity & Immunodeficiency, AIDS,

Vaccines - Major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines). Recent trends in vaccine preparation.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 10.

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Sobha& Sharma (2008) *Essentials of Modern Biology One's Student edition* PP 463-468.

Selected Further Readings

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

Colemen: Fundamentals of Immunology

Guyton, Medical Physiology

Ivan Roitt: *Essentials of Immunology ELBS*.

Madhavankutty, Medical Physiology

Mahupathra, Human Physiology, Current Books

Michael J. PelczarECS,Chan& Noel. R. Kreig, Microbiology, Tata McGraw Hill 5th ed.
1996.

Michael J. Gibuay, Ian A. Macdonald and Helen M. Roche, Nutrition and Metabolism.

Monica Cheesbrough: Laboratory Manual for Tropical Countries. Vol.II Microbiology,
ELBS – Cambridge Ed. 1986.

Paniker S., Francis G. and Abraham G.K 2008, Microbiology and Immunology, Study
Material Series published by Zoological Society of Kerala.

Park, K. Park's Text Book of Preventive and Social Medicine – 2002, 17t Ed.
BanarasidassBhenot Publications

Prosser and Brown, Comparative Animal Physiology

Sebastian Prof. M.M., Animal Physiology

William S Hoar, Animal Physiology.

Practicals

19U4PCZOO2: HUMAN PHYSIOLOGY AND IMMUNOLOGY

2Hrs/Week

36Hrs

Credit 1

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Analyse human blood cell configuration	PO1 PSO4	An	P	8
CO2	Analyse chemical nature of biological fluids.	PO1 PSO4	An	P	8
CO3	Application of role of salivary amylase on starch	PO1 PSO4	A	P	6
CO4	Analysis of haemoglobin content in human blood.	PO1 PSO4	An	P	6
CO5	Analyse different types of blood groups and Rh factor	PO1 PSO4	An	P	4
CO6	Application of Sphygmomanometer and stethoscope.	PO1 PSO4	A	P	4

- 1 Preparation of Human Blood smear & identification of leucocytes
- 2 Qualitative analysis of Reducing Sugar, Protein and Lipid
- 3 Action of Salivary amylase on Starch (Demonstration Only)

- 4 Estimation of Haemoglobin (Demonstration only)
- 5 Identification of human blood groups, A, AB, B and O, Rh factor
- 6 Instruments (Principle & use)– Sphygmomanometer , Stethoscope ,
Measurement of blood pressure using Sphygmomanometer (demonstration)

SEMESTER IV

19U4CPZ004 - APPLIED ZOOLOGY

3hrs/week
54 hrs
Credits 3

Course Code	19U4CPZ004
Title of the course	Applied Zoology (Aquaculture, Sericulture, Vermiculture, Apiculture)
Semester in which the course is to be taught	4
No. of credits	3
No. of contact hours	54

OBJECTIVES

Equip the students interested in the applied branches of zoology with skills and knowledge which can lead to self employment opportunities.

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
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CO1	Application of aquaculture management practices for developing entrepreneurial skills.	PSO2	A	P	10
CO2	Application of aquarium fish management practices for developing entrepreneurial skills.	PSO2	A	P	10
CO3	Application of sericulture management practices for developing entrepreneurial skills.	PSO2	A	P	12
CO4	Application of apiculture management practices for developing entrepreneurial skills.	PSO2	A	P	6
CO5	Application of vermiculture management practices for developing entrepreneurial skills.	PSO2	A	P	12
CO6	Application of pearl culture management practices for developing entrepreneurial skills.	PSO2	A	P	4

Module 1: Aquaculture

24 hrs

Traditional methods of aquaculture, Advantages and salient features of aquaculture, Types of aquaculture, Biotic and abiotic factors of water, Importance of Alga in aquaculture, Common Cultivable fishes of Kerala Economic importance and morphology of culturable species *Catla, Rohu, Mrigal, Cyprinus carpio, Etroplus, & Tilapia* .

Penaeus indicus, P. monodon, Penaeus monodon/Pernaviridis/Pernaindicus, Pinctadafucata.

Pond culture (Construction and maintenance) Brief Description of Carp culture Composite fish culture. Integrated Fish Culture, Induced breeding in fishes, Important Fish Diseases. Fish preservation and processing

Aquarium management, Setting up of an Aquarium, Biological filter and

Aeration . Common species of Aquarium fishes.

Prawn culture, Mussel culture , Pearl culture

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Module 2 Sericulture

12 hrs

Four species of silkworms, Life history of silkworms, Silkworm Rearing Techniques. Diseases and Pests of silkworms. Mounting of worms. Harvesting and stiffling of cocoons. Silkworm diseases. Preventive and control measures.

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)

Module 3 Vermiculture

6 hrs

Species of Earthworms suitable for vermiculture. Reproduction and Life Cycle . Physical and Chemical effects of Vermiculture, Vermicomposting, Site Selection, Cement pit Soil pit . Preparation of pit. Maintenance and Monitoring

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

Module 4 Apiculture

12 hrs

Species of Honey bees. Organization of honeybee colony. Bee keeping methods and equipments Apiary management and maintenance. Bee pasturage, Byproducts of honey bees and their uses. Diseases and pests of honey bees, control measures.

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Shukla G.S., &Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)

Selected Further Readings

Alikunhi, K.h., Fish Cluture in India (ICAR, New Delhi)

Bhosh, C.C., 1949, Silk Production and Weaving in India (CSIR), New Delhi) Director.

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Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)

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An Account of the Oligochacta of the Travancore

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Shukla G.S., &Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)

Andhra Pradesh Agricultural University, Hydrabad)

Sinhan, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)

Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)

Singh, V.P.P. and Ramachandran, V., 1985 Freshwater Fish Culture (ICAR, New Delhi)

Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)

Ullal, S. R. and Narasimahanna, M.N., Handbook of Practical Sericulture (Central Silk Board Bombay.)

Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

Practicals

19U4PCZO02 -APPLIED ZOOLOGY

2 hrs/week

1 credit

36 hrs

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Analyse, identify and examine the culturable species of fishes	PO1, PO4 PSO4	E	P	6
CO2	Analyse, identify and examine culturable species of earthworms, castes of honey bees and silkworm	PO1, PO4 PSO4	E	P	6
CO3	Analyse the bee keeping equipments and chandrike and develop entrepreneurial skills	PO1, PO4 PSO4	E	P	6
CO4	Examine the products and by-products of apiculture, sericulture and vermicomposting	PO1 PSO4	E	P	6
CO5	Analyse and study the different types of fish diseases and fish parasites	PO1, PO4 PSO4	E	P	6
CO6	Analysis of the gut content of fish and determine its feeding habits	PO1 PSO4	E	P	6
CO7	Hands on training in maintenance of aquarium, aquaculture farms, apiary, sericulture, poultry farms	PO1 PO2, PO4 PSO4	E	P	1 week

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
 - a. Economic importance and morphology of culturable species
(Catla, Rohu, Mrigal ,Grass carp, Common carp, , Etroplus,Tilapia, *Penaeus indicus*,/*P.monodon*, *Pernaviridis*/*P.indicus*,*Pinctadafucata*)
 - b. 2 species of earthworms used in Vermiculture
 - c. Two species of honey bees
 - d. Silkworm. Cocoon/Adult
2. Castes of bees
3. Bee keeping equipments Beehive, Smoker, honey extractor
4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)
5. Chandrika /Natrika used in sericulture
6. Fish diseases (any 2diagrams/specimens)
7. Fish Parasite (any one)

SYLLABUS OF ZOOLOGY OPEN COURSE FOR OTHER STREAMS

SEMESTER V

19U50CZ001: HUMAN GENETICS, NUTRITION, COMMUNITY HEALTH AND SANITATION

72 hrs

4hrs/Week

Credits 3

Course Code	15U50CZ001
Title of the course	Human Genetics, Nutrition, Community Health and Sanitation
Semester in which the course is to be taught	5
No. of credits	3
No. of contact hours	72

Objectives of the Course

- To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.
- To emphasize the central role that biological sciences plays in the life of all organisms.

To introduce the student to some of the present and future applications of bio-sciences

CO	CO Statement	POs/PSOs	CL	KC	Class sessions
CO1	Understand the basic principles of human genetics, the disorders associated with it and awareness on pre natal diagnosis	PO1 PSO3	U	c	9

CO2	Understand the genetic principle of blood group inheritance, importance of blood donation, causes of infertility, DNA fingerprinting and its applications	PO5 PSO3	U	c	9
CO3	Understand psychoneuroimmunology of physical activity, exercise, yoga and programmes related to community health promotion	PO5 PSO3	U	c	8
CO4	Understand the importance of balanced diet, and awareness on nutritional disorders	PO1 PSO3	U	c	5
CO5	Understand the principles of accident prevention and first aid	PO5 PSO3	U	c	5
CO6	Understand the pathology of water borne diseases and their prevention; waste water and solid waste management	PO4 PSO3	U	c	12
CO7	Understand the microbiology of food borne diseases and their prevention	PO4 PSO3	U	c	12
CO8	Understand the pathology and control measures of emerging diseases, vector borne and life style diseases	PO4 PSO3	U	c	12

PART I HUMAN GENETICS

18 hrs

Module I Human normal chromosome complement. Genetic disorders in man. **9 hrs**
 Chromosomal anomalies. Eg. Down Syndrome and Cri-du chat syndrome. Sex chromosomal anomalies – Syndromes- Klinefelters Syndrome and Turners Syndrome. Pre – natal Diagnosis (Amniocentesis, and Chorionic Villus Sampling) Ultra sound scanning and Fetoscopy Genetic Counselling. Eugenics and Euthenics.

Core Readings

Zoological Society of Kerala Study Material Series 2002– Cell biology Genetics & Biotechnology published by Zoological Society of Kerala.

Module II	<p>Human blood groups and their inheritance pattern. Rh factor Blood transfusion – Universal Donor, Universal recipient – Importance of Blood donation.</p> <p>DNA finger printing and applications – Probing for criminals – Method to resolve paternity and maternity disputes.</p> <p>Causes of human infertility – a brief account. Human genome project – a brief account.</p> <p>Core Readings</p> <p>Zoological Society of Kerala Study Material Series 2002– Cell biology Genetics & Biotechnology published by Zoological Society of Kerala.</p>	9 hrs
PART – II NUTRITION AND COMMUNITY HEALTH		15 hrs
Module III	<p>Health and Nutrition</p> <p>Definition and Meaning of Health, Dimensions and Determination of Health</p> <p>Concept of Food and Nutrition, Food Stuffs – Carbohydrates, Proteins, Lipids - their sources and importance.</p> <p>Vitamins - their sources and importance, Deficiency Disease</p> <p>Minerals – their role in body functions, resources</p> <p>Importance of water and roughage in diet</p> <p>Concept of Balanced diet, Malnutrition and associated problems</p> <p>Determination of Caloric intake and expenditure, Body Mass Index (BMI) and its importance, Lifestyle diseases - Obesity, causes and preventing measures, Diabetese, Cardiovascular disorders - Prevention and Management.</p> <p>Core Readings</p> <p>K Park, (2008) Park’s Text Book of Preventive and Social Medicine 18th Edition. BanarasidassBhenot Publication.</p> <p>Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book.</p>	10 hrs
Module IV	<p>Physical Activity and Health benefits</p> <p>Physical activity, Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular</p>	5 hrs

Health and Safety in daily life, Principles of Accident prevention, Common injuries and their management, First aid and emergency care.

Emotional adjustment and well being, Psychoneuroimmunology.

Core Readings

Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi.

Fashey , Tomas D, Insel , Paul M and Roth Walt (2005) Fit and Well. New York; Mc Graw Hill Inc

Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow

PART III COMMUNITY HEALTH AND SANITATION

39 hrs

Module V Public health and water quality. Prevention of Water borne diseases. Potable water quality monitoring and waste water management. Faecalbacteriae and pathogenic microorganisms transmitted by water. Cholera and Typhoid. Determination of sanitary quality of drinking water, water purification techniques. **12 hrs**

Core Readings

Pelczar M.J. Jr. E.C.S. Chane& N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.

Module VI Public Health and Food borne diseases and their prevention **12 hrs**

Food poisoning caused by toxins produced by microbes eg Staphylococcal food poisoning, Botulism, Salmonellosis

Food infection caused by growth of microorganisms in the human body after the contaminated food has been eaten. Eg Food Infection hepatitis

(hepatitis A)

Core Readings

Pelczar M.J. Jr. E.C.S. Chane& N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

Panicker S, Franis G And Abraham g. (2008) Microbiology & Immunology. Zoological Society Study Material Series. Published by Zoological Society of Kerala.

Module VII Public health and diseases (a) Emerging pathogens and diseases – Swine flue (H1N1), bird flue (H5N1), Reemerging pathogens and diseases – TB **12 hrs**

(b) Vector borne diseases (mosquito) and their control measures (Malaria, Filariasis, Chikungunya and Dengu fever)

(c) Leptospirosis and preventive measures – Rodent control measures

(d) Cancer different types, causes of cancer, carcinogens, diet & cancer

(e) HIV, AIDS – causes & preventive measures

Core Readings

Zoological Society of Kerala Study Material Series 2002– Cell biology Genetics & Biotechnology published by Zoological Society of Kerala.

K Park, (2008) Park’s Text Book of Preventive and Social Medicine

BanarasidassBhenot Publication.

Community Health Promotion – Definition of community Health, Importance of community Health, Programmes on Community health promotion (Individual, Family and Society), Dangers of alcoholism and drug abuse, medico-legal implications.

Module VIII **3 hrs**

Core Readings

K Park, (2008) Park’s Text Book of Preventive and Social Medicine

BanarasidassBhenot Publication.