Foreword

The Board of Studies in Biotechnology (Pass) of the University of Kerala decided to revise the syllabus of the Biotechnology UG courses with effect from the academic year 2019-20 as part of its continued efforts to provide the latest information to the students. Accordingly, the Board of studies in Biotechnology held series of discussions and a workshop of two days duration involving representatives of the colleges offering B. Sc. courses in Biotechnology under the University of Kerala during 27th and 28th September 2018 at the Seminar Hall, Department of Botany, University of Kerala, Kariavattom. A total of 25 teachers from 12 different Colleges offering the two courses participated in the workshop. After detailed deliberations and incorporating the suggestions of experts such as Dr. G. M. Nair, Chairman, Kerala Biotechnology Commission, Dr. Suhara Beevy, Head, Dept. of Botany, University of Kerala, the syllabus was revised. The existing syllabi were updated by addition relevant information contents and online resources. The various directions of UGC and University of Kerala regarding courses on Disaster Management, Informatics, Environmental Studies etc. were discussed and included in the syllabus in the appropriate places. The following BOS members functioned as coordinators of the two streams:

Dr. P. S. Jairani - Group 2 (b); BIOTECHNOLOGY (Multi-major)

Dr. Dinesh Raj R. - Group 2 (a); BOTANY & BIOTECHNOLOGY

The syllabi, prepared by the teachers and compiled by the coordinators were circulated among the participants and others from all the colleges offering the courses by Email/WhatsApp and feedback incorporated. The draft syllabus was discussed and approved by the Boad of Studies held on 10th January 2019. The Chairman and Members of the Board of Studies would like to place on record their gratitude to the entire faculty who took part in the discussion and contributed to the design of the syllabus, which will be effective from the academic year 2019-20. The Chairman places on record his deep sense of appreciation to the Registrar, Head, Department of Botany, University of Kerala, Members of Board of Studies in Biotechnology (Pass), especially Dr. A. Gangaprasad, office staff of the Department of Botany, University of Kerala, the teachers who participated in the workshop and all the administrative staff of the University Academic and Audit Sections and Department of Botany for their timely help and directions. Comments and suggestions for improvement are welcome.

Thiruvananthapuram
08-02-2019

Dr. G. Nagendra Prabhu
Chairman, BOS in Biotechnology (Pass)

UNIVERSITY OF KERALA

Career-related First Degree programme

Under CBCS System

Group 2 (a)

BOTANY & BIOTECHNOLOGY

Course Structure & Syllabus

(For those who joined the course from the academic year 2019 onwards)

Foundation Courses, Core Courses, Vocational Courses and Open /Elective Courses

2019

Eligibility for admission to Career Related First Degree Programme in Botany and Biotechnology (BSc. Botany and Biotechnology)

Candidates shall be admitted to the course provided he/ she has passed plus two examinations of the state or central board with biology as one of the subjects.

Aim and Objectives

The Career related first degree programme in Group 2(a) is a two main course with Botany as core and Biotechnology as Vocational Core subject is designed to develop a scientific attitude and an interest towards the modern areas of Biotechnology in particular and life science in general. It is aimed to get an aptitude in Biotechnology without losing the importance of basic science such as Botany. It will help the students to become critical and curious in their outlook. The courses are designed to impart the essential basics in Botany, Zoology, Chemistry, Biochemistry and Biotechnology.

The programme consists of Language courses, Foundation courses, Complementary courses, Core courses and open or Elective courses. There are two foundation courses, one is focused on the modern information technology, statistics and its application in modern life sciences, and a general introduction and awareness on Biotechnology and its influence in human life. The second foundation course is to give a general introduction and awareness in the general instrumentation and its principles and application in Biology and Biotechnology, in addition to give biophysical basics.

The various courses in the programme is aimed to develop proficiency in the theory as well as practical experiments, common equipments, laboratory, along with the collection and interpretation and presentation of scientific data in proper manner. In addition to this, students will be equipped with knowledge in the modern areas of biotechnology and its application in medical science, agriculture, industry, proteomics, genomics, bioinformatics, nanobiotechnology *etc*. Apart from understanding biotechnology and its power in developing the nation, it will create awareness about biotechnology and will help in eliminating public fear about the contribution of biotechnology and confusion on GM crops, GM foods and transgenic organisms. Students, who pursue this programme and pass out successfully, will surely have an urge to continue higher studies in Biotechnology and contribute significantly in its development.

The total minimum credits of the programme is 120 and the various courses and its corresponding credits are depicted in the following table, which is followed by the general structure and semester wise allocation of courses, its credits and contact hours.

The subject code is BB (Botany & Biotechnology)

1 - Language
1.1 - Additional Language
2 - Foundation course
3 - Complementary Course
4 - Core courses
5 - Open course
6 - Project
7 - Vocational Core Course
8 - Elective Course

Evaluation of Examination

Distribution of marks in theory and practicals between external and internal assessment is 80: 20. Pass minimum of 40% for external and overall components.

Career Related First Degree Programme

Group 2(a)

BOTANY & BIOTECHNOLOGY

Summary of courses

	Study Components		No. of courses	Credits /course		Max / Total Credits
1	**Languages**					
	1	**English**	4	3		12
	2	**Additional Language**	2	3		6
2	**Foundation Course**		2	2-3		5
	1	Methodology and Perspective of Biotechnology	1	3		
	2	Biophysics and Instrumentation	1	2		
3	**Complementary Courses**		5	2-4		14
	Biochemistry			T	P	
	1	Introduction to Biochemistry		3		
	2	General Biochemistry		3		
	3	Physiological aspects of Biochemistry		4		
	4	Metabolism		2		
	5	Practical Biochemistry IV (Practical of 1, 2, 3 & 4)			2	
4	**Core Courses**		27	2- 4		75
	Botany		13	L	P	35
	1	Angiosperm Anatomy and Reproductive Botany		2		
	2	Environmental Studies		3		
	3	Practical Botany I (Practical of 1 & 2)			2	
	4	Phycology, Mycology, Lichenology & Plant Pathology		3		
	5	Horticulture, Mushroom Cultivation & Marketing		4		
	6	Bryology, Pteridology, Gymnosperms & Paleobotany		2		
	7	Cell biology, Plant breeding and evolutionary biology		2		
	8	Practical Botany II (Practical of 4, 5,6 & 7)			2	
	9	Plant Physiology		4		
	10	Angiosperm Morphology & Systematic Botany		4		
	11	Genetics		3		
	12	Economic Botany, Ethnobotany & Medicinal Botany		2		
	13	Practical Botany III (Practical of 9, 10,11 & 12)			2	

7	**Biotechnology (Vocational core)**		14	2-4		40
	1	Microbiology	1	4		
	2	Microbial Metabolism, Genetics & Diseases	1	3		
	3	Biotechniques I (Practical of 1 and 2)			2	
	4	Protista and Animal Diversity	1	4		
	5	Animal Physiology and Anatomy	1	3		
	6	Molecular Biology	1	3		
	7	Immunology	1	2		
	8	Biotechniques II (Practical of 4,5,6 & 7)			2	
	9	Recombinant DNA Technology	1	4		
	10	Plant Biotechnology	1	3		
	11	Animal Biotechnology	1	3		
	12	Industrial Biotechnology	1	3		
	13	Environmental Biotechnology	1	2		
	14	Biotechniques III (Practical of 9,10,11,12 & 13)			2	
5	**Open Courses of Vocational Subject**		3	2		2
	1	Bioinformatics		2		
	2	Food and dairy Biotechnology		2		
	3	Basics of Environmental Biotechnology		2		
8	**Elective Courses of Vocational Subject**		3			2
	1	Bioinformatics and Nanobiotechnology		2		
	2	Genetic Engineering		2		
	3	Food and Dairy Biotechnology		2		
6	**1**	**Project**	1	4		4
				Total C		120

T- Theory

P- Practical

Course structure and syllabus of Career Related First Degree in Biotechnology (2a) as per the regulations of CBCS

The Career related first degree programme in Group 2(a) Botany as core subject Biotechnology as Vocational Core subject consists of a total of 42 courses distributed in eight categories. They are language courses, foundation courses, Complementary courses, Core courses, Vocational Core courses, Open course of vocational core subject, Elective course of vocational core subject and a project. The project is compulsory and the students may be assigned a topic for the project in the 5^{th} semester itself and should be completed and submitted during the practical assessment at the end of VI semester. The total credits of the entire programme is 120, and the distribution of credits, contact hours etc. for each course in each semester is summarized below as tables. Total credits for each semester is 20 and contact hours is 25 per week and the total working hours for a semester is 450.

Each course title is represented by a course code consisting of a two letter subject code followed by four digits. The first digit indicates the first degree programme, which is always one. The second digit indicated the semester number which is 1-6, the 3rd digit denotes the category of the course which ranges from 1-8, since there are eight categories and the last digit indicates the serial number of the course with in a semester. The following are the category of courses included in the Career Oriented First Degree Programme under the group 2(a).

Summary of Semester wise hour distribution

SEMESTER I

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University*	*Marks for Evaluation*	
		T	*P*			*Exam*	*CE*	*ESE*
EN 1111	English	5		90	3	3Hrs.	20	80
1111.1	Additional language	5		90	3	3Hrs.	20	80
BB 1121	Methodology and Perspective of Biotechnology	3		54	3	3Hrs.	20	80
BB 1131	Introduction to Biochemistry	3	2	90	3	3Hrs.	20	80
BB 1141	Angiosperm Anatomy and Reproductive Botany	2	2	72	2	3Hrs.	20	80
BB 1171	Microbiology	2	1	54	4	3Hrs.	20	80
	Total	25		450	18			

Hour distribution: BT 6, BO 4, CC 5, LC 5+5 = 25

SEMESTER II

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University*	*Marks for Evaluation*	
		T	*P*			*Exam*	*CE*	*ESE*
EN1211	English	5		90	3	3Hrs.	20	80
1211.1	Additional language	5		90	3	3Hrs	20	80
BB1221	Biophysics and Instrumentation	2		36	2	3Hrs	20	80
BB1231	General Biochemistry	3	2	90	3	3Hrs	20	80
BB1241	Environmental Studies	3	2	90	4	3Hrs	20	80
BB1242	Practical Botany I (Practical of BB1141 & BB1241)				2	3Hrs	20	80
BB1271	Microbial Metabolism, Genetics and Diseases	2	1	54	3	3Hrs	20	80
BB1272	Biotechniques I (Practical of BB1171, BB1271)				2	3Hrs	20	80
	Total		25	450	22			

Hour distribution: BT 5, BO 5, CC 5, LC 5+5 = 25

SEMESTER III

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University*	*Marks for Evaluation*	
		T	*P*			*Exam*	*CE*	*ESE*
EN1311	English	5		90	3	3 Hrs	20	80
BB1331	Physiological aspects of Biochemistry	3	2	90	4	3 Hrs.	20	80
BB1341	Phycology, Mycology, Lichenology & Plant Pathology	3	1	72	3	3 Hrs	20	80
BB1342	Horticulture, Mushroom Cultivation & Marketing	3	1	72	3	3 Hrs	20	80
BB1371	Protista and Animal Diversity	3	1	72	4	3 Hrs	20	80
BB1372	Animal Physiology and anatomy	2	1	54	3	3 Hrs	20	80
	Total		25	450	20			

Hour distribution: BT-7, BO-8, CC-5, EN-5 = 25

SEMESTER IV

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University*	*Marks for Evaluation*	
		T	*P*			*Exam*	*CE*	*ESE*
EN1411	English	5		90	3	3 Hrs.	20	80
BB1431	Metabolism	3	2	90	2	3 Hrs.	20	80
BB1432	Practical Biochemistry IV (Practicals of BB1131, BB1231, BB1331, & BB1431)				2	3 Hrs.	20	80
BB1441	Bryology, Pteridology, Gymnosperms & Paleobotany	3	1	72	2	3 Hrs.	20	80
BB1442	Cell biology, Plant breeding and evolutionary biology	3	1	72	2	3 Hrs.	20	80
BB1443	Practical Botany II (Practicals of BB1341, BB1342, BB1441 & BB1442)				2	3 Hrs.	20	80
BB1471	Molecular Biology	3	1	72	3	3 Hrs.	20	80
BB1472	Immunology	2	1	54	2	3 Hrs.	20	80
BB1473	Biotechniques II (Practical of BB1371, BB1372, BB1471 & BB1472)				2	3 Hrs.	20	80
	Total		25	450	20			

Hour distribution: BT-7, BO-8, CC-5, EN-5 = 25

SEMESTER V

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University*	*Marks for Evaluation*	
		T	*P*			*Exam*	*CE*	*ESE*
BB1541	Plant Physiology	4	2	108	4	3 Hrs	20	80
BB1542	Angiosperm Morphology & Systematic Botany	4	2	108	4	3 Hrs	20	80
BB1571	Recombinant DNA Technology	3	1	72	4	3 Hrs	20	80
BB1572	Plant Biotechnology	2	1	54	3	3 Hrs	20	80
BB1573	Animal Biotechnology	2	1	54	3	3 Hrs	20	80
BB1551.1	Open course: Bioinformatics	3		54	2	3 Hrs	20	80
BB1551.2	Food and Dairy Biotechnology	3		54	2	3 Hrs	20	80
BB1551.3	Basics of Environmental Biotechnology	3		54	2	3 Hrs	20	80
	Total	18	7	450	20			

Hour distribution: BT-10+OC 3, BO-12 = 25

SEMESTER VI

Course code	*Course Title*	*Teaching hrs./week*		*Total Hrs*	*Total Credits*	*Duration of University*	*Marks for Evaluation*	
		T	*P*			*Exam*	*CE*	*ESE*
BB1641	Genetics	4	3	126	3	3 Hrs.	20	80
BB1642	Economic Botany, Ethnobotany & Medicinal Botany	4	2	108	2	3 Hrs.	20	80
BB1643	Practical Botany III (Practical of BB1541, BB1542, BB1641, BB1642)				2	3 Hrs.	20	80
BB1671	Industrial Biotechnology	2	2	72	3	3 Hrs.	20	80
BB1672	Environmental Biotechnology	2	2	72	2	3 Hrs.	20	80
BB1673	Biotechniques III (Practical of BB1571, BB1572, BB1573, BB1671 & BB1672)				2	3 Hrs.	20	80
BB1681.1	Elective Course: Bioinformatics and Nanobiotechnology	2		36	2	3 Hrs.	20	80
BB 1681.2	Genetic Engineering	2		36	2	3 Hrs.	20	80
BB 1681.3	Food & Dairy Biotechnology	2		36	2	3 Hrs.	20	80
BB1661	Project on Biotechnology Tutorial 2			36	4	3 Hrs.	20	80
		25		450	20			

Hour distribution: BT-8+P2+EC2, BO-13 =25

Total work Load in Hours

Subjects	*Work Load in Hours*
Core-Botany	900
Vocational core -Biotechnology	900
Complementary -Biochemistry	360
English	360
Second Language	180
Total	2700

- **Project/Dissertation** is compulsory. It can be carried out individually or by a group not exceeding five students. The topic of the project should be innovative and relevant to the field of Biotechnology. The topics are either be allotted by the supervising teacher or be selected by the students in consultation with the supervising teacher. The project report duly attested by the Supervising teacher and certified by the HOD has to be submitted on the day of Viva voce examination. The project shall be evaluated by two external examiners. The report (not less than 40 pages) should be prepared as per the following formats.

1. Title page
2. Declaration by the student
3. Certificate (Supervising teacher and HOD)
4. Acknowledgement if any
5. Table of contents
6. Abbreviations if any
7. Introduction and Review of literature
8. Materials and Methods
9. Results and Discussion
10. Summary and Conclusions
11. References

Care should be taken to represent the data in tables/graphs /figures.

Field visit: It is compulsory that every student has to undertake a field study tour of not less than three days for observing plant diversity under the guidance of teachers of the Department during V or VI semester. Moreover, they have to submit a tour report countersigned by the Head of the department during the practical examination of BB1643. If a student fails to undergo the study tour he /she may not be permitted to attend the examination.

Industry or Institute visit: It is also compulsory that every student has to undertake an Industry or Institute visit as part of their Biotechnology curriculum. They have to submit the report of the same, duly certified by the Head of the Department during the practical examination of BB1673.

Semester I
Foundation Course
BB 1121 Methodology and Perspective of Biotechnology

Credits 3 **Contact hours- 54**

Aim and Objectives: *The aim is to introduce the modern scientific methods and to familiarize Biotechnology and its various areas. The students will be able to understand how science works. Students will learn how to apply statistics and IT in Biological science. They will receive a general awareness about Biotechnology and its application in various fields.*

Module I
Science, Design and planning of experiment **8 hrs**

Basic concepts of – What is Science, Need for scientific research, Importance of reviewing the literature, Hypothesis formulation (Null and alternate hypothesis - definition only), Basis of designing research (sample design and research design), types of data and methods of data collection, Interpretation and report writing.

Module II
Data handling in science and Biostatistics **10 hrs**

Significance of statistical methods in biological investigations; classification and tabulation, graphical and diagrammatic representation, central tendency- Mean, Median, Mode- any one method with simple problems. Standard Deviation, Variance, standard error. Hypothesis testing (Chi square test).

Module III:
Overview of Information of Technology **15 hrs**

Introduction to Computers, Types, Features of modern personal computers and peripherals, Characteristic of hardware and software, overview of operating systems and major application software,. Introduction to use of IT in teaching and learning- educational software- INFLIBNET, NICNET, BRNET; online learning platforms – MOOCS, Swayam**,** Internet as a knowledge repository- Google scholar, Science direct.

Application of IT in Medicine, Healthcare, Industry, Crime detection, Publishing, Communication, Resource management and Education. Cyber ethics, Cyber security, cyber-crime, security privacy issues

Module IV: **15 hrs**
Origin and development of Biotechnology - Introduction and definitions, Historic perspectives, classical concepts of Biotechnology, beginning of modern Biotechnology. Scope of Biotechnology- Commercial potential, Biotechnology in India and its global trends, Major Biotechnology institutes and companies in India.

Application of Biotechnology (Basic idea with only applications needed).

Environmental Biotechnology, Genetic engineering - gene cloning; Medical Biotechnology- Safer and cheaper medicines by Biotechnology; Agricultural Biotechnology - Genetically Modified crops; Food Biotechnology - application of Biotechnology in food processing, Traditional and modern food processing.

Module V
Safety and Ethics in Biotechnology- 6 hrs

Good Laboratory Practices (GLP), Good Laboratory Practices for Students, Quality control in manufacturing, Good manufacturing Practices (GMP), Marketing of Biotechnology Products. Impact of Biotechnology on Society, Ethical issues in Biotechnology. IPR and Patents in Biotechnology - basic concepts of IPR, patents and copyrights, plagiarism.

Suggested Readings

1. An Introduction to Biostatistics: A Manual for studies in Health Sciences., P. Sundar Rao, and J. Richard, Prentice Hall .
2. Biotechnologies and the Public: An International Study of Policy, Media Coverage and Public Attitudes from 1973 to 1996 (1995-1998), Helge Torqersen, Institute of Technology Assessment.
3. Biotechnology and Ethics: A Blueprint for the Future, Daniel Callahan President, Hastings Center, Center for Biotechnology, Northwestern University.
4. Biotechnology: Issues, Ethics and Regulations, Tina M. Prow, Communications Specialist, Office of Agricultural Communications and Education.
5. Computers Today, Alexis Leon and Mathews Leon., Leon Vikas.
6. Conceptual Integrated science, Hewitt, Paul G, Suzanne Lyons, ohn A. Suchocki & Jennifer Yeh, Addison-Wesley.2007.
7. Cultural Boundaries of Science, Gieryn, T.F. University of Chicago Press, 1999.
8. Fundamentals of Information Technology, Alexis and Mathew Leon., Leon Vikas
9. Introduction to Genetic Engineering & Biotechnology, Nair, A.J., Infinity Science Press, USA.
10. Introduction to Information Technology, V. Rajaraman., Prentice Hll.
11. Learning Computer Fundamentals., Ramesh Bangia ., Khanna Book Publishers
12. Methods for Teaching Science as Inquiry, Bass, Joel, E and et. al., Allyn & Bacon, 2009 The truth of science, Newton R.G.,
13. Patenting in Biotechnology - Part I, R. Stephen Crespi, Tibtech, Vol. 9, 117-122, 1991.
14. People's Perception of Biotechnology, Renato Schibeci, Ian Barns.
15. Plant Biotechnology: Facts and Public Perception, D. Boulter, Department of Biological Sciences, University of Durham, South Road, Durham DH1 3LE, U.K. 'Phytochemistry' (Vol. 40, No.1, pp.1-9, 1995).
16. Public Attitudes to Genetically Engineered Products, Wendy Ross, Katy Marsh, Alexi Jackson, Jaqui Skoyles, (1998), John Innes Centre, Norwich, U.K.
17. Social issues in Science and Technology: An Encyclopedia, David E. Newton (ABC-CLIO, Santa Barbara), 1999.
18. The Golem: What everyone should know about science, Collins H. and T. Pinch, Cambridge University Press, 1993.

Semester I
Core Course
BB1141 Angiosperm Anatomy and Reproductive Botany

Credits 2 **Contact Hours 72 (T 36 + P 36)**

Aim and objectives: *The course is aimed to bring the basic concept and understanding about the anatomy of the flowering plants and its relationship to the physiology and environmental adaptability of the plants. It also gives a basic idea on the reproduction and development of the flowering plants and its adaptation to suit to its environment.*

Angiosperm Anatomy

Module- I **7 hrs**

1. Objectives, methodology and scope of plant anatomy. Basic techniques- Sectioning - Killing and fixation (FAA and Carnoy's fluid), Dehydration (Ethanol, Isopropyl alcohol, Glycerine), Stains (Saffranin, Haematoxylin and Acetocarmine) and staining techniques, Mounting (Canada balsam, DPX).
2. Cell wall organization - Gross structure - Primary and secondary wall - pits – plasmodesmata - microscopic and sub microscopic structures – Extra cell wall material. Non-living inclusions of the cell – Reserve food - secretory products and byproducts.

Module –II **10 hrs**

3. Tissues – Meristems, Definition, Classification based on origin, position, growth patterns, functions.
4. Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica Corpus theory. Organization of root apex in dicots & monocots.
5. Permanent tissues – Definition, classification - simple, complex and secretory.
6. Tissue systems – Epidermal tissue systems-stomata, structure and functions, Ground tissue systems & vascular tissue systems. Different types of vascular arrangements.

Module III **9 hrs**

7. Primary structure – Root, stem and leaf [Dicot & Monocot].
8. Secondary growth - Root and stem - cambium (structure and function), Growth rings, heart wood and sap wood, tyloses, ring porous wood and diffuse porous wood, periderm formation - phellum, phellogen and phelloderm; Lenticels.
9. Anomalous secondary growth - *Bignonia*, *Boerhaavia*, *Dracaena*.

Module IV

Reproductive Botany **8 hrs**

1. Introduction to angiosperm embryology
2. Microsporogenesis - structure and functions of wall layers. Development of male gametophyte - Dehiscence of anther.
3. Megasporogenesis - Development of female gametophyte - Embryo sac - Development and types- Monosporic – *Polygonum* type, Bisporic - *Allium* type, Tetrasporic – *Adoxa* type.
4. Pollination - Germination of pollen grains – Double Fertilization.
5. Structure of Embryo- Dicot [*Capsella*], Monocot [*Sagittaria*] Endosperm types, its development and functions.

Module V **2 hrs**

Palynology: Pollen structure and morphology, viability test for pollen grains (Tetrazolium test and Fluorescein diacetate test). Pollen allergy.

Practical

Anatomy **26 hrs**

1. Preparation and composition of Fixatives (FAA and Carnoy's Fluid), Stains (Acetocarmine, Saffranin, Haematoxylin), Mounting mediums (Canada balsam, DPX).
2. Non-living inclusions - Cystolith, Raphide, Sphaero-raphide, Aleurone grains.Starch grains (Eccentric, concentric, compound)
3. Simple permanent tissue-Parenchyma, Chlorenchyma, Aerenchyma, Collenchyma and Sclerenchyma
4. Secretory tissue: Resin canal, Lysigenous and Schizogenous cavities. Laticifers – Articulated and non-articulated
5. Primary structure – Dicot stem: *Hydrocotyle, Eupatorium* or any normal type, Bicollateral (*Cephalandra*)
6. Monocot stem: Grass, *Asparagus* or any normal type.
7. Dicot root: Pea, *Limnanthemum* (*Nymphoides*) or any typical dicot root
8. Monocot root: *Colocasia* or any typical monocot root.
9. Secondary structure - Stem - *Vernonia* or any normal type
10. Secondary structure - Root - *Tinospora, Carica papaya*, or any normal type
11. Stomatal types (anomocytic, anisocytic, diacytic and paracytic)
12. Anomalous secondary thickening - *Bignonia, Dracaena, Boerhaavia*
13. Leaf anatomy - Dicot leaf: *Ixora*. Monocot leaf: Grass

Reproductive Botany **8hrs**

Students should be familiar with the structure of anther (mature and young) and embryo (dicot and monocot) using permanent slides.

Estimation of pollen sterility and fertility percentage – Acetocarmine method

Palynology **2hrs**

Study of pollen morphology of the following plants –*Hibiscus, Vinca, Balsam, Ixora, Crotalaria, Bougainvillea* by microscopic observation.

Suggested Readings

1. Esau K. (1965) - Plant Anatomy – Wiley Eastern, New York.
2. Fahn A. (2000) - Plant Anatomy – Pergamon Press, Oxford.
3. Pijush Roy (2010) Plant anatomy
4. Pandey, B .P. (1997) - Plant Anatomy - S.Chand and co. New Delhi
5. Vashista .P. C (1984) - Plant Anatomy – Pradeep Publications – Jalandhar
6. Prasad and Prasad (1972) Out lines of Botanical Micro technique, Emkay publications, New Delhi.
7. SN Pande and Chadha A. Plant anatomy and Embryology. Vikas Publishing
8. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verleg, Berlin.
9. Maheswari P. - Embryology of Angiosperms - Vikas Pub:
10. P.K.K. Nair. Palynology of Angiosperms
11. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
12. Bhojwani, S. S. and S. P. Bhatnagar. 2008. The Embryology of Angiosperms (5th Ed.), Vikas Publishing House, Delhi.

Semester I
Core Course Vocational
BB1171 Microbiology

Credits- 4 **Contact hours-54 (T 36 + P 18)**

Aim and Objective*: The course on Microbiology is destined to give a thorough and basic understanding in various aspects of classical Microbiology, which forms the basis of any Biotechnology application. Students are expected to master the major theoretical and practical expertise from this course.*

Module I
Introduction **6 hrs**

Scope and history of Microbiology: Pasteur's experiments, Diversity of Microbial world Sterilization - concept of sterilization, methods of sterilization - dry heat, wet heat or steam, radiation, chemical and filtration.

Module II **7 hrs**

Classification of bacteria; concept of microbial species, strains, biovars, serovars. Brief introduction to Bergey's manual.

Microbial cell structure - Comparison of Eukaryotic and Prokaryotic cells, Structure of Gram positive and Gram negative bacteria; Motility in bacteria, kinds of flagella and ultra-structure of flagella; Sporulation.

Module III
Bacterial nutrition **7 hrs**

Culture media - types and uses, Bacterial growth curve, factors affecting growth of microbes; measurement of growth; Batch culture, fed batch culture and continuous culture; Synchronous growth of microbes.

Pure culture Methods: Direct plating, Serial dilution technique, Spread plate, Streak plate, Pour plate; Slant culture and Stab culture, Anaerobic bacterial culture (any two methods).

Module IV **6 hrs**
Agricultural Microbiology

Biological nitrogen fixation, free living and symbiotic nitrogen fixation, Mechanism of Nitrogen fixation; Mycorrhizal associations; Biofertilizers- types and applications; Rhizosphere effect

Module V
Environmental Microbiology **6 hrs**

Biogeochemical cycles-Carbon, Nitrogen, Sulphur and Phosphorous; Methanogenic bacteria Extremophiles – Thermophiles, Acidophiles, Halophiles and Alkalophiles; Biotechnological application of extremophiles

Module VI
Virology **4 hrs**

Viruses, general characteristics, structure of viruses. Bacteriophages - structure of T4 bacteriophage; Lytic and Lysogenic cycles. Viral culture.

Experiments for Microbiology Practical **18 hrs**

1. Laboratory safety and good laboratory practices.
2. Principles and application of laboratory instruments - Microscope, Incubator, Autoclave, Centrifuge, LAF, Filtration unit, Shaker, pH meter.
3. Cleaning and sterilization of glassware.
4. Preparation of media - Nutrient Agar and Broth.
5. Inoculation and culturing of Bacteria in Nutrient agar and Nutrient broth.
6. Preparation of agar slant, stab, agar plate.
7. Purification techniques- streak plating method- T streaking, Quadrant, Zig Zag; pour plate, spread plate.
8. Staining of Bacteria- Simple staining, Gram staining and Negative staining.
9. Growth of Bacteria in liquid media: Determination of kinetics of bacterial growth.
10. Microscopic tests for bacterial motility – Hanging drop method.
11. Isolation of bacteria from air – open plate method.
12. Enumeration of bacteria in a given soil sample using pour plate method.
13. Microbiological examination of water samples- Standard plate count method

Suggested Readings

1. A Textbook of Microbiology – P. Chakraborthy, New central Book agency Pvt. Ltd, Calcutta.
2. Modern concept of Microbiology – D. D. Kumar, S. Kumar; Vikas Publishing House Pvt. Ltd. New Delhi.
3. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
4. Introduction to Microbiology- J Heritage, E G V Evans, R A Killington; Cambridge University Press.
5. Microbiology (9^{th} Ed) - Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York.
6. Principles of Biotechnology – A. J. Nair, Laxmi Publications, New Delhi.
7. Advances in Microbiology – J. P. Tewari, T. N. Lakhanpal, I. Singh, R. Gupta and B. P. Chanola; A. P. H. Publishing Corporation, New Delhi.
8. Microbiology: Principles and Explorations – Jacquelyn G. Black. Prentice Hall, New Jersey.
9. Microbiology- P D Sharma; Rastogi Publications, Meerut.
10. Holt J. S., Krieg N. R., Sneath, P.H.A. and Williams S. T. 1994. Bergey's Manual of Determinative bacteriology. (9th ed).Williams & Wilkins, Baltimore.
11. Brock Biology of Microorganisms (15th Edition). Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl. NY : Pearson, [2018]
12. Microbiology: An Introduction, 12th Edition, Gerard J. Tortora, Berdell R. Funke, and Christine L. Case. Pearson, [2016]

Semester II
Foundation Course
BB1221 Biophysics & Instrumentation

Credits: 2 **Contact hours 36**

Aim and Objectives*: The aim is to introduce the physical aspects and bioenergetics of the living system and to familiarize the principle and working of various instruments used in Biotechnology experiments. The students will be able to understand the fundamentals of Biophysics and the general instrumental techniques used in Biotechnology.*

Module I
Introduction to Biophysics: **8 hrs**

Laws of thermodynamics (excluding problems); Mechanism of vision, vision faults and their correction; hearing, generation and reception of sonic vibrations, hearing aids; fluorescence and phosphorescence; Isotopes and radioisotopes, radioactive tracer technique, Autoradiography.

Module II
Biophysics of Respiration **7hrs**

Oxidative phosphorylation - Respiratory electron transport chain and sequence of electron carriers, synthesis of ATP; structure of ATP synthase, chemiosmotic hypothesis, Bioenergetics of respiration.

Module III **6 hrs**
Microscopy

Principle of Microscopy, various types of Microscopy - Simple, Phase contrast, Fluorescence and Electron microscopy (TEM and SEM), Modern developments in Microscopy- Atomic force microscopy, Confocal microscopy.

Module IV **9 hrs**
Bioinstrumentation

Basic principles and working of instruments - pH meter, Spectrophotometer (UV and Visible) and colorimeter- Beer-Lambert law. Brief account on fluorimetry, IR, NMR and X-ray crystallography, Mass spectrometry, differential & density gradient centrifugation, Flow cytometry (FACS).

Module V **6 hrs**

Electrophoresis - Principle of electrophoresis, Components of Polyacrylamide gels, native gel electrophoresis, SDS-PAGE, Immuno electrophoresis, Isoelectric focusing, Submarine electrophoresis.

Suggested Readings

1. A Textbook of Biophysics – R. N. Roy, New central Book Agency Pvt. Ltd, Calcutta.
2. Fundamentals of Biochemistry, Voet, D., Voet, J.G. & Pratt C.W. Jogn Wiley & Sons, Inc.
3. Biophysics- S.Thiruvia Raj, Saras Publications, Tamilnadu.
4. Biophysics, Volkenstein, M.V
5. Introduction to biophysical chemistry Martin

6. Introduction to Genetic Engineering & Biotechnology - A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
7. Lehninger's Biochemistry , Nelson D.L and Cox, M.M., Worth Publishers, New York
8. Molecular Biology of the gene, 7th Edition. Watson et al. Pearson © 2016
9. Principles of Biotechnology- AJ Nair, Laxmi Publications, New Delhi.
10. Biochemistry; Lubert Stryer; (5th Ed) W.H. Freeman and Company, New York.

Semester II
Core Course
BB 1241 Environmental Studies

Credits 4 **Contact Hours 90 (T 54+P 36)**

Aim and Objectives*: Students should acquire a basic understanding about the structure and function of the environment and its interaction with the living systems. It will impart knowledge about the geographical distribution of plants, the impact of human intervention in the environment and the delicate balance of various factors in the environment. It gives an idea about the various types of biodiversity and the influence of environmental pollution on the biodiversity.*

Module I **14 hrs**

1. Definition- Scope and relevance to society. Need for public awareness

Natural Resources

1. Renewable and non-renewable resources.
2. Forest resources: Use and over exploitation. Deforestation.
3. Mineral resources: Use and exploitation, Environmental effects of extracting and using mineral resources.
4. Water resources: Use and over exploitation of surface water and ground water, floods, drought.
5. Food resources: Food problems - Changes caused by agriculture and over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging and salinity.
6. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.
7. Land resources: Land as a resource, land degradation, human induced landslides, soil erosion and desertification.
8. Role of an individual in conservation of natural resources. Understanding the resource ecology and life supporting capacity of resources - Economic models: Green building concept- green technology concept.

Module II **6 hrs**
Ecosystems

1. Ecosystems-Concept of an ecosystem- structure and function of an ecosystem

2. Biotic and abiotic components and energy flow in an ecosystem.
3. Ecological succession - Definition & types.
4. Food chains, food web & ecological pyramids.
5. Types of ecosystem. Characteristic features, structure and functions of the following ecosystems (Brief study only).
   i). Forest ecosystem ii). Grassland ecosystem iii). Desert ecosystem iv). Aquatic ecosystems - Ponds, Streams, Rivers, Oceans and Estuaries.
6. Ecological niche and habitat. Morphological, anatomical & physiological adaptations of plants in different habitats - Hydrophytes, Xerophytes, Halophytes, Epiphytes, Parasites.

Module III **14 hrs**
Biodiversity and its conservation

1. Introduction, Biodiversity Conservation and Biodiversity Act.
2. Definition- genetic, species and ecosystem diversity. Alpha, Beta and Gama diversity, ecotypes & ecological indicators.
3. Value of biodiversity - social, ethical, aesthetic and option values.
4. Biodiversity at global, National and local levels. Hot-spots of biodiversity. India as mega-diversity nation.
5. Biodiversity of Kerala- Western Ghats, Shola forests, Mangroves and wet lands in Kerala. Need of protection of mangrove vegetation.
6. Threats to biodiversity: Climate change, habitat loss, Overexploitation, Invasive species poaching of wild life, anthropogenic pressures on wild life. Problems in wildlife protection.
7. Conservation of Biodiversity. *In-situ* conservation: sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots. *Ex-situ* conservation: botanical gardens, zoos, aquaria, homestead garden; *In-vitro* Conservation: germplasm and gene Bank; tissue culture: pollen and spore bank, DNA bank. National and international programmes for biodiversity conservation. Role of WWF, WCU, CITES, TRAFFIC, Forest Rights Act and Participatory forest management, Eco-tourism and Social Forestry. Ramsar wetland sites.

Module IV **8 hrs**
Social issues and the Environment

1. Unsustainable to sustainable development. Environment protection Act. Air [prevention and control of pollution] Act. Water [prevention and control of pollution] Act. Wildlife Protection Act. Forest conservation Act. Hill preservation Act.
2. Definition causes, effects and control measures of – 1. Air pollution 2. Water pollution 3. Soil pollution 4. Marine pollution 5. Noise pollution 6. Thermal pollution.

3. Solid waste Management- (Brief account only): Causes, effects and control measures of urban and industrial wastes.

Module V **6 hrs**
Natural hazards and disaster management

1. Introduction to Hazards- Hazard classification-types of hazards.
2. Natural Hazards: causes, (continental drift, plate tectonics, sea floor spreading, isostacy etc.,) distribution pattern, consequences and mitigation: Earthquake, Tsunami, Volcanoes, Cyclone, Flood, Drought, Landslide, cold and heat hazards, forest fire, etc.,- causes, types, distribution adverse effects, etc.
3. Manmade hazards, Bomb threat, explosion, hazardous material spill, Fire, Terror attacks, Nuclear hazards.
4. Disaster introduction, disaster Management, Capability, Vulnerability, risk- preparedness and mitigation.
5. Disaster management cycle, community planning, education and Engineered structural strengthening techniques- Hazard zonation and mapping, Risk Reduction Measures-Unexpected loss of income, Financial emergency and Insurance.

Module VI **6 hrs**
Bio-geography of India and Geo-informatics.

1. Principles of Biogeography and vegetation types of India-tropical rain forest, sholas and deciduous forests and dunes and mangroves, scrub jungle, phyto-geographical regions and major forests in India.
2. Remote sensing & GIS applications on Environmental problems and Geo-resource evaluation.

Practicals **36 hrs**

1. Study of morphological adaptations of Xerophytes (*Opuntia, Asparagus, Muehlenbeckia, Casuarina. Acacia, Euphorbia tirucalli*), Hydrophytes (Submerged-*Hydrilla*; Floating-*Eichhornia*, *Salvinia*, *Pistia*; Floating and rooted-*Nymphaea*; Amphibious- *Marselia*), Halophytes (Pneumatophores), Epiphytes (*Vanda, Drymoglossum, Drynaria*) and Parasites (*Loranthus*, *Cuscuta*).

2. Anatomical adaptions of selected Hydrophytes *(Hydrilla* stem, *Nymphaea* petiole) /Xerophytes (*Nerium* leaves, *Casuarina* stem, *Muehlenbeckia* phylloclade) /Epiphyte (Velamen root).

3. Study of plant community by quadrat method.

4. Observation and study of different ecosystems mentioned in the syllabus.

5. Visit at least three local polluted sites and report the major pollutants. Record the same in practical record.
6. Fire/Disaster alarm and response - Mock drill.
7. Phyto-geographical regions of India (Photos or Diagrams).

Suggested Reading

1. Ahluwalia V. K. and Sunitha Malhotra. 2009, Environmental science, Ane Books Pvt. Ltd.
2. Ambasht R. S. **–** Text book of Plant Ecology, Students and Friends & Co., Varanasi.
3. Chandoco S. Weaver and Clements **–** Plant Ecology, McGraw Hill Publications, New York.
4. Chapman J. L. (2006) Ecology - Principles and Application. Cambridge University Press India Pvt. Ltd.
5. Erach Bharucha **–** Text book of environmental Studies for undergraduate Courses, Universities Press, University Grants Commission.
6. Kumaresan B. **–** Plant Ecology & Phytogeography **–** Rastogi Pub:
7. Misra S.P. and Pandey S. N., 2009, Essential Environmental studies, Ane Books Pvt. Ltd.
8. Odum Eugene P. **–** Fundamentals of Ecology, Edn. Philladephia & Saunders, Tokyo, Toppon.
9. Periasamy, K. **–** Elements of Plant Ecology, (M.K. Publications).
10. Prithipal Singh 2007- An Introduction to Biodiversity. Ane Books Pvt. Ltd
11. Sharma, P.D. **–** Elements of Ecology (Rastogi's Company Ltd., Publications).
12. The Geography of Flowering Plants - Good
13. Vashista P.C. – Plant Ecology Edu. Vishali Publications.
14. Verma and Agarwal **–** Principles of Ecology, S. Chand and Co.
15. Verma, P. S. and V. K. Agrawal. 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
16. Paritosh Srivastava. 2017. Disaster Management: Disaster Management and Mitigation approaches in India. PHI Learning. ASIN: B0725CQC2D
17. Tyler Miller G., Scott Spoolman. 2018. Environmental Science (16 Edn) Cengage Learning,

Semester II
Core Course
BB1242: Practical Botany I
(Practical of BB1141 and BB1241)

Credit 2 **Contact hours 72**

BB1341 Angiosperm Anatomy and Reproductive Botany **36 Hrs**

Anatomy

1. Preparation and composition of Fixatives (FAA and Carnoy's Fluid), Stains (Acetocarmine, Saffranin, Haematoxylin), Mounting mediums (Canada balsam, DPX).
2. Non-living inclusions - Cystolith, Raphide, Sphaero-raphide, Aleurone grains.Starch grains (Eccentric, concentric, compound).
3. Simple permanent tissue-Parenchyma, Chlorenchyma, Aerenchyma, Collenchyma and Sclerenchyma
4. Secretory tissue: Resin canal, Lysigenous and Schizogenous cavities. Laticifers **–** Articulated and non-articulated
5. Primary structure **–** Dicot stem: *Hydrocotyle, Eupatorium* or any normal type. Bicollateral (*Cephalandra*)

6. Monocot stem: Grass, *Asparagus* or any normal type.
7. Dicot root: Pea, *Limnanthemum* (*Nymphoides*) or any typical dicot root
8. Monocot root: *Colocasia* or any typical monocot root.
9. Secondary structure - Stem - *Vernonia* or any normal type
10. Secondary structure - Root - *Tinospora, Carica papaya*, or any normal type
11. Stomatal types (anomocytic, anisocytic, diacytic and paracytic)
12. Anomalous secondary thickening - *Bignonia, Dracaena, Boerhaavia*
13. Leaf anatomy - Dicot leaf: *Ixora*. Monocot leaf: Grass

Reproductive Botany
Students should be familiar with the structure of anther (mature and young) and embryo (dicot and monocot) using permanent slides.

Palynology
Study of pollen morphology of the following plants **–***Hibiscus, Vinca, Balsam, Ixora, Crotalaria, Bougainvillea* by microscopic observation.

Estimation of pollen sterility and fertility percentage – Acetocarmine method

BB1342 Environmental Studies and Phytogeography **36 hrs**

1. Study of morphological adaptations of Xerophytes (*Opuntia, Asparagus, Muehlenbeckia, Casuarina. Acacia, Euphorbia tirucalli*), Hydrophytes (Submerged-*Hydrilla*; Floating-*Eichhornia*, *Salvinia*, *Pistia*; Floating and rooted-*Nymphaea*; Amphibious- *Marselia*), Halophytes (Pneumatophores), Epiphytes (*Vanda, Drymoglossum, Drynaria*) and Parasites (*Loranthus, Cuscuta*).
2. Anatomical adaptions of selected Hydrophytes *(Hydrilla* stem, *Nymphaea* petiole) /Xerophytes (*Nerium* leaves, *Casuarina* stem, *Muehlenbeckia* phylloclade) /Epiphyte (Velamen root).
3. Study of plant community by quadrat method.
4. Observation and study of different ecosystems mentioned in the syllabus.
5. Visit at least three local polluted sites and report the major pollutants. Record the same in practical record.
6. Fire/Disaster alarm and response - Mock drill.
7. Study of phytogeographical regions of India.

Semester II
Core Course Vocational
BB1271 Microbial Metabolism, Genetics and Diseases

Credits: 3 **Contact hours - 54 (T 36+ P 18)**

Aim and Objectives*: This course is designed to get an in-depth knowledge about microbial metabolism, microbial genetics, and microbial diseases. This knowledge is very important as far as Biotechnology is concerned. The students are expected to master all microbial related techniques to pursue studies in Biotechnology.*

Module I

Introduction to Microbial metabolism **12 Hrs**

Metabolic diversity among microbes-autotrophs and heterotrophs; Nutritional classification of bacteria; Uptake of solutes into bacterial cell.

Photosynthesis in bacteria - photosynthetic pigments of bacteria- chlorophyll a and bacterio chlorophyll, carotenoids, phycobiliproteins, leghaemoglobin, mechanism of photosynthesis in bacteria (purple nonsulphur bacteria, green sulphur bacteria) and cyanobacteria.

Respiration in bacteria- aerobic respiration, Glycolysis and tricarboxylic acid cycle, Electron transport and oxidative phosphorylation in Bacteria; Anaerobic respiration- Fermentation- lactic acid and alcohol fermentation.

Module II **12 Hrs**

Bacterial genetics

Transfer of genetic information in bacteria, Bacterial chromosomes- DNA, Plasmids, different types of plasmids- stringent and relaxed; Col plasmids, non-conjugative, mobilizable plasmids, resistance plasmids and transferable drug resistance.

Bacterial Mutation – Spontaneous mutation, induced mutations, Isolation of auxotrophs- replica plating technique; Test for mutagenicity-Ames test; Brief account on repair mechanisms.

Bacterial recombination: Conjugation- Fertility factors, F+ and F- cells, F pili, High frequency recombination. Transformation - Griffith's effect, evidence of DNA as genetic material; Transduction-Lambda phage- bacterial recombination through transduction.

Module III **12 Hrs**

Bacterial Diseases of Humans

Airborne bacterial diseases – Streptococcal diseases, Tuberculosis; Foodborne and waterborne bacterial diseases; Foodborne and waterborne intoxications - Botulism; Food borne and waterborne infections - Typhoid fever, Cholera, Shigellosis, *E.coli* Diarrhea; Soil borne bacterial diseases- Anthrax, Tetanus, Leptospirosis.

Viral diseases of Humans - Pneumotropic viral diseases - Influenza, Adenoviral infections, Rhinoviral infections, Dermatoviral diseases - Herpes simplex, chickenpox, Measles, Rubella; Viscerotropic Viral diseases - yellow fever, Dengue fever; Neurotropic viral diseases - Rabies, Polio, H1N1, Nipah.

Practical **18 Hrs**

1. Isolation and identification of *E.coli* from water samples and its identification.
2. Isolation of microorganisms from spoiled food materials.
3. Isolation of starch degrading microorganisms - fungus/bacteria.
4. Examination of microbial flora of the skin.
5. Examination of the microbial flora of mouth.
6. Inhibition of microorganisms by antibacterial agents by disc diffusion method.

Suggested Readings

1. A Textbook of Microbiology – P. Chakraborthy, New central Book agency Pvt. Ltd, Calcutta

2. Modern concept of Microbiology – D. D. Kumar, S. Kumar; Vikas Publishing House Pvt. Ltd. New Delhi
3. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
4. Introduction to Microbiology- J Heritage, E. G. V. Evans, R. A. Killington; Cambridge University Press.
5. Microbiology – L. M. Prescott, Brown Publishers, Australia
6. Principles of Biotechnology – A. J. Nair Laxmi Publications New Delhi
7. Advances in Microbiology – J. P. Tewari, T. N. Lakhanpal, I. Singh, R. Gupta and B. P. Chanola; A. P. H. Publishing Corporation, New Delhi.
8. Microbiology: Principles and Explorations – Jacquelyn G. Black. Prentice Hall, New Jersey.
9. Microbiology- P. D. Sharma; Rastogi Publications, Meerut
10. Microbiology (7^{th} Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester II
Core Course Vocational

Credit 2 **Contact hours 36**

BB1272 Biotechniques - I (Practical of BB1171 & BB1271)

Experiments for microbiology practicals **18Hrs**

1. Laboratory safety and good laboratory practices Principles and application of Laboratory instruments-microscope, incubator, autoclave, centrifuge, LAF, filtration unit, shaker, pH meter.
2. Cleaning and Sterilization of glassware.
3. Preparation of media - Nutrient Agar and Broth.
4. Inoculation and culturing of bacteria in Nutrient agar and nutrient broth.
5. Preparation of agar slant, stab, agar plate.
6. Purification techniques- streak plating method- T streaking, Quadrant, Zig Zag; pour plate, spread plate.
7. Staining of bacteria- Simple staining, Gram staining, Negative staining.
8. Growth of Bacteria in liquid media: Determination of kinetics of bacterial growth.
9. Microscopic tests for bacterial motility – Hanging drop method.
10. Isolation of bacteria from air – open plate method.
11. Enumeration of bacteria in a given soil sample using pour plate method.
12. Microbiological examination of water samples- Standard plate count method.

Practical of BB1271

Experiments for Microbial Metabolism, Genetics & Diseases **18 hrs**

1. Isolation and identification of *E.coli* from water samples and its identification.
2. Isolation of microorganisms from spoiled food materials.
3. Isolation of starch degrading microorganisms - fungus/bacteria.
4. Examination of microbial flora of the skin.
5. Examination of the microbial flora of mouth.
6. Inhibition of microorganisms by antibacterial agents by disc diffusion method.

Semester III
Core Course
BB1341 Phycology, Mycology, Lichenology & Plant pathology

Credit 3 **Contact hours 72 (Theory 54 + Practical 18)**

Aim and Objectives: *To impart basic knowledge about lower plants such as algae, fungi, Lichen and the diseases caused by these organisms in plants. This will give an account on the life cycle, habitat, anatomy, classification and its involvement in the life cycle of other members of living world.*

Module-I **22 hrs**
Phycology

1. Introduction – Range of thallus structure – Phylogenic trends – Pigments – Reproduction – Life cycle – Classification based on F. E. Fritsch.

2. Salient features of the following major groups with reference to the structure, reproduction and life cycle of the types given below *(Excluding the developmental details)* –
   a. Cyanophyceae – *Nostoc*
      Chlorophyceae - *Chlorella, Volvox, Oedogonium* and *Chara*
   b. Xanthophyceae – *Vaucheria*
   c. Bacillariophyceae – *Pinnularia*
   d. Phaeophyceae – *Sargassum*
   e. Rhodophyceae - *Polysiphonia*

3. Economic importance of algae
   a. Role of algae in soil fertility- Fertilizer – Nitrogen fixation- Symbiosis
   b. Commercial products of algae – Agar, Alginates, Carrageenin, Diatomaceous earth
   c. Algae - medicinal aspects, algal blooms and red tides

Module -II **23 hrs**
Mycology

1. Introduction, structure, reproduction, life cycle, evolutionary trends, Classification based on Ainsworth.
2. Distinguishing characters of different classes of fungi representing the following genera. *(Excluding Developmental details)*
   a. Myxomycotina -General characters.
   b. Zygomycotina - *Rhizopus*
   c. Ascomycotina
      Hemiascomycetes - *Saccharomyces*
      Plectomycetes - *Penicillium*
      Pyrenomycetes - *Xylaria*
      Discomycetes – *Peziza*
   d. Basidiomycotina
      Teliomycetes - *Puccinia*
      Hymenomycetes - *Agaricus*

e. Deuteromycotina - *Cercospora*.

3. Economic importance of Fungi.

Module-III
Lichenology **4 Hrs**

Lichens - nature of association – classification - habit and habitat - Type – *Usnea* - thallus morphology – internal structure – reproduction - economic importance.

Module-IV
Plant Pathology **5 Hrs**

1. Introduction to plant pathology. Classification of plant diseases on the basis of causative organisms and symptoms – Host parasite interaction, Disease triangle.
2. Study of the following diseases with emphasis on symptoms, disease cycle and control measures of Leaf mosaic of Tapioca, Bunchy top of Banana, Citrus Canker, Blast disease of Paddy, Rhizome rot of Ginger, Root wilt of Coconut
3. Brief account of the following fungicides- Bordeaux mixture, Lime sulphur, Tobacco decoction, Neem cake & oil.

PRACTICALS **18Hrs**
Phycology **8Hrs**

Study of vegetative and reproductive structures of the types mentioned in the syllabus. Identify the algal specimens up to the generic level and make labelled sketches of the specimens observed.

Nostoc, Chlorella, Volvox, Oedogonium, Chara, Vaucheria, Pinnularia, Sargassum, Polysiphonia

Mycology **8 Hrs**

A detailed study of structure and reproductive structures of types given in the syllabus and submission of record.

Rhizopus, Saccharomyces, Penicillium, Xylaria, Peziza. Puccinia. Agaricus and Cercospora

Lichenology **1Hr**

Study of vegetative and reproductive parts of *Usnea*. Make sketches of the specimens observed.

Plant Pathology **1 Hr**

1. Identify the Diseases mentioned with respect to causal organism and symptoms.
2. Students should be trained to prepare the fungicide Bordeaux mixture & Tobacco decoction.

Suggested Readings

1. Alain Durieux. 2009, Applied Microbiology, Springer International Edition
2. Alexopoulos, C.J & Mims C.V. 1988. Introductory Mycology, John Wiley & Sons.
3. Chapman, V. J. & Chapman D. J., The Algae, Macmillan.
4. Gunasekharan, G. - Laboratory Manual of Microbiology – New Age Pub:

5. Fritsch, F. E., 1945, Structure and Reproduction of Algae Vol. I & II. Cambridge University Press.
6. Heritage, L., 2007, Introductory Microbiology, Cambridge University Press India Pvt. Ltd
7. Jim Deacon, 2007, Fungal Biology, 4th edition, Blackwell Publishing, Ane Books Pvt. Ltd.
8. Kanika Sharma, 2009, Manual of Microbiology, Ane Books Pvt. Ltd.
9. Mamatha Rao, 2009, Microbes and Non flowering plants, Impact and applications; Ane Books Pvt. Ltd.
10. R .C .Dubey & D .K .Maheswari - A text Book of Microbiology – Chand & Co.
11. Schlegel ,2008 General Microbiology , Cambridge University Press India Pvt. Ltd.
12. Singh V, Pandey PC and Jam D.K 1998, A Text Book of Botany for Under Graduate Students, Rastogi Publications.
13. Vasishta B.R 1990, Botany for Degree Students, Algae, S.Chand & Co.
14. Webster J 1970, Introduction to Fungi, Cambridge University Press.

Semester III
Core Course
BB1342 Horticulture, Mushroom Cultivation & Marketing

Credits: 3 **Contact hours: 72 (T 54+ P 18)**

Aim and Objectives*: This course will give an idea about the application of plant science in business generations and self-employment. This focuses on the Horticulture, Mushroom cultivation and its marketing.*

Horticulture
Module I 12 hrs

1.Introduction : Divisions of horticulture, Importance and scope of horticulture, Principles of garden making, Types of pots and containers, Potting mixture and potting media (soil, sand, peat, *Sphagnum* moss, vermiculite), Soil types, Soil preparation, Irrigation methods, Hydroponics.

2. Propagation methods

a). Cuttings – Leaf, Stem and root cutting.

b). Layering – Air layering, Ground layering (Simple, Trench Mound and Compound).

c). Budding – T- budding, Patch budding, Chip budding.

d). Grafting – Approach grafting, Bridge grafting, Whip grafting, Whip and tongue grafting, Wedge grating, Cleft grafting.

3. Garden tools and implements - Pruning shears, secateurs, spade, trowel, garden rake, hand rake, sprinkers/sprayers, showel and lawn mower.

4. Manures and fertilizers - Farmyard manure, compost, vermicompost and biofertilizers. Chemical fertilizers – NPK. Time and application of manures and fertilizers. Foliar sprays.

Module II 14 hrs

5. Components of Garden- Lawns and landscaping, Trees, shrubs and shrubberies, climbers and creepers, Flower beds and borders, ornamental hedges, edges, drives, roads, walks and paths, Carpet beds, topiary, trophy, rockery, Conservatory or green houses, Indoor garden, Roof garden, Bonsai, Terrarium, Vertical garden.

6. Flower Arrangement- Containers and requirements for flower arrangements, Free style, Shallow and Mass arrangement, Japanese – Ikebana, Bouquet and garland making, Dry flower arrangement.

7. Harvesting - Methods, Storage, Marketing of Fruits, vegetables and flowers, Preservation and processing of fruits and vegetables.

Module III **10 hrs**

8. Growth regulators in horticulture - Rooting hormones, Growth promoters, Flower induction, Parthenocarpy.

9. Plant protection: Common diseases of fruits (Mango. Guava, Papaya, Citrus, Banana, Apple, Grapes) and vegetable crops (Tomato, Capsicum, Potato, Onion, Carrot, Cabbage, Melons).

10. Brief account on Weedicides, Fungicides and Pesticides.

Module IV

Mushroom Cultivation and Marketing **10 Hrs**

11. History and introduction: Edible mushrooms (milky, straw, button) and Poisonous mushrooms.

12. Systematic position, morphology, distribution, structure and life cycle of *Agaricus* and *Pleurotus*. Nutritional value, medicinal value and advantages of mushrooms.

13. Cultivation:

a) Paddy straw mushroom cultivation–substrate, spawn making. Methods– bed method, polythene bag method, field cultivation.

b) Oyster mushroom cultivation **–**Substrate, spawning, pre-treatment of substrate. Maintenance of mushroom.

c) Cultivation of white button mushroom – Spawn, composting, spawning, harvesting.

Module V **8Hrs**

14. Diseases-Common pests, disease prevention and control measures.

15. Processing- Blanching, steeping, sun drying, canning, pickling, freeze drying.

16. Storage – short term and long term storage.

Common Indian mushrooms. Production level and economic return.

PRACTICAL. **18 Hrs**

Horticulture

- Propagation methods - Layering, Budding and Grafting.
- Flower arrangement.

Mushroom Cultivation and Marketing.

Collection and Identification of Button mushroom, Oyster mushroom and Paddy straw mushroom. Basic training in mushroom cultivation is recommended.

Field Study: Visit to a Botanical garden and Mushroom cultivating Laboratory/Facility under the guidance of teachers is recommended.

Semester III
Core Course Vocational
BB1371 Protista and Animal Diversity

Credits 4 **Contact Hours 72 (Theory 54+Practical 18)**

***Aim and Objectives**: This course is designed in such a way to get a basic insight into the diversity of animals and its morphological and physiological adaptations suited to their ecosystems.*

Module I
Classification of Organisms **4 hrs**

Two kingdom system; Three kingdom system; Four kingdom system; Five kingdom system.

Module II
Kingdom Protista **6 hrs**

Taxonomic positions, general features and classification. Salient features of the following phyla with brief note on the examples cited.

Phylum Rhizopoda. eg. *Entamoeba;* Phylum Dinoflagellata eg. *Noctiluca;* Phylum Parabasalia eg. *Trichonympha;* Phylum Ciliophora eg. *Paramecium;* Phylum Apicomplexa eg. *Plasmodium* (Detailed study of life history and pathogenicity)

Module III
Kingdom Animalia **28 hrs**

Salient features; Levels of organization: cellular, tissue, organ and system; Branches- Mesozoa, Parazoa and Eumetazoa; Eumetazoa- Radiata and Bilateria; Bilateria- Protostomia and Deuterostomia; Acoelomata, Pseudocoelomata and Eucoelomata; Schizocoela and Enterocoela; Body segmentation - metamerism and pseudometamerism.

Salient features of the following phyla; Classification up to classes.

Phylum Porifera, eg. *Sycon*
Phylum Cnidaria (Coelenterata)

Class Hydrozoa eg. *Obelia* (mention alternation of generation) Class Scyphozoa eg. *Aurelia;* Class Anthozoa eg. Sea anemone

Phylum Platyhelminthes

Class Turbellaria eg. *Bipalium;*Class Cestoda eg. *Taenia solium;* Class Trematoda eg. *Fasciola*

Phylum Nematoda

Class Secernentea (Phasmida) eg. *Ascaris;* Class Adenophorea (Aphasmida) eg. *Trichinella*

Phylum Annelida

Polychaeta-Class Polychaeta eg. *Nereis;* Clitellata-Class Oligochaeta eg. Earthworm; Class Hirudomorpha eg. *Hirudinaria*

Phylum Mollusca

Class Aplacophora eg. *Neomenia;* Class Monoplacophora eg. *Neopilina;* Class Bivalvia (Pelecypoda or Lamellibranchiata) eg. Pearl oyster; Class Polyplacophora eg. *Chiton;* Class Gastropoda eg. *Pila;* Class Cephalopoda eg. *Sepia;* Class Scaphopoda eg. *Dentalium*

Phylum Onychophora eg. *Peripatus* (morphology and its significance as connecting link)

Phylum Arthropoda

Subphylum Trilobitomorpha-Class Merostomata eg. *Limulus;* Class Arachnida eg. *Scorpion;*
Subphylum Mandibulata-Class Crustacea eg. Prawn (*Penaeus*); Class Chilopoda eg. *Scolopendra;* Class Symphyla eg. *Scutigeralla;* Class Diplopoda eg. *Spirostreptus;* Class Pauropoda eg. *Pauropus;* Class Insecta eg. Cockroach (mouth parts; digestive system and nervous system)

Pests of: (1) Paddy: *Leptocorisa acuta* (2) Stored food grains: *Sitophilus oryzae*

Phylum Echinodermata

Class Asteroidea eg. Star fish; Class Ophiuroidea eg. Brittle star; Class Echinoidea eg. sea urchin; Class Holothuroidea eg. Sea cucumber;Class Crinoidea eg. Sea lily

Module IV
Phylum Chordata **16 hrs**

Salient features of the phylum chordata; Classification upto classes; External features, adaptations and economic importance of examples cited.

Subphylum Urochordata eg. *Ascidia;* Subphylum Cephalochordata eg. *Branchiostoma* (Amphioxus*);* Subphylum Vertebrata; Division Agnatha eg. *Petromyzon;* Division Gnathostomata - Superclass Pisces eg. *Scoliodon, Sardinella* - Superclass Tetrapoda.

Class Amphibia: Frog (*Rana*) **–** general characters. eg:, *Ambystoma* (mention axolotl larva).

Class Reptilia eg. *Calotes.*

Snakes: Identification of nonpoisonous and poisonous snakes- Nonpoisonous snakes eg. *Ptyas* Poisonous snakes eg. *Naja, Viper, Bungarus*.

Class Aves (Birds): Flightless birds. eg. *Ostrich.*

Flying birds eg. Pigeon (morphology and different types of feathers); Flight adaptations of birds.

Class Mammalia

eg. *Echidna,* Kangaroo, Blue whale.

Adaptations of aquatic mammals.

Practicals **18 Hrs**

Identification and assigning the systematic position of the following specimens:

1. Protozoa - any 2.

2. Porifera - any 1.
3. Coelenterata - any 3.
4. Aschelminthes - any 2.
5. Platyhelminthes - any 2 (adaptations of parasitic forms to be stressed)
6. Annelida - any 2.
7. Arthropoda - any 6 (including at least 2 insect pests of paddy/banana plant/stored food grains and 2 beneficial insects).
8. Mollusca - any 4 (including any 2 beneficial and any 2 harmful species).
9. Echinodermata - any 3
10. Prochordates - *Branchiostoma* (Amphioxus).
11. Pisces-any 4 (including 1 cartilaginous fish, 1 fish with accessory respiratory organ, 2 common food fishes).
12. Amphibia - any 1.
13. Reptilia - any 4 (including at least two poisonous and one non-poisonous snake of Kerala).
14. Aves - any 2 common birds of Kerala (based on museum specimens or field observations).
15. Mammalia - any 2 (based on museum specimens or field observations).

Note: Practical examinations shall give emphasis on systematics of animals. Questions on taxonomy may be designed so as to assess the student's knowledge in identification of organisms and assigning the systematic position down to the prescribed taxa. Students may be asked to arrange a miscellaneous group of animals into different taxonomic groups in chart form mentioning the salient features of the groups.

Suggested Readings

1. Ruppert E.E., Fox R and Barnes R.D. (2004) Invertebrate Zoology. Thomson Books/Cole. USA.
2. Ekambaranatha Ayyar, M. and Ananthakrishnan, T. N. A Manual of Zoology. Vol II
3. Jordan, E. L. and Verma, P. S. Invertebrate Zoology. S. Chand and Co.
4. Jordan, E. L. and Verma, P. S. Vertebrate Zoology. S. Chand and Co.
5. Kotpal, R. L. (2002) Modern Text Book of Zoology: Invertebrates. Rastogi Publishers.
6. Kotpal, R. L. (2002) Modern Text Book of Zoology: Vertebrates. Rastogi Publishers.
7. Mayer E. (1980) Principles of Systematic Zoology. Tata McGraw Hill Publishing Co. New Delhi.
8. Vijayakumaran Nair K, J. Jayakumar and P.I. Paul (2007) Protista and Animal Diversity. Academica.
9. Nayar, K. K. et al. General & Applied Entomology TMH
10. Nigam S. (1978) Invertebrate Zoology. S. Nagin and Co.
11. Hickman C.P. and Roberts L.S. (1994) Animal Diversity. Wm. C. Brown, Dubuque, IA
12. Venugopal Rao et al. (2003) Integrated Insect Pest Management. Agro.
13. The New Encyclopedia Britannica, Macropedia, (1998). Encyclopedia Britannica Inc., Chicago.
14. Green N.P.O., et al (2000) Biological Science. Cambridge University Press.
15. Outlines of Zoology- Ekambaranatha Iyer; Chand Publications, New Delhi
13. Brusca R.C. and Brusca G.J. (1990) Invertebrates. Sinauer Associates, Sunderland, MA.
14. Pearse V and Pearse J, Buchsbaum M and Buchsbaum R. (1987) Living Invertebrates Blackwell Scientific Publications, California.
15. Chandler, A.C. and Read. Parasitology.
16. Dhami, P. S. and Dhami, J. K. Invertebrate Zoology. R. Chand and Co.
17. Dhami, P. S. and Dhami, J. K. Vertebrate Zoology. R. Chand and Co.
18. Ekambaranatha Ayyar, M. and Ananthakrishnan, T. N. A Manual of Zoology. Vol I
19. Invertebrate Zoology- Chand publications, New Delhi
20. Manual of Zoology – Ekambaranatha Iyer; Chand Publications, New Delhi
21. Vertebrate Zoology - Chand Publications, New Delhi

Semester III

Core Course Vocational

BB1372 Animal Physiology and Anatomy

Credits 3 **Contact Hours 54 (T 36 + P 18)**

Aim and Objectives*: This course will give very fundamental and essential information about the anatomy and functioning of the various types of cell, tissues and organs in selected model organisms.*

Module I **4 hrs**

Animal cell, Tissues, organs and organ systems.

Nutrition: Feeding mechanisms, Digestion - types of digestion, basic mechanisms of digestion, Human digestive system.

Module II **4 hrs**

Respiratory system - Respiration, types of respiration, cellular respiration - oxidation of glucose, Human respiratory system, pulmonary respiration.

Module III **5 hrs**

Circulatory system: Circulation, types of circulation - open and closed circulation, Human circulatory system, Human Heart, Heart beat; Tissue fluid, Lymphatic system - comparison of blood and lymph.

Module IV **5 hrs**

Reproductive system - reproduction, types of reproduction - asexual, sexual and vegetative reproduction Human reproductive system - gametogenesis, spermatogenesis, structure of human sperm, Oogenesis, Menstrual cycle, Human embryogenesis (up to gastrulation).

Module V **5 hrs**

Excretory system: Excretory products of body, excretory organs of invertebrates (Nephridia and Flame cells), Human excretory organs, Nephrons - structure and function, Kidneys - structure and function, Formation of urine, Accessory excretory organs - skin, its structure and function.

Module VI **5 hrs**

Endocrine system: Endocrine glands, Hormones and feedback mechanism.

Module VII **5hrs**

Nervous system: Neurons- structure and function, nervous system of invertebrates (Prawn) and vertebrates (Human Nervous system).

Module VIII **3hrs**

Muscular system – Types of muscles. Ultra structure of striated muscle fibre, mechanism of muscle contraction, sliding filament theory, all or none law.

Practical

Minor practicals

1. Nereis - parapodium.
2. Earthworm - body setae.
3. Cockroach - mouth parts.
4. Prawn - appendages.
5. Fishes - different types of scales (placoid, ctenoid and cycloid scales).

Major practicals (any three)

1. Earthworm - nervous system.
2. Cockroach- alimentary canal.
3. Cockroach - nervous system.
4. Prawn - nervous system.

Suggested Readings

1. Arthur C. Guyton, Textbook of Medical Physiology, W.B. Suanders Co.
2. C.C. Chatterjee, Human Physiology Vol. 1 & 2 -; Medical Allied Agency
3. Chandler, A.C. and Read. Parasitology.
4. Dhami, P. S. and Dhami, J. K. Invertebrate Zoology. R. Chand and Co.
5. Dhami, P. S. and Dhami, J. K. Vertebrate Zoology. R. Chand and Co.
6. Ekambaranatha Ayyar, M. and Ananthakrishnan, T. N. A Manual of Zoology. Vol II
7. Ekambaranatha Ayyar, M. and Ananthakrishnan, T. N. A Manual of Zoology. Vol I
8. HT Yost , Cellular physiology, Prentice Hall
9. John B. West, Physiological Basis of Medical Practice, William & Wilkins
10. Jordan, E. L. and Verma, P. S. Invertebrate Zoology. S. Chand and Co.
11. Jordan, E. L. and Verma, P. S. Vertebrate Zoology. S. Chand and Co.
12. Kotpal, R. L. (2002) Modern Text Book of Zoology: Invertebrates. Rastogi Publishers.
13. Kotpal, R. L. (2002) Modern Text Book of Zoology: Vertebrates. Rastogi Publishers.
14. Mayer E. (1980) Principles of Systematic Zoology. Tata McGraw Hill Publishing Co. New Delhi.
15. Vijayakumaran Nair K, J. Jayakumar and P.I. Paul (2007) Protista and Animal Diversity. Academica.
16. William S. Hoar General and Comparative physiology, Prentice Hall.

Semester IV
Core Course
BB 1441 Bryology, Pteridology, Gymnosperms & Paleobotany

Credit: 2 **Contact hours: 72 (Theory 54 + Practical 18)**

Aim and Objectives*: Students should be trained in basic botany such as lower plants like Bryophytes, Pteridophytes, Gymnosperms, etc. to get an in-depth knowledge about various plant groups.*

Module -I
Bryology **12 hrs**

1. Introduction and Classification
2. Study of the habit, thallus organization, vegetative and sexual reproduction and alternation of generation of the following types *(Developmental details are not required).*
   Riccia, Marchantia, Funaria.
3. Economic Importance of Bryophytes.

Module- II **18hrs**
Pteridology

1. Introduction: General characters morphological and classification by Smith.
2. Study of the habitat, habit, internal structure, reproduction and life cycle of the following types *(Developmental details not required)*.
   Psilotum, Selaginella, Equisetum, Pteris and *Marsilea.*
3. General Topics: Stelar evolution in Pteridophytes, heterospory and seed habit, relationships of pteridophytes with bryophytes and gymnosperms, Economic importance of pteridophytes.

Module- III **18 hrs**
Gymnosperms

1. Introduction and classification of gymnosperms.
2. Study of the Habit, Anatomy, Reproduction and life cycle of the following types.
   (Developmental details not required)
   Cycas, Pinus and *Gnetum*
3. Evolutionary trends in gymnosperms - Relationship of gymnosperm with pteridophytes and angiosperms
4. Economic importance of gymnosperms.

Module-IV
Paleobotany **6 hrs**

1. Process of fossilization and types of fossils. Methods of studying fossils.
2. Geological time scale –brief account.
3. Fossil pteridophytes – *Rhynia, Lepidodendron, Lepidocarpon*. Fossil Gymnosperm - *Lyginopteris*.
4. Applied aspects of Paleobotany - Exploration of fossils fuels.

Suggested Reading

1. Andrews H.N. (1967) - Studies on Paleobotany – C .J. Felix.
2. Arnold C. A (1947) - Introduction to Paleobotany - McGraw Hill Co. New Delhi.
3. Chopra RN and P. K. – Biology of Bryophytes - Wiley Eastern Ltd. New Delhi
4. Coutler. J. M. - and Chamberlain C. J. (1958) – Morphology of Gymnosperms - Central Book Depot , Allahabad
5. Gupta V .K. and Varshneya U. D (1967) – An Introduction to Gymnosperms – Kedarnath, Ramnath– Meerut.
6. Parihar N .S. – An introduction to Bryophyta - Central Book Depot. Allahabad
7. Smith G.M. (1955) - Cryptogamic Botany – Vol.II – Mc Graw Hill Co. New Delhi
8. Sporne K. R. (1966) - Morphology of Pteridophytes - Hutchin University Library , London
9. Sporne K. R. (1967) - Morphology of Gymnosperms - Hutchin University Library , London
10. Vashista B. R. (1993) - Pteridophyta – S.Chand and co. New Delhi
11. Vashista B. R. (1993) Gymnosperms - S. Chand and co. New Delhi
12. Vasishta B. R. - Bryophyta - S. Chand and Co. New Delhi

PRACTICAL **18hrs**

Bryology **5hrs**

1. *Riccia* – Habit - Internal structure of thallus – V. S. of thallus through archegonia, antheridia and sporophyte.
2. *Marchantia* –Habit- thallus T. S., thallus with Archegonial receptacle, Antheridial receptacle, Male receptacle V .S., Female receptacle e VS., T.S . of thallus through gemma, Sporophyte V.S.
3. *Funaria* - Habit, V. S. of archegonial cluster, V .S. of antheridial cluster, Sporophyte V. S.

Pteridology **6Hrs**

1. *Psilotum* : External features, stem T. S., synangium T. S.
2. *Selaginella* : Habit, rhizophore T. S , stem T. S, axis with strobilus, V.S. of strobilus, Megasporophyll and microsporophyll.
3. *Equisetum* - Habit, rhizome and stem T .S. and V. S. of strobilus.
4. *Pteris* - Habit, petiole T. S., sporophyll T. S., prothallus.
5. *Marsilea* - Habit, Rhizome and petiole T. S., sporocarp T.S, V. S. & R.L .S. (Permanent slides can be used).

Gymnosperms **6 Hrs**

1. *Cycas* – seedling, coralloid root and coralloid root T. S., T. S. of leaflet and petiole, micro and mega sporophyll, male cone V. S., micro sporophyll T. S. , entire and V. S. of ovule.
2. *Pinus* - Branch of indefinite growth, spur shoot, T. S of old stem and needle, male and female cone, V .S. of male and female cone.
3. *Gnetum* -: Habit, stem young and mature T. S (Permanent slides can be used), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed

Paleobotany **1 Hr**

1. Fossil pteridophytes – *Rhynia* Stem, *Lepidodendron*, *Lepidocarpon*.
2. Gymnosperm - *Lyginopteris.*

Semester IV
Core Course
BB1442 Cell Biology, Plant Breeding and Evolutionary Biology

Credits 2 **Contact hours: 72 (Theory 54 + Practical 18)**

Aim and Objectives: *This course will provide a basic understanding in cell biology, plant breeding and evolution, which is needed as a student of biology and can supplement in understanding and pursuing studies in Biotechnology.*

Module-I
Cell biology **30 hrs**

1. History and progress of cell biology.
2. Ultra structure and functions of the cell components and organelles (A brief account only); The cell membrane, Endoplasmic reticulum, Ribosomes, Golgi apparatus, Lysosomes, Peroxisomes, Vacuole, Mitochondria, Chloroplast & Nucleus- Nuclear envelope and nuclear pore complex.
3. The chromosomes- Chromosome morphology- Eukaryotic chromosomes and its molecular organization. Chromatin - composition and structure; hetero chromatin and euchromatin; Chemical organization. Nucleoproteins – histones and non-histones. Nucleosome model of DNA organization.
4. Special types of chromosomes- Salivary gland, Lamp brush and B chromosomes.
5. Variation in Chromosome number (Numerical aberrations) - aneuploidy and Euploidy- haploidy, polyploidy; Significance.
6. Variation in Chromosome structure (Structural aberrations) - deletion, duplication, inversion and translocation; Significance.
7. Mitosis and Meiosis: - Cell cycle, check points and regulation (brief): Significance of mitosis and meiosis.

Module II **14 hrs**
Plant breeding

1. Introduction, objectives in plant breeding.
2. Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization - Achievements.
3. Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection methods.
4. Hybridization: Procedure of hybridization, inter generic, inter specific, inter varietal hybridization with examples. Composite and synthetic varieties.
5. Heterosis and its exploitation in plant breeding.
6. Mutation breeding – methods and achievements in India.
7. Breeding for biotic and abiotic resistance.

Module -III
Evolutionary Biology **10 hrs**

1. Progressive and Retrogressive evolution.
2. Parallel and Convergent evolution.
3. Micro and Macro evolution.

4. Theory of Lamarck, Wiesman and De Vries, Darwinism, Neo- Darwinism.
5. Isolation, Mutation, Genetic drift, Speciation.
6. Variation and Evolution – Hybridization and Evolution – Polyploidy and evolution – Mutation and evolution.

Practical **18 Hrs**

1. Make acetocarmine squash preparation of onion root tip and to identify different stages of mitosis.
2. Calculation of Mitotic Index.
3. Make squash preparation of the flower buds of any of the following plants to identify the stages of Meiosis.
   Rhoeo, Chlorophytum, Capsicum
4. Hybridization techniques - Emasculation and labeling.
5. Visit to a plant breeding station is desirable.

Suggested Readings

1. Aggarwal S.K. (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
2. Allard R.W. (1960) Principles of Plant Breeding. John Willey and Sons. Inc. New York
3. B.D. Singh (2003) Plant Breeding. Kalyani Publishers
4. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, New Delhi
5. Lodish, H. et al. (2008) Molecular and Cell biology. Freeman and Company New York.
6. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology. Scientific American books.
7. Dobzhansky, B. (1961) Genetics and origin of species, Columbia University Press New York.
8. Gerald Karp, Janet Iwasa, Wallace Marshall (2015) Cell and molecular biology- Concepts and experiments, 8th edn. Wiley.
9. Lewin, B, (2008) Genes IX, Johns and Bartlett Publishers.
10. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
11. Roy S.C. and Kalyan Kumar De (1997) Cell biology. New central Books, Calcutta.
12. Sandhya Mitra (1998) Elements of molecular biology. Macmillan, India Ltd.
13. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi.
14. Sharma, A.K and Sharma A (1980) Chromosome Technique - Theory and practice, Aditya Books, New York.
15. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, New York.
18. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd.
19. Twymann, R.M. (1998) Advanced molecular biology Viva books New Delhi.
20. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd.
21. The Cell: A Molecular Approach. Geoffrey M. Cooper and Robert E. Hausman. (2013) Sinauer Associates, Inc. Sunderland, Massachusetts.

Semester IV
Core Course
BB 1443 Practical Botany II

(Practical of BB1341, BB1342, BB1441 & BB1442)

Credits 2 **Contact hours: 72**

BB1341 Phycology, Mycology, Lichenology & Plant pathology (18 Hrs)

Phycology 8Hrs

1. Study of vegetative and reproductive structures of the types mentioned below. *Nostoc, Chlorella, Volvox, Oedogonium, Chara, Vaucheria, Pinnularia, Sargassum, Polysiphonia*

2. Identify the algal specimens up to the generic level and make labelled sketches of the specimens observed.

Mycology 5 Hrs

A detailed study of structure and reproductive structures of types given in the syllabus and submission of record.

Rhizopus, Saccharomyces, Penicillium, Xylaria, Peziza. Puccinia. Agaricus and Cercospora

Lichenology 2 Hrs

Make micropreparation of vegetative and reproductive parts of *Usnea*. Make sketches of the specimens observed.

Plant Pathology 3 Hrs

1. Identify the Diseases mentioned with respect to causal organism and symptoms

2. Students should be trained to prepare the fungicide Bordeaux mixture & Tobacco decoction.

BB1342 Horticulture, Mushroom Cultivation & Marketing 18 Hrs

1. Demonstration of Propagation methods- Layering, Budding and grafting
2. Study of various Flower arrangement
3. Undertake a visit to a Botanical garden under the guidance of the teacher is recommended
4. Collection and Identification, study of morphology of button mushroom, oyster mushroom, paddy straw Mushrooms.
5. Basic Training in mushroom cultivation is recommended.

BB 1441 Bryology, Pteridology, Gymnosperms & Paleobotany (18 Hrs)

Bryology 5Hrs

1. Riccia – Habit - Internal structure of thallus – V. S. of thallus through archegonia, antheridia and sporophyte

2. Marchantia –Habit- thallus T. S., thallus with Archegonial receptacle, Antheridial receptacle,Male receptacle V .S., Female receptacle VS., T.S . of thallus through gemma, Sporophyte V. S .

3. Funaria - Habit, V. S. of archegonial cluster, V .S. of antheridial cluster, Sporophyte V. S.

Pteridology 6Hrs

1. Psilotum : External features , stem T.S., synangium T. S

2. Selaginella : Habit , rhizophore T. S , stem T . S, axis with strobilus, V .S. of strobilus, Megasporophyll and microsporophyll.

3. Equisetum - Habit, rhizome and stem T .S. and V. S. of strobilus.

4. *Pteris* - Habit, Petiole T. S., sporophyll T. S. , prothallus

5. Marsilea - Habit, Rhizome and petiole T. S., sporocarp T.S, V. S. & R.L .S.

Gymnosperms 5 Hrs

1. Cycas – seedling, coralloid root and coralloid root T. S., T. S. of leaflet and petiole, micro and mega sporophyll, male cone V. S., micro sporophyll T. S. , entire and V. S. of ovule.

2. Pinus - Branch of indefinite growth, spur shoot, T. S of old stem and needle, male and female cone, V .S. of male and female cone.

3. Gnetum -: Habit, stem young and mature T. S (Permanent slides can be used), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed

Paleobotany 2 Hrs

1. Fossil pteridophytes – *Rhynia* Stem, *Lepidodendron, Lepidocarpon*.

2. Fossil Gymnosperm - *Lyginopteris*

BB1442 Cell Biology, Plant Breeding and Evolutionary Biology 18Hrs

1. Make acetocarmine squash preparation of onion root tip to identify the stages of Mitosis.

2. Calculation of Mitotic Index

3. Make squash preparation of the flower buds of any of the following plants to identify the stages of Meiosis.

Rhoeo, Chlorophytum, Capsicum

4. Hybridization techniques - Emasculation and labeling.

5.Visit to a plant breeding station is desirable.

Semester IV
Core Course Vocational
BB1471 Molecular Biology

Credits 3 **Total contact hours 72 (Theory 54 + Practical 18)**

Aim and Objectives*: Molecular biology is basis of modern biology and biotechnology. This course imparts a very essential foundation for the proper understanding of life at molecular level, which is essential for further studies related to genetic engineering, immunology and other modern applied aspects of biology.*

Module I **8 hrs**

Introduction

History and significant discoveries in molecular biology; Molecular basis of life, Experiments demonstrating DNA as the genetic material, Central dogma.

Structure of DNA; Replication of DNA **–** both prokaryotic and eukaryotic, enzymes of DNA replication, action of telomerase.

Module II **8 hrs**

Genes and genetic code

Organisation of prokaryotic and eukaryotic gene- split genes, introns and exons, reading frame, promoters and enhancers; Genetic code - properties of genetic code, Codons, codon assignment, redundancy and wobble concept

Module III **12 hrs**

Gene expression:

Prokaryotic and Eukaryotic Transcription - Initiation factors, transcription products, types of RNA-mRNA, tRNA, rRNA and small nuclear RNA (snRNA), mi RNA; post-transcriptional modification of mRNA in eukaryotes-capping and splicing mechanisms.

Translation- translation of prokaryotic and eukaryotic mRNA, Initiation complex, Post translational modification of proteins.

Module IV **12 hrs**

Gene regulation: Prokaryotic gene regulation, regulation of operon, (*lac*, and *trp* operon), catabolic repression, attenuation. Regulation of eukaryotic gene expression, level of control of gene expression, regulation of RNA processing, mRNA degradation and protein degradation control, RNA interference.

Module V **8 hrs**

Eukaryotic chromosomes- molecular organization, nucleosomes, transposons - insertional elements

6 hrs

Module VI

Cytoplasmic genome – mitochondrial DNA and chloroplast DNA – structure, important genes

Practical **18 hrs**

Experiments for Molecular biology

1. Familiarization of Instruments and equipment used in molecular biology.
2. Isolation of Genomic DNA
3. Examination of the purity of DNA by agarose gel electrophoresis.
4. Quantification of DNA by UV-spectrophotometer
5. Extraction of Protein and RNA from plant samples.
6. Isolation and purification of plasmid DNA
7. Agarose gel analysis of plasmid DNA
8. Restriction digestion of plasmid DNA
9. Visit a molecular biology laboratory within the entire course tenure.

Suggested Readings

1. Applied Molecular genetics – R L Miesfeld; Wiley.Liss , New Delhi.
2. Basic Biotechnology- A. J. Nair, Laxmi Publications, New Delhi
3. Essential molecular Biology- A practical Approach, T A Brown; Oxford, New York
4. Gene IX- Benjamin Lewin; Oxford University Press.
5. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
6. Introduction to Molecular biology- P. Paolella; Mc Graw Hill, New York
7. Molecular Biology of the gene – Watson, Baker, Bell Gann, Lewinw, Losick; Pearson Education Pvt.Ltd, New Delhi
8. Molecular cell biology H S Bhamrah; Anmol Publications Pvt. Ltd., New Delhi.
9. PCR 3 - Practical Approach – C. Simon Hearington & John J O'Leary; Oxford, New York
10. Principles of Gene manipulation- R.W.Old & S.B. Primrose; Blackwell Scientific Publications
11. Microbiology (7^{th} Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester IV
Core Course
BB1472 Immunology

Credits-2 **Contact hours 54 (Theory 36+ Practical 18)**

Aim and Objectives*: To give a basic training to the students of Biotechnology on immune system, immunology and immunology related techniques. Training in this course will create an interest in immunology and is essential for further studies in Biotechnology.*

Module I
Introduction to Immunology **7 hrs**

Historical perspective of immunology; haematopoisis; Lineages The Human Immune System: Organs and cells of immune system - structure and functions.

Module II **6 hrs**

Types of immunity - Innate and specific or acquired immunity, Humoral immunity and cell mediated immunity; Brief account on-antigens, Immunogens, haptens, adjuvants.

Module III **6 hrs**

Immunoglobulins

Antibody structure and functions, antigen binding, epitope and paratope, types of antibodies and their structures: isotypes, allotypes and idiotypes.

Module IV **7 hrs**

Measurement of antigen

Antibody-antigen interaction, antigen-antibody reactions, agglutination, ABO blood grouping and Rh incompatibility, immuno-diffusion, immuno-electrophoresis, ELISA-types, RIA; production of monoclonal antibodies using hybridoma technology.

Module V

Immunoglobulin gene **6 hrs**

Genetic basis of antibody diversity-VDJ recombination, Clonal proliferation theory of antibody production.

Immunity to infections of diseases: Brief account on Vaccines and toxoids (Attenuated, Killed, Purified Macro molecules, Peptide Vaccines, Subunit Vaccines , DNA Vaccines, Edible Vaccines).

Module VI **4 hrs**

Autoimmune disease and hypersensitivity: Organ Specific autoimmune diseases - Hashimoto's thyroiditis; Myasthenia gravis; Pernicious anemia. Systemic autoimmune disease - Rheumatoid Arthritis, Hypersensitivity disease - Asthma.

Experiments for Immunology Practical **18 hrs**

1. Immune cells – observation and identification by staining.
2. Enumeration of RBC.
3. Enumeration of WBC.
4. Separation of immune cells from lymphoid organs of lab animals / blood.
5. Blood grouping – Determination of blood groups and Rh typing.
6. Precipitin reaction - Double immunodiffusion- Ochterlony method.
7. Demonstration of Immuno-electrophoresis and staining.
8. WIDAL test – demonstration.
9. Demonstration of Radio immunoassay.
10. ELISA technique-demonstration (Dot method).

Suggested Readings

1. An Introduction to Immunology – C V Rao, Narosa Publishing House, New Delhi
2. Basics of Biotechnology- A J Nair; Laxmi Publications, New Delhi
3. Immunology – Joshi, Osama; AgroBotanica, New Delhi
4. Immunology – R A Goldsby, T J Kindt, B A Osborne, Janis Kuby; W H Freeman & Company, New York
5. Instant Notes in Immunology – P M Abbas, A. H. Lichtman, M W Fanger; Viva Books Pvt. Ltd, New Delhi.
6. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.

7. Principles of Cellular and Molecular Immunology- Jonathan M Austyn Kathryn J Wood; Oxford, New York
8. Microbiology (7th Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester IV
Core Course Vocational
BB1473 Biotechniques II
(Practical of BB1371, BB1372, BB1471& BB1472)

Credits: 2 **Contact Hrs: 72**

Practical of BB1371: Protista and Animal Diversity **18 hrs**

Identification and assigning the systematic position of the following specimens:

Identification and assigning the systematic position of the following specimens:

1. Protozoa - any 2.
2. Porifera - any 1.
3. Coelenterata - any 3.
4. Aschelminthes - any 2.
5. Platyhelminthes - any 2 (adaptations of parasitic forms to be stressed)
6. Annelida - any 2.
7. Arthropoda - any 6 (including at least 2 insect pests of paddy/banana plant/stored food grains and 2 beneficial insects).
8. Mollusca - any 4 (including any 2 beneficial and any 2 harmful species).
9. Echinodermata - any 3
10. Prochordates - *Branchiostoma* (Amphioxus).
11. Pisces-any 4 (including 1 cartilaginous fish, 1 fish with accessory respiratory organ, 2 common food fishes).
12. Amphibia - any 1.
13. Reptilia - any 4 (including at least two poisonous and one non-poisonous snake of Kerala).
14. Aves - any 2 common birds of Kerala (based on museum specimens or field observations).
15. Mammalia - any 2 (based on museum specimens or field observations).

BB1372 Animal Physiology and Anatomy **18hrs**

Practical
Minor practicals

1. Nereis - parapodium.
2. Earthworm - body setae.
3. Cockroach - mouth parts.

4. Prawn - appendages.
5. Fishes - different types of scales (placoid, ctenoid and cycloid scales).

Major practicals (any three)

1. Earthworm - nervous system.
2. Cockroach- alimentary canal.
3. Cockroach - nervous system.
4. Prawn - nervous system

BB1471 Molecular Biology **18 hrs**

1. Familiarization of Instruments and equipment used in molecular biology.
2. Isolation of Genomic DNA
3. Examination of the purity of DNA by agarose gel electrophoresis.
4. Quantification of DNA by UV-spectrophotometer
5. Extraction of Protein and RNA from plant samples.
6. Isolation and purification of plasmid DNA
7. Agarose gel analysis of plasmid DNA
8. Restriction digestion of plasmid DNA
9. Visit a molecular biology laboratory within the entire course tenure.

BB1472 Immunology **18 hrs**

1. Immune cells **–**observation and identification by staining
2. Enumeration of RBC
3. Enumeration of WBC
4. Separation of immune cells from lymphoid organs of lab animals / blood.
5. Blood grouping **–**Determination of blood groups and Rh typing
6. Precipitin reaction- Double immune diffusion- Ochterlony method
7. Demonstration of Immuno-electrophoresis and staining
8. WIDAL test- demonstration
9. Demonstration of Radio immunoassay
10. ELISA technique-demonstration (Dot method)

Semester V
Core Course
BB1541 Plant Physiology

Credit 4 **Contact Hours 108 (Theory 72 + Practical 36)**

Aim and objectives*: To give basic information on plant physiology and the related biochemical and biophysical aspects to the students of Biotechnology. This course will equip the students to understand the functions of the plant system on biophysical and biochemical approach.*

Module I **3 Hrs**

Introduction to plant physiology - Physiological processes, their significance other applications

Module II **10 Hrs**

Water relations of Plants

Water absorption

a. Importance of water to plants- the physical and chemical properties of water.
b. Organs of absorption - root and root hairs.
c. Membranes- permeable, differentially permeable and impermeable.
d. Physical aspects of absorption, imbibition, diffusion and osmosis.
e. Plant cell as an osmotic system, osmotic pressure, turgor pressure, wall pressure and diffusion pressure deficit, water potential osmotic potential, pressure potential matrix potential Plasmolysis and its significance.
f. Mechanism of absorption of water - active and passive absorption -root pressure.

Ascent of Sap

Vital theories.
Physical theories - Cohesion tension theory.

Loss of water from plants:

a. Transpiration - cuticular, lenticular and stomatal mechanism.
b. Factors affecting transpiration
c. Significance of transpiration.
d. Guttation.
e. Water stress and its physiological significance.

Module III **6 Hrs**
Mineral Nutrition

Gross chemical analysis of plant - Essential and non-essential elements Criteria of essentiality of elements, Essential elements: major end minor. Role of essential elements their deficiency diseases.

Culture methods: Solution culture, Sand culture, Hydroponics, Aeroponics, Foliar nutrition Soil as source of nutrients Mechanism of mineral absorption.

(a) Passive absorption - ion exchange - Donnan equilibrium.

(b) Active absorption - Carrier concept

Module IV **14 Hrs**

Photosynthesis

1. Significance and general equation
2. Photosynthetic apparatus and pigment systems-chromatographic techniques for the separation of photosynthetic pigments
3. Raw materials of photosynthesis
4. Mechanism

a) Light reaction

i) Radiant energy and its effects on chlorophyll pigments

ii) Cyclic and non-cyclic photophosphorylation

iii) Source of oxygen liberated

iv) Hill reaction

b) Dark reaction

i) Trace the path of carbon in photosynthesis

ii) Calvin cycle

iii) C3 and C4 plants. CAM plants.

iv) Photorespiration

v) Factors affecting photosynthesis. Law of limiting factors

Module V **12 Hrs**

Respiration

1. Definition and general equation
2. Significance
3. Respiratory substrates
4. Mechanism - Glycolysis, Krebs cycle, terminal oxidation
5. Oxidative pentose phosphate path way
6. Factors affecting respiration
7. Anaerobic respiration-Alcoholic fermentation and lactic acid fermentation
8. Energy relations - aerobic and anaerobic respiration
9. Respiratory quotient and its significance
10. Oxidation of Fats

Module VI **8 Hrs**
Nitrogen metabolism

1. Source of nitrogen
2. Nitrification, Denitrification and Ammonification
3. Symbiotic nitrogen fixation
4. Rotation of crops
5. Nitrogen Cycle

Module VII **4 Hrs**
Translocation of solutes

1. Pathway of organic solutes
2. Mechanism of phloem transport
3. Mass flow hypothesis
4. Protoplasm streaming theory

Module VIII **7 Hrs**
Growth and Development

1. Definition
2. Dormancy and germination of seeds.
3. Phases of growth - measurement and factors affecting growth.
4. Differentiation, morphogenesis and senescence.
5. Growth Hormones - Auxins, Gibberellins, Cytokinins, Abscissic acid, Ethylene and their practical applications
6. Photoperiodism
7. Vernalization

Module IX **8 Hrs**
Plant Movements and Stress Physiology.

Tropic and nastic movements, Circadian rhythm.

General account on stress physiology (Brief account on drought, salt and water).

Practicals **36 Hrs**

1. Water potential of onion peel, *Rhoeo* peel by plasmolytic method
2. Thistle funnel experiment
3. Tissue tension
4. Root Pressure
5. Suction force due to transpiration

6. Foliar transpiration by using bell jar
7. Transpiring surface - Four leaves experiment
8. Farmer's and Ganong's Potometer
9. Water balance - Relation between transpiration and absorption.
10. Evolution of oxygen during photosynthesis
11. Necessity of chlorophyll, CO2 and light in photosynthesis
12. Measurement of photosynthesis.
13. Simple respiroscope
14. Respirometer of R.Q.
15. Anaerobic respiration
16. Fermentation
17. Geotropism and phototropism — Klinostàt
18. Hydrotropism
19. Measurement of growth — Arc or Lever Auxonometer

Suggested textbooks

1. Devlin & Witham – Plant Physiology, C B S publishers.
2. Devlin R.M. (1979) Plant Physiology.
3. Dieter Hess (1975): Plant physiology.
4. Jain V. K. (1996) Fundamentals of Plant Physiology.
5. Kochhar P. L. & Krishnamoorthy H. N. – Plant Physiology. Atmaram & Sons Delhi, Lucknow.
6. Kumar & Purohit – Plant Physiology - Fundamentals and Applications, Agrobotanical publishers.
7. Malik C. P. & Srivastava A. K. – Text book of Plant Physiology Kalyani Publishers New Delhi.
8. Noggle G R & Fritz G J (1991) Introductory Plant physiology, Prentice Hall of India.
9. Pandey S.N. & Sinha B. K. (1986) – Plant physiology,Vikas publishing House- New Delhi.
10. Salisbury F.B and Ross C.W. (2006): Plant Physiology 4Edn, Wadsworth publishing company.
11. Sundara Rajan S. – College Botany Vol. IV, Himalaya publishing House.
12. William G. Hopkins – Introduction to Plant Physiology John Wiley & Sons, New York.

Semester V
Core Course
BB1542 Angiosperm Morphology and Systematic Botany

Credit 4 **Contact hrs 108 (Theory 72+ Practical 36)**

Aim and Objectives*: The course is designed to give a basic awareness in systematic botany and morphology of higher plants and the course should generate interest on students to pursue continuous studies in systematic botany.*

Module I
Morphology **12 hrs**

Brief account on the various types of inflorescence including special types (Cyathium, Verticillaster, Hypanthodium, Coenanthium and Thyrsus) with examples; floral morphology- Flower as a modified shoot, Flower parts, their arrangements, relative position, numeric plan, cohesion, adhesion, symmetry of flower, aestivation types, placentation types; floral diagram and floral formula. Fruit types: simple, aggregate and multiple. Seeds: albuminous and exalbuminous .

Module –II **8 hrs**
Systematic Botany

Definition, scope and significance of Taxonomy.

Systems of classification

1. Artificial- Linnaeus's sexual system
2. Natural - Bentham and Hooker (Detailed account)
3. Phylogenetic- Engler and Prantl (Brief account only)
4. APG System (recent) of classification (Very Brief account)

Module -III **7 hrs**

Basic rules of Binomial Nomenclature and International Code of Botanical nomenclature (ICBN). Importance of Herbarium, Herbarium techniques and Botanical gardens. Trends in taxonomy; Chemotaxonomy, Numerical Taxonomy, Cytotaxonomy and Molecular taxonomy (Brief account only)

Module –IV **45 hrs**

A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)

1	Annonaceae	9	Apiaceae	17	Verbenaceae
2	Nymphaeaceae	10	Rubiaceae	18	Lamiaceae
3	Malvaceae	11	Asteraceae	19	Amaranthaceae
4	Rutaceae	12	Sapotaceae	20	Euphorbiaceae
5	Anacardiaceae	13	Apocynaceae	21	Orchidaceae
6	Leguminosae	14	Asclepiadiaceae	22	Liliaceae 23. Scitamineae
7	Myrtaceae	15	Solanaceae	24	Arecaceae
8	Cucurbitaceae	16.	Acanthaceae	25	Poaceae

Practical **36 hrs**

1. Study on various types of inflorescences with vivid record of practical work.

2. Students must be able to identify the angiosperm members included in the syllabus up to the level of families.

3. Draw labeled diagram of the habit, floral parts, L S of flower, T S of ovary, floral diagram, floral formula and describe the salient features of the member in technical terms

4. Students must submit practical records, Herbarium sheets (25 Nos:) and Field book at the time of practical examination. There should be sufficient representation of plants collected during field trips.

5. Field trips are to be conducted for three days either as continuous or one day trips.

Suggested Readings

1. Davis, P.11. and Haywood, V.H, 1963. Principles of Angiosperm Taxonomy. Oliver and Royd, London.
2. Heywood, V.H. and Moore D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
3. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge London.
4. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
5. Kapoor LD, 2001 Hand Book of Ayurvedic Medicinal Plants, CRC Press New York, Ane Books Pvt. Ltd
6. Lawrence. G.H.M. 1951. Taxonomy of Vascular Plants. Macmillan, New York.
7. Naik, V.N. 1984. Taxonomy of Angiosperms. Tata McGraw Hill, New York.
8. Nordenstam. B.., El-Gazaly, G. and Kassas. M. 2000. Plant Systematics for 21st Century
9. Pandey SN and Misra SP, 2008 Taxonomy of Angiosperms; Ane Books Pvt. Ltd.
10. Radford. A.E.1986. Fundamentals of Plant Systematics Harper and Row, New York.
11. Singh. G. 1999. Plant Systematics: Theory and practice Oxford & IBH Pvt, Ltd. New Delhi.
12. Sivarajan,V.V. Introduction to the principle of plant taxonomy, Oxford and IBH Publishing Company
13. Stace. C.A. 1989. Plant Taxonomy and Biosystematics. 2nd ed. Edward Arnold, London.
14. Verma V, 2009 Text Book of Economic Botany; Ane Books Pvt. Ltd.
15. Woodland. D.E. 1991. Contemporary Plant Systematics. Prentice Hall, New Jersey.

Semester V
Core Course Vocational
BB1571 Recombinant DNA Technology

Credits-4 **Contact hours 72 (Theory 54+ Practical 18)**

Aim and Objectives*: To give a basic training to the students of Biotechnology on recombinant DNA and related techniques. Training in this course will create an interest in genetic engineering and is essential for further studies in Biotechnology*.

Module I **8 hrs**
Introduction to gene cloning and its applications:

Introduction and overview of steps in recombinant DNA technology – Enzymes involved: Restriction endonucleases, DNA ligases, Alkaline phosphatase, Polynucleotide kinase, Terminal transferase, Taq polymerase, Reverse transcriptase. Adapters and linkers.

Module II **15 hrs**

Vectors – Definition and properties - Plasmid vectors - pBR322, pUC series; Bacteriophage lambda and M13 based vectors, Phagmids and Cosmid vectors, Shuttle vectors, Yeast Artificial vectors (YACs), Bacterial artificial vectors (BACs).

Module III **15 hrs**
Cloning of genes

Host cells, Competent cell preparation, Construction of recombinant DNA, screening and selection of transformed cells. DNA libraries – preparation and uses of Genomic DNA and cDNA libraries. Gene transfer methods – Direct and vector mediated gene transfer.

Module IV
Techniques in rDNA technology **10 hrs**

Polymerase chain reaction and its types. Molecular marker techniques: RFLP, AFLP, RAPD; DNA Barcoding, Nucleic acid sequencing (Maxam and Gilbert method, Sanger's method). Gene expression analysis – Southern hybridization, Immunoblotting, RT- PCR, Northern hybridization and microarrays.

Module V **6 hrs**

Transgenic organisms and its impact in agriculture, Medicine and Environment.

Biosafety and ethics in genetic engineering. Human genome project – a brief account.

Practical **18 Hrs**

Experiments for Practical of rDNA Technology

1. Preparation of the reagents for rDNA experiments
2. Purification of Plasmid from bacterial Cultures.
3. Electrophoresis and evaluation of plasmid DNA-pUC 18 / pBR 322
4. Estimation of plasmid DNA by UV-VIS spectrophotometer
5. Restriction Digestion of pUC 18 and analysis by Agarose gel electrophoresis

6. Transformation of *E. coli* with pUC 18 and selection of ampicillin resistant clones
7. Extraction and purification of Genomic DNA
8. Competent cell preparation
9. PAGE demonstration
10. Quantification of DNA using diphenyl amine method

Suggested Readings

1. Animal cell culture - John R W Master; Oxford University Press
2. Culture of animal cells – A manual of basic technique, R Ian Freshney; Wiley- Liss Publication, New York.
3. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi.
4. Introduction to Biotechnology & Genetic Engineering, Jones & Bartlett Publishers, Boston.
5. Modern concept of Biotechnology- H D Kumar; Vikas Publishing House, Pvt. Ltd., New Delhi.
6. Introduction to Genetic Engineering & Biotechnology- Nair, A. J., Jones & Bartlett Publishers, Boston,USA.
7. Biotechnology – B D Singh Kalyani Publishers, New Delhi
8. Microbiology (7^{th} Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester V
Core Course Vocational
BB1572 Plant Biotechnology

Credits 3 **Contact hours 54 (T 36+P 18)**

Aim and Objectives*: This course is designed to impart basic knowledge in the applied aspects of plant biotechnology for the improvement of agriculture and plant based industries. It will give an outline of plant tissue culture cell culture and plant genetic transformation methods, which will help the students to pursue further studies in these aspects.*

Module I **6 hrs**
Introduction to plant tissue culture

Brief history of plant tissue culture. Fundamental principles of *in vitro* plant cultures: Basic techniques of plant tissue culture-Plant Tissue Culture Laboratory Organization, Tools and Instruments for Plant Tissue Culture, Sterilization Techniques, Surface sterilization of explants, Components of plant tissue culture media- preparation and its functions, use of plant growth regulators

Module II **8 hrs**
Types of *in vitro* cultures

Callus cultures, Micropropagation Methods, Cell Suspension Cultures, Organ culture- root cultures, Meristem Culture, Production of gynogenic (Ovule Culture) and androgenic (Pollen Culture) haploids.

Protoplast- isolation and culturing of protoplast- principle and application, regeneration of protoplasts, protoplast fusion and somatic hybridization- selection of hybrid cells.

Somaclonal variation - isolation of Somaclonal variants and applications of Somaclonal variations

Module III **6 hrs**
Application of *in vitro* cultures

Somatic Embryogenesis and Artificial Seed Production. Plant secondary metabolites production, hairy root cultures, Advantages and disadvantages of in vitro methods

Module IV **8 hrs**

Genetic engineering of plants

Methods of gene transfer in plants – Physical, chemical and biological methods- *Agrobacterium tumefaciens*, tumor formation in plants by *A. tumefaciens*, application of *A. tumefaciens* in plant genetic engineering, Virus mediated gene transfer in plants.

Module V **8 hrs**

Transgenic plants

Insect Resistant Plant- BT Cotton, Herbicide Resistant Plant- Glyphosate Resistant, Salt Tolerant, Stress Tolerant Crops, FLAVR SAVR Tomato and Golden Rice. Biopharming- production of therapeutic proteins in transgenic plants, edible vaccines.

Practical **18 Hrs**

Experiments for Plant Biotechnology Practical

1. Familiarization of instruments and special equipments used in the plant tissue culture experiments
2. Preparation of plant tissue culture medium, and sterilization, Preparation of stock solutions of nutrients for MS Media.
3. Surface sterilization of plant materials for inoculation (implantation in the medium)
4. Development of callus cultures and its sub-culturing
5. Organogenesis- shoot regeneration, root regeneration, somatic embryogenesis
6. Micropropagation of potato/tomato/ - Demonstration
7. Production of artificial seeds (encapsulation method)

Suggested readings

1. An Introduction to Plant Tissue Culture – M K Razdan; Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi.
2. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi.
3. Biotechnology-Fundamentals and Application- S S Purohit and S K Mathur; Agrobotanica, India.
4. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
5. Introduction to Plant Biotechnology- H S Chawla; Oxford & IBH publishing Co.Pvt.Ltd., New Delhi.
6. Modern concept of Biotechnology – H. D. Kumar; Vikas Publishing House, Pvt. Ltd., New Delhi.
7. Plant biotechnology, Recent Advances – P. C. Trivedi; Panima Publishing Corporation, New Delhi.
8. Plant cell, Tissue and Organ Culture - Fundamental Methods, O. L. Gamborg, G. C. Philips; Narosa Publishing House, New Delhi.
9. Role of Biotechnology in Medicinal and aromatic plants - Irfan A Khan and Atiya Khanum; Ukaaz Publications, Hyderabad.

Semester V
Core Course Vocational
BB1573 Animal Biotechnology

Credits 3 **Contact hours 54 (Theory 36+Practical 18)**

Aim and Objectives*: To introduce the basics of the subject of Animal biotechnology and its applications to the students in an attractive and simple manner.*

Module I **12 hrs**
Animal cell culture

History, organ, tissue and cell culture, animal cell culture techniques, Primary cell cultures and secondary cell cultures, cell lines, cell strain, immortalized cell cultures, transformed cell lines. Media - media components and physical parameters, cell viability assays Instruments and equipments needed for animal cell cultures, uses of animal cell cultures.

Module II **6 hrs**
Application of Animal Cell Cultures

Characterization of cell lines, Products of animal cell cultures- hormones (Insulin, growth hormones), interferon, t-plasminogen activator, factor VIII, Factor IX and virus cultivation.

Module III **8 hrs**
Scale up of animal cell cultures

Special bioreactors for large-scale cultivation of animal cells, anchor dependent cells and suspension cultures, Cell culture vessels- Roller bottles and spinner flasks

Module IV **10 hrs**
Stem cell technology

Stem cell culture and its clinical uses, types of stem cells; gene therapy; Growth factors promoting proliferation of animal cell cultures Preservation and maintenance of animal cell cultures- cryopreservation and transport of animal cell cultures; Animal bioreactors. Transgenic animals and its practical uses, Bioethics in animal cell culture, stem cell technology and transgenic animals

Practical **18 hrs**
Experiments for Practical in Animal Biotechnology

1. Familiarization of methods, equipments and techniques of animal cell culture
2. Isolation of lymphocytes from blood
3. Cell viability assay by die exclusion method and cell counting

Suggested Readings

1. Biotechnology-Fundamentals and Application- S S Purohit and S K Mathur; Agrobotanica, India.
2. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi.
3. Animal cell culture- John R W Master; Oxford University Press
4. Culture of animal cells – A manual of basic technique, R Ian Freshney; Wiley- Liss Publication, New York.

5. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
6. Modern concept of Biotechnology- H D Kumar; Vikas Publishing House, Pvt. Ltd., New Delhi.
7. Biotechnology – U. Sathyanarayana Books and Allied (P) Ltd, Kolkata
8. Biotechnology – David p. Clark and Nanette J. Pazdernik (2009). Elsevier

Semester V
Open course for Non –Biotechnology students
BB1551.1 Bioinformatics

Credits: 2 **Contact hours: 54**

Aim and Objectives*: To introduce the subject of bioinformatics to the students of other subjects. Students should be familiarized with the importance of the bioinformatics, databases, genomics and proteomics, tools and software of bioinformatics at the elementary levels.*

Module I **10 hrs**

Bioinformatics- definition, scope, limitations. History and evolution of Bioinformatics, Impact of Bioinformatics in modern biology and research. Databases - various types of databases, Biological Databases- Importance of databases in biotechnology, NCBI, Gene bank, PubMed.

Module II **10 hrs**

Sequence alignment - Pair wise sequence alignment - sequence homology vs similarity; similarity and identity. Database similarity searching - BLAST, FASTA format ; Multiple sequence alignment, scoring function, CLUSTAL-W.

Module III **10 hrs**

Phylogenetic tree construction- distance based methods and character based methods, PHYLIP

Module IV **14 hrs**

Proteomics – technology of protein expression analysis, 2D PAGE, MS, Protein identification through database search, protein data bank

Module V **10 hrs**

Functional Genomics- Sequence based approaches, Microarray based approaches, Applications of proteomics and genomics

Suggested Readings

1. Introduction to Bioinformatics – V. Kothekar, Druv Publication
2. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
3. Bioinformatics- Genomics and Post-genomics, Frederich Dardel & Francois Kepes; John Wiley & Sons.
4. Essential Bioinformatics- Jin Xiong, Cambridge University Press, UK.
5. Nanobiotechnology: Concepts, Applications and Perspectives-C.M. Niemeyer and C.A. Mirkin, Wiley, US
6. Bioinformatics- Data bases, tools and algorithms- Bosu O. U and Thukral S. K. Oxford University Press, New Delhi.
7. Bioinformatics basics: Applications in biological science and medicine. H.H. Rashidi and L.K. Buehler CRC Press, London.
8. Bioinformatics - Sequence, structure and databases - Des Higgins and Willie Taylor. Oxford University Press.

Semester V
Open course for Non –Biotechnology students
BB1551.2 Food & Dairy Biotechnology

Credit 2 **Contact hours: 54**

Aim and Objectives: *This course is for non-biotechnology students. Students from other disciplines can also opt this course to get basic knowledge in the application of Biotechnology in food processing, food spoilage, food preservation and dairy industry.*

Module I **15 hrs**

Concept and scope of food biotechnology- food composition, types of foods; fermented foods and microorganisms involved in fermentation of food materials, food contamination and its sources.

Microbiological examination of foods - indicator organisms, cultural techniques, direct methods, immunological methods etc.

Module II **15 hrs**

Food spoilage and poisoning

Spoilage of foods, Microorganism in food spoilage, chemical changes, microbes in the spoilage of canned foods, meat, fish; Factors affecting growth of spoilage organisms Principles of preservation of foods; food poisoning, mycotoxins; food borne diseases and intoxications.

Module III **14 hrs**

Food preservation- principles of preservation of foods, methods of food preservation, Physical and chemical methods, Osmotic pressure – preserving foods in sugar and salt, chemical preservatives, Radiation as preservation methods.

Module IV
Dairy Biotechnology **10 hrs**

Microbes in dairy industry, contamination, spoilage, microbes of milk and dairy products, fermented dairy products, Pasteurization; Industrial process of cheese making, milk borne diseases, Milk quality testing- resazurin, methylene blue reduction test, Standard plate count.

Suggested Readings

1. Food Microbiology- M.R. Adams and Moss
2. Food Processing- Biotechnological applications Marwah & Arora
3. Food Microbiology-William C. Frazer
4. Industrial microbiology – L.E. Casida
5. Basic food microbiology (2^{nd} Ed)- George J. Banwart, CBS publishers and distributers, New Delhi
6. A modern introduction to food microbiology - Board RC., Blackwell scientific publishers, Oxford.
7. Microbiology (7^{th} Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester V

Open course for Non –Biotechnology students
BB1551.3 Basics of Environmental Biotechnology

Credits: 2 **Contact hours 54**

Aim and Objective: This course is aimed to bring an enthusiasm on environmental protection and to learn the techniques of biotechnology to keep the environment clean and healthy. It highlights the economic aspects in protecting the environment from pollution through biotechnology techniques.

Module I **20 hrs**

Introduction

Ecosystems, Types – Terrestrial, Aquatic, Biodiversity concept.

Environment Basic concepts- Atmosphere, hydrosphere, lithosphere, biosphere Scope and Importance of Environmental Biotechnology; Pollution- sources of pollution, general characteristics; Environmental legislation-water Act; Forest Act; Environmental Protection act.

Module II **10 hrs**

Water pollution

Organic load in aquatic systems - BOD and COD, microbial quality of water, fecal and non-fecal bacteria; Treatment of municipal wastes and hazardous industrial effluents.

Module III **12 hrs**

Non-conventional energy sources

Biomass: utilization of biomass as energy source– application of microbes in production of fuels from biomass- biogas and methanogenic bacteria, Steps and process of Biogas production; vegetable oils as engine fuels, energy crops-Jojoba; Bioplastics.

Module IV **12 hrs**

Bioremediation: herbicides and other toxic chemicals in the environment; Biodegradation, phytoremediation, superbug; Biopesticides- *Bacillus thuringiensis*, bioherbicides; Solid waste treatment-Composting, vermicomposting; Disposal of sludge- Land filling, lagooning.

Suggested readings

1. Environmental Biotechnology - Alan Scragg; Longman, England
2. Biotechnology fundamentals and applications – Purohit & Mathur; Agrobotanica, India
3. Biotechnology – B D Singh; Kalyani Publishers, New Delhi
4. Biological waste water treatment 2nd Edition- Grady C P L
5. Biological Conservation – Spellerberg I F and Hardes S. R.
6. Environmental issues and options – Mishra C.
7. Biodiversity- Status and Prospects- Pramod tandon et al Narosa Publishing House, New Delhi
8. Ecology 2nd Edn, Subrahmanyam N S, Sambamurty V.S.S; Narosa Publishing House.
9. Biotechnology –U. Sathyanarayana; Biotechnology – U. Sathyanarayana Books and Allied (P) Ltd, Kolkata
10. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi.
11. Microbiology (7^{th} Ed) Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester VI
Core Course
BB1641 Genetics

Credits 3 **Contact Hours: 126 (T 72 + P 54)**

Aim and Objectives*: This course is supposed to supplement the basic knowledge in genetics in general and Mendelian genetics in particular. This is essential to study the various branches of biology like molecular biology and gene technology.*

Module: I
Classical Genetics **27 hrs**

1. Mendelian Genetics - Mendel and his experiments, Mendel's success, Mendelian principles, Mendelian ratios, monohybrid and dihybrid crosses, back cross and test cross.
2. Genetics after Mendel - Modified Mendelian ratios; Incomplete dominance - Flower color in *Mirabilis*; Interaction of genes - Comb pattern in poultry 9:3:3:1; Recessive epistasis - Coat color in mice. 9:3:4; Dominant epistasis - Fruit colour in summer squash. 12:3:1; Complementary genes - Flower color in *Lathyrus* 9:7; Duplicate gene with cumulative effect - Fruit shape in summer squash. 9:6:1; Duplicate dominant genes in shepherd's purse. 15:1; Inhibitory factor - Leaf color in Paddy. 13:3.
3. Multiple alleles - General account. ABO blood group in man. Rh factor. Self-sterility in *Nicotiana*.
4. Quantitative characters- General characters of quantitative inheritance, polygenic inheritance; Skin color in Man, ear size in Maize.

Module II **27 hrs**

5. Linkage and crossing over - Linkage and its importance, linkage and independent assortment. Complete and incomplete linkage. Crossing over - a general account, two point and three point test cross. Determination of gene sequence. Interference and coincidence. Mapping of chromosomes.
6. Sex determination - Sex chromosomes, chromosomal basis of sex determination XX-XY, XX-XO mechanism. Sex determination in higher plants (*Melandrium album*). Genic balance theory of sex determination in *Drosophila.* Sex chromosomal abnormalities in man. Klinefelter's syndrome, Turner's syndrome. Sex linked inheritance. Eye color in *Drosophila*, Hemophilia in man. Y- Linked inheritance.
7. Extra nuclear inheritance- General account, maternal influence. Plastid inheritance in *Mirabilis*. Shell coiling in snails, kappa particle in *Paramecium*.

Module-III
Molecular Genetics **16 hrs**

1. DNA as genetic material- Structure of DNA; A, B and Z forms of DNA, satellite and repetitive DNA
2. Replication of DNA, Circular and helical DNA. Semi conservative model, experimental support, Meselson and Stahl experiment. Enzymology of replication: topoisomerase, helicase, primase, polymerase and ligase. DNA repairing mechanism.
3. RNA structure- Properties and functions of tRNA, mRNA and rRNA. Genetic code.
4. Synthesis of protein: Transcription, translation - Central dogma - reverse transcription

5. Concept of gene - Units of a gene, cistron, recon, muton; Types of genes- Housekeeping genes (constitutive genes), Luxury genes (non-constitutive genes), interrupted genes (Split genes) - introns, overlapping genes.
6. Transposable genetic elements - General account, Characteristic, Transposons (jumping genes), Cellular oncogenes (general account only). Epigenetics (brief account).

Module IV **2 Hrs**

Population Genetics

Hardy Weinberg Law, factors affecting equilibrium **–** Mutation, migration and selection.

Practical **54 hrs**

Work out problems in

1. Monohybrid cross (Dominance and incomplete dominance)
2. Dihybrid cross (Dominance and incomplete dominance)
3. Gene interactions (All types of gene interactions mentioned in the syllabus)
    a. Recessive epistasis 9: 3: 4.
    b. Dominant epistasis 12: 3: 1
    c. Complementary genes 9: 7
    d. Duplicate genes with cumulative effect 9: 6: 1
    e. Inhibitory genes 13: 3
    f. Duplicate dominant gene 15: 1
    g. Comb pattern in poultry 9:3: 3:1
4. Linkage and crossing over
5. Two point and three point crosses
6. Construction of genetic map.

Suggested Reading

1. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
2. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New York
3. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
4. Gardner, E. J and Snustad, D. P (2006) Principles of Genetics. John Wiley, New York.
5. Gupta P. K. – Genetics (Rastogi publications).
6. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd
7. John Ringo (2004) Fundamental Genetics. Cambridge University Press India Pvt. Ltd.
8. Lewin, B, Genes IX, Oxford University Press, New York.
9. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
10. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
11. Sharma, A.K and Sharma A (1980) Chromosome technique Theory and practice, Aditya Books, New York
12. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, New York.
13. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd

Semester VI
Core Course
BB1642 Economic Botany, Ethnobotany & Medicinal Botany

Credit 2 **Contact hours 108 (Theory 72 + Practical 36)**

***Aim and Objectives**: This gives awareness about the importance of Medicinal plants and its useful parts, economically important plants in our daily life and also about the traditional medicines and herbs, and its relevance in modern times*.

Module I **30 hrs**
Economic botany

1. Study of the major crops of Kerala - Coconut and Paddy - with special reference to their Methods of cultivation, Botanical description, morphology of the useful part and economic importance.

2. A brief account on the utility of the following plants, specifying the Binomial, family and morphology of the useful parts.

   Fruits & Vegetables- Banana, Jackfruit, Pineapple, Citrus, Apple, Cashew, Watermelon, Tomato, Brinjal, Common bean, Sword bean, Pumpkin, Cucumber, Snake gourd, Bitter gourd, Ash gourd, Bottle gourd.

Cereals and millets	-	Wheat and Ragi
Pulses	-	Black gram and Bengal gram
Sugar yielding Plants	-	Sugar cane
Spices	-	Pepper and Cardamom
Beverages	-	Coffee, Tea
Fibre yielding plant	-	Cotton
Dye Yielding plants	-	Henna and *Bixa orellana*
Resins	-	Asafoetida
Tuber crops	-	Tapioca
Oil yielding Plants	-	Sesame and Coconut
Insecticides	-	Neem

Module II
Ethnobotany **20 hrs**

1. Definition — importance, scope, categories and significance.

2. Study of various methods to collect Ethno botanical data.

3. Plant parts used by tribes in their daily life as food, clothing, shelter, agriculture and medicine.

4. Study of common plants used by tribes. *Aegle marmelos*, *Ficus religiosa*, *Cynodon dactylon*, *Ocimum sanctum* and *Trichopus zeylanicus.*

5. Ethnobotanic aspect of conservation and management of plant resources.

Module III **15 hrs**

Medicinal botany

1. Importance and the need for its conservation- Sacred groves. Role of CSIR-CIMAP, NMPB, BSI, JNTBGRI in conservation and cultivation of medicinal plants.

2. A general account of the medicinal value of the following plants **– Rhizome** - *Curcuma* and *Zingiber;* **Bulb** - *Allium cepa* and *A. sativa*; **Root** - *Asparagus, Hemidesmis, Acorus calamus; Adhatoda vasica, Catharanthus roseus, Phyllanthus amarus, Andrographis paniculata;* **Leaves** - *Aloe vera, Centella asiatica,* Asoka (*Saraca indica*) and Brahmi (*Bacopa monnieri*), Sarpagandha (*Rauvolfia serpentina*).

3. Production of herbal drugs. Extraction procedure (maceration, percolation, Hot continuous (soxhlet), aqueous alcoholic extraction by fermentation, counter current extraction, Sonication, superficial fluid extraction, phytotonic process.) - Adulteration of drugs

Module IV **7 hrs**

1. Definition and scope of Pharmacognosy – Ancient and modern medicines -Sidha, Ayurveda, Unani, Acupuncture, Homoeopathy and Allopathy

2. Sources of crude drugs – roots, rhizome, bulb, corm, leaves, stems, flowers, fruits and seeds

Practical **36 hrs**

1. Collection and study of economically important plants and morphology of the useful parts.
2. Identify the economic products obtained from the plants mentioned under Economic Botany.
3. Visit a tribal area and collect information on their traditional method of treatment using crude drugs.
4. Familiarize with at least 5 folk medicines.
5. Observe the plants of ethno botanical importance in your area.
6. Students are expected to identify the plants mentioned in the Ethnobotany syllabus.
7. Visit to Ayurveda college or other Ayurvedic institutions is recommended.

Suggested Readings

1. Verma V, 2009 Text Book of Economic Botany; Ane Books Pvt. Ltd.
2. Kapoor LD, 2001 Hand Book of Ayurvedic Medicinal Plants, CRC Press New York,
3. Davis, P. and Haywood, V.H, 1963. Principles of Angiosperm Taxonomy, Oliver and Boyd, London.
4. K. Jain. Glimpses of Ethnobotany. Oxford and IBH Publishing Company, New Delhi.
5. S.K. Jain, 1987. A Manual of Ethno botany. Scientific Publishers, Jodhpur
6. T.E Walles. Text book of Pharmacognosy,
7. Rajiv K Sinha. Ethnobotany.

Semester VI
Core Course
BB1643 Practical Botany III
(Practical of BB1541, BB1542, BB1641, BB1642)

Credit 2 **Contact Hours: 162**

BB1541 Plant Physiology (36 Hrs)

1. Water potential of onion peel, *Rhoeo* peel by plasmolytic method
2. Separation of plant pigments by paper chromatography Demonstration Experiments
3. Thistle funnel experiment
4. Tissue tension
5. Root Pressure
6. Suction force due to transpiration
7. Foliar transpiration by using bell jar
8. Transpiring surface - 4 leaf experiment
9. Potometer — Farmer and Ganong's,
10. Water balance — Relation between transpiration and absorption.
11. Evolution of oxygen during photosynthesis
12. Necessity of chlorophyll, CO2 and light in photosynthesis
13. Measurement of photosynthesis.
14. Simple respiroscope
15. Respirometer of R.Q.
16. Anaerobic respiration
17. Fermentation
18. Geotropism and phototropism — Klinostàt
19. Hydrotropism
20. Measurement of growth — Arc or Lever Auxonometer

BB1542 Angiosperm Morphology and Systematic Botany (36 hrs)

1. Study on various types of inflorescences with vivid record of practical work.

2. Students must be able to identify the angiosperm members included in the following families up to the level of family.

1	Annonaceae	9	Apiaceae	17	Verbenaceae
2	Nymphaeaceae	10	Rubiaceae	18	Lamiaceae
3	Malvaceae	11	Asteraceae	19	Amaranthaceae
4	Rutaceae	12	Sapotaceae	20	Euphorbiaceae
5	Anacardiaceae	13	Apocynaceae	21	Orchidaceae
6	Leguminosae	14	Asclepiadiaceae	22	Liliaceae 23. Scitamineae

7	Myrtaceae	15	Solanaceae	24	Arecaceae
8	Cucurbitaceae	16.	Acanthaceae	25	Poaceae

3. Draw labeled diagram of the habit, floral parts, L S of flower, T S of ovary, floral diagram, floral formula and describe the salient features of the member in technical terms

4. Students must submit practical records, Herbarium sheets (Minimum 25 Nos) and Field book at the time of practical examination. There should be sufficient representation of plants collected during field trips.

5. Field trips are to be conducted for three days either as continuous or one day trips. The report of the same should be submitted during university practical examination of BB1643

BB1542 Genetics **54 Hrs**

Work out problems in

1. Monohybrid cross (Dominance and incomplete dominance)
2. Dihybrid cross (Dominance and incomplete dominance)
3. Gene interactions (All types of gene interactions mentioned in the syllabus)
   a) Recessive epistasis 9: 3: 4.
   b) Dominant epistasis 12: 3: 1
   c) Complementary genes 9: 7
   d) Duplicate genes with cumulative effect 9: 6: 1
   e) Inhibitory genes 13: 3
   f) Duplicate dominant gene 15: 1
   g) Comb pattern in poultry 9:3: 3:1
4. Linkage and crossing over
5. Two point and three point crosses
6. Construction of genetic map.

BB1642 Economic Botany, Ethnobotany & Medicinal Botany **36 hrs**

1. Collection and study of economically important plants and morphology of the useful parts.
2. Identify the economic products obtained from the plants mentioned under Economic Botany.
3. Visit a tribal area and collect information on their traditional method of treatment using crude drugs.
4. Familiarize with at least 5 folk medicines.
5. Observe the plants of ethno botanical importance in your area.
6. Students are expected to identify the plants mentioned in the Ethnobotany syllabus.
7. Visit to Ayurveda College or other Ayurvedic institution is recommended.

Semester VI
Core Course Vocational
BB1671 Industrial Biotechnology

Credits: 3 **Contact Hours: 72 (T 36 + P 36)**

Aim and Objectives*: The students will be introduced to the industrial application of Biotechnology and Bioprocess technology through this course. Students get familiarized to the commercial importance of Biotechnology through this course.*

Module I **4 hrs**

Introduction of different Biotechnology industries in India, Screening of industrially important microbes (primary and secondary screening) and isolation.

Module II **8 hrs**

Fermentation

The biological process of fermentation- various types of fermentation, alcohol fermentation, Bioreactors - types of bioreactors (Airlift bioreactors, continuous stirred tank reactor, tower reactor, batch reactor, upflow anaerobic sludge blanket reactor) /Fermentors, Design and parts of a bioreactor.

Module III **10 hrs**

Upstream Processing: Media for fermentation, characteristics of ideal production media, media sterilization, aeration, pH, temperature; batch fermentation, continuous fermentation, fedbatch fermentation, chemostatic cultures.

Downstream processing: Downstream processing and product recovery, Different physical and chemical methods for the separation of fermentation products.

Module IV **8 hrs**

Agricultural waste and food industry wastes as the substrate for fermentation, solid state fermentation; production of single cell proteins, microbial production of enzymes - protease and amylase; Immobilization of cells and enzymes **–** applications.

Module V **6 hrs**

Microbial production of antibiotics-Penicillin, vitamins- B_{12}, amino acids- Glutamic acid; Organic acid - Citric acid; Beverages - beer; solvents **–** butanol.

Practicals

Experiments for Industrial Biotechnology Practical **36 hrs**

1. Isolation of yeast from fruit samples and its culturing.
2. Preparation of media for alcohol fermentation by yeast.
3. Preparation of Ethyl alcohol from glucose by Yeast fermentation

4. Separation and quantification of ethanol by distillation (demonstration)
5. Production of wine (Demonstration)
6. Isolation of microorganisms from spoiled food and identification
7. Isolation of organisms from curd/ milk and fermentation of lactose
8. Demonstration of setting laboratory fermentor- basic features, purpose, procedure

Suggested Reading

1. Modern Concept of Biotechnology- H D Kumar; Vikas Publishing House Pvt. Ltd., New Delhi.
2. Food Processing – Biotechnological Applications- S S Marwaha & J K Arora, Asiatech Publishers Inc., New Delhi
3. Food Microbiology- M R Adams & M O Moss; Panima Publishing Corporation, New Delhi.
4. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
5. Industrial Microbiology – A H Patel, Panima Publishing House New Delhi.
6. Fermentation technology- Whittaker,
7. Fundamentals of Microbiology, Jones & Bartlett Publishers, Boston, USA.
8. Microbiology (7^{th} Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester VI
Core Course Vocational
BB1672 Environmental Biotechnology

Credits: 2 **Contact hours 72 (T 36 + P 36)**

Aim and Objectives*: This course is aimed to bring an enthusiasm on environmental protection and to learn the techniques of biotechnology to keep the environment clean and healthy.*

Module I **4 hrs**

Introduction

Importance of Environmental Biotechnology; Pollution - sources of pollution, general characteristics.

Module II **5 hrs**

Water pollution

Organic load in aquatic systems - BOD and COD, microbial quality of water, Laboratory methods for the detection of coliforms in drinks and food; fecal and non-fecal bacteria; Treatment of municipal wastes and hazardous industrial effluents.

Module III **10 hrs**

Non-conventional energy sources

Biomass: utilization of biomass as energy source – application of microbes in production of fuels from biomass- biogas and methanogenic bacteria, Steps and process of Biogas production; microbial hydrogen production, the gasohol experiment. Energy production from photosynthetic pigments; vegetable oils as engine fuels, energy crops-jojoba; Bioplastics

Module IV **8 hrs**

Bioremediation and Bioleaching: Microbial degradation of pesticides, herbicides and other toxic chemicals in the environment; Bioaugmentation; phytoremediation, superbug

Bioleaching-Enrichment of ores by microorganisms (bioaccumulation and biomineralisation).

Bio-assessment of environmental quality.

Module V **5 hrs**

Solid waste treatment

Solid waste treatment - Composting, vermicomposting; Disposal of sludge- Land filling, lagooning.

Module VI **4 hrs**

Environmental legislation:

Water Act; Forest Act; Environmental Protection act.

Practical

Experiments for Environmental Biotechnology **36 hrs**

1. Microbiological assessment of drinking water using MPN technique- water from well, river, water supply department and packaged drinking water.
2. Isolation of microbes from polluted and non polluted environment.
3. Estimation of Dissolved Oxygen using Winkler's method.
4. Assessment of organic load in aquatic systems and factory effluent- Determination of BOD and COD.
5. Biogas production by methanogenic bacteria or by mixed culture.
6. Isolation of nitrogen fixing bacteria from leguminous plants.
7. Vermiculture for recycling solid waste.

Suggested readings

1. Environmental Biotechnology - Alan Scragg; Longman, England
2. Biotechnology fundamentals and applications – Purohit & Mathur; Agrobotanica, India
3. Biotechnology – B D Singh; Kalyani Publishers, New Delhi
4. Biological waste water treatment 2nd Edition- Grady C P L
5. Biological Conservation – Spellerberg I F
6. Environmental issues and Options – Mishra C.
7. Biodiversity- Status and Prospects- Pramod tandon etal Narosa Publishing House, New Delhi
8. Ecology 2nd Edn, Subrahmanyam N S, Sambamurty V.S.S; Narosa Publishing House.
9. Biotechnology –U. Sathyanarayana; Biotechnology – U. Sathyanarayana Books and Allied (P) Ltd, Kolkata
10. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi.
11. Microbiology (7^{th} Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester VI
Elective course for Biotechnology students
BB1681.1 Bioinformatics and Nanobiotechnology

Credit 2 **Contact hours: 36**

Aim and Objective: This course is for biotechnology students, who are interested to know about the methods and application of bioinformatics and modern Nanobiomolecules and their contribution in the various fields of biotechnology and healthcare.

Module I **8 hrs**

Bioinformatics - definition, scope, limitations. History and evolution of Bioinformatics, Impact of Bioinformatics in modern biology and research. Databases- various types of databases, Biological Databases - Importance of databases in biotechnology, NCBI, Gene bank, PubMed.

Module II **6 hrs**

Sequence alignment - Pair wise sequence alignment - sequence homology vs similarity; similarity and identity. Database similarity searching - BLAST, FASTA format; Multiple sequence alignment, scoring function, CLUSTAL-W.

Module III **6 hrs**

Phylogenetic tree construction - distance based methods and character based methods, PHYLIP.

Module IV **6 hrs**

Proteomics – technology of protein expression analysis, 2D PAGE, MS, Protein identification through database search, protein data bank. Functional Genomics - Sequence based approaches, Microarray based approaches. Applications of proteomics and genomics.

Module V **10 hrs**

Nanobiotechnology - Introduction to nanoworld, classification of nano materials, application of nano crystals, DNA chip, nano biosensors – DNA sensors; Quantum dots; Drug delivery systems and techniques - prosthesis and implants - diagnosis and screening; Applications of Nanobiotechnology in medicine and health.

Suggested Readings

1. Introduction to Bioinformatics – V. Kothekar, Druv Publication
2. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
3. Bioinformatics- Genomics and Post-genomics, Frederich Dardel & Francois Kepes; John Wiley & Sons.
4. A text book of Biotechnology, R. C. Dubey, S. Chand Publications, New Delhi
5. Essential Bioinformatics- Jin Xiong, Cambridge University Press, UK.
6. Nanobiotechnology: Concepts, Applications and Perspectives-C.M. Niemeyer and C.A. Mirkin, Wiley, US
7. Bioinformatics- Data bases, tools and algorithms- Bosu O. U and Thukral S. K. Oxford University Press, New Delhi.

8. Bioinformatics basics: applications in biological science and medicine-H.H. Rashidi and L.K. Buehler CRC Press, London.
9. Bioinformatics- sequence, structure and databases- Des Higgins and Willie Taylor. Oxford University Press

Semester VI
Elective course for Biotechnology students
BB1681.2 Genetic Engineering

Credit 2 **Contact hours: 36**

Aim and Objectives*: This course is intended to know about the methods and application of genetic engineering and its contribution in the various fields of Biotechnology.*

Module I
Introduction to gene cloning **6 hrs**

Introduction to gene cloning, enzymes and basic tools involved in gene cloning.

Module II **14 hrs**

Isolation and purification of total cell DNA.

DNA sequencing methods, Principle and applications.

Molecular hybridization techniques (Northern, southern, western blotting), *In Situ* hybridization.

PCR: Principle and applications.

Techniques for genome analysis: RFLP, AFLP, RAPD - DNA finger printing.

Human genome project– a brief account.

Module III **8 hrs**

Introduction of recombinant DNA into living cells an overview. Selection and screening of recombinant clones.

Module IV **8 hrs**

DNA libraries: genomic libraries and cDNA libraries. Application of genomic libraries and cDNA libraries. Various methods of genetic transformation in eukaryotes - Direct gene transfer and vector mediated gene transfer. Screening methods of transformed cells and organisms.

Suggested Reading

1. Animal cell culture - John R W Master; Oxford University Press
2. Culture of animal cells – A manual of basic technique, R Ian Freshney; Wiley- Liss Publication, New York.
3. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi.
4. Introduction to Biotechnology & Genetic Engineering, Jones & Bartlett Publishers, Boston.
5. Modern concept of Biotechnology- H D Kumar; Vikas Publishing House, Pvt. Ltd., New Delhi.
6. Introduction to Genetic Engineering & Biotechnology- Nair, A. J., Jones & Bartlett Publishers, Boston, USA.
7. Biotechnology – B D Singh Kalyani Publishers, New Delhi

Semester VI
Elective course for Biotechnology students
BB1681.3 Food & Dairy Biotechnology

Credit 2 **Contact hours: 36**

Aim and Objectives: This course is intended to get a basic knowledge in the application of Biotechnology in food processing, food spoilage, food preservation and dairy industry.

Module I **8 hrs**

Concept and scope of food biotechnology - food composition, types of foods; fermented foods, food contamination and its sources

Microbiological examination of foods- indicator organisms, culture techniques, direct methods, immunological methods etc.

Module II

Food spoilage and poisoning **10 hrs**

Spoilage of foods, Microorganisms in food spoilage, chemical changes, microbes in the spoilage of canned foods, meat, fish; Factors affecting growth of spoilage organisms.

Food poisoning, mycotoxins; food borne diseases and intoxications.

Module III **10 hrs**

Food preservation - principles of preservation of foods, methods of food preservation, Physical and Chemical Methods, Osmotic pressure – preserving foods in sugar and salt, chemical preservatives, Radiation as preservation methods.

Module IV

Dairy Biotechnology **8 hrs**

Microbes of milk and dairy products, fermented dairy products, Homogenization and Pasteurization; methods of packing milk. Milk quality testing- resazurin, methylene blue reduction test, Standard plate count. Industrial process of cheese making.

Suggested Readings

1. Food Microbiology- MR Adams and Moss
2. Food Processing- Biotechnological applications Marwah & Arora
3. Food Microbiology-William C Frazer
4. Industrial microbiology -LE Casida
5. Basic food microbiology(2^{nd} Ed)- George J. Banwart, CBS publishers and distributors, New Delhi
6. A modern introduction to food microbiology - Board RC., Blackwell scientific publishers, Oxford.

Semester VI
Core Course Vocational
BB 1673 Biotechniques III (Practical of BB1571, BB1572, BB1573, BB1671 & BB1672)

Credit: 2 **Contact hours: 126**
(Practical Hours of above courses)

Practical of BB1571 **18 Hrs**

Experiments for Practical of rDNA Technology

1. Preparation of the reagents for rDNA experiments.
2. Purification of Plasmid from bacterial Cultures.
3. Electrophoresis and evaluation of plasmid DNA-pUC 18 / pBR 322.
4. Estimation of plasmid DNA by UV-VIS spectrophotometer.
5. Restriction Digestion of pUC 18 and analysis by agarose gel electrophoresis
6. Transformation of *E. coli* with pUC 18 and selection of ampicillin resistant clones.
7. Extraction and purification of Genomic DNA.
8. Competent cell preparation.
9. PAGE demonstration.
10. Quantification of DNA using diphenyl amine method.

Practical of BB1572

Experiments for Plant Biotechnology Practical **18 hrs**

1. Familiarization of instruments and equipments used in the plant tissue culture experiments
2. Preparation of plant tissue culture medium, and sterilization, Preparation of stock solutions of nutrients for MS Media.
3. Surface sterilization of plant materials for inoculation (implantation in the medium)
4. Development of callus cultures and its sub-culturing
5. Organogenesis- shoot regeneration, root regeneration, somatic embryogenesis
6. Micropropagation of potato/tomato/ - Demonstration
7. Production of artificial seeds (encapsulation method)

Practical of BB1573

Experiments for Practical in Animal Biotechnology **18 hrs**

1. Familiarization of methods, equipments and techniques of animal cell culture.
2. Isolation of lymphocytes from blood.
3. Cell viability assay by dye exclusion method and cell counting.

Practical of BB1671

Experiments for Industrial Biotechnology Practical **36 hrs**

1. Isolation of yeast from fruit samples and its culturing.
2. Preparation of media for alcohol fermentation by yeast.
3. Preparation of Ethyl alcohol from glucose by Yeast fermentation.
4. Separation and quantification of ethanol by distillation (Demonstration).
5. Production of wine (Demonstration).
6. Isolation of microorganisms from spoiled food and identification.
7. Isolation of organisms from curd/ milk and fermentation of lactose.
8. Demonstration of setting laboratory fermentor- basic features, purpose, procedure.

Practical of BB1672

Experiments for Environmental Biotechnology **36 hrs**

1. Microbiological assessment of drinking water using MPN technique- water from well, river, water supply department and packaged drinking water.
2. Isolation of microbes from polluted and non-polluted environment.
3. Estimation of Dissolved Oxygen using Winkler's method.
4. Assessment of organic load in aquatic systems and factory effluent- Determination of BOD and COD.
5. Biogas production by methanogenic bacteria or by mixed culture.
6. Isolation of nitrogen fixing bacteria from leguminous plants.
7. Vermiculture for recycling solid waste.

- **One Day Industry/ Institute Visit –** During the course, students should visit at least two Biotechnology related industries or Institutes. Report based on Visit, duly certified by the HOD should be submitted along with the Record at the time of University Practical Examination of BB1673.

MODEL QUESTION PAPERS

Core Course: Botany

First Semester Career Related CBCSS Degree Programme in B.Sc. Botany and Biotechnology
Degree Examination
Core Course

BB 1141-ANGIOSPERM ANATOMY AND REPRODUCTIVE BOTANY

Time : 3 Hours **Max. Marks : 80**

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. Give an example for a living mechanical tissue in plants.
2. A living component of xylem.
3. Who proposed Tunica-Corpus theory?
4. What are tyloses?
5. Give an example for a secondary meristem.
6. What is meant by exarch condition?
7. What are annual rings?
8. Write the source of Canada balsam.
9. Mention the chemical constituent of exine.
10. Point out the physiological significance of tapetum.

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph

11. Comment on the types of non-living inclusions in a plant cell.
12. Briefly describe the kinds of vascular arrangements.
13. Give the application and composition of FAA.
14. Mention the types of stomata found in plants.
15. Differentiate heart wood and sap wood.
16. Explain the components of periderm.
17. How will you differentiate shoot apex and root apex?
18. Briefly describe the structure of anther wall.
19. Describe the types of pollen aperture.
20. Explain the structure of cambium.
21. Mention any four differences between dicot and monocot leaf.
22. Write a brief account on double fertilization.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Describe the types of meristems in plants.
21. Explain the features of secondary wall pits.
25. Discuss the type of secondary thickening in Dracaena stem.
26. Mention the structure of male gametophyte.
27. Mention the types of pollination mechanisms in plants.
28. Give an account of the types of simple permanent tissues.
29. Explain briefly on secretory tissues.
30. Discuss the structure and chemical composition of plant cell wall.
31. Explain Histogen theory.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the types of complex permanent tissues and point out their function in plants.
33. Describe the development of female gametophyte. Point out the types and differentiate them.
34. Discuss the types of anomalous secondary thickening in Dicot stems.
35. Explain the development and function of endosperm. Add a note on types of endosperm.

(15 x 2 = 30 marks)

Second Semester Career Related CBCSS Degree Programme in B.Sc. Botany and Biotechnology Degree Examination
Core Course

BB 1241-ENVIRONMENTAL STUDIES AND PHYTOGEOGRAPHY

Time : 3 Hours **Max. Marks : 80**

SECTION –A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. Give a method for *in-situ* conservation of plants.
2. Mention any two anatomical adaptations in xerophytes.
3. Define endemism
4. Cite the names of any two National Parks in Kerala
5. Give an example for renewable resource.
6. What is meant by endangered species?
7. What are green house gases?
8. Mention the hazards of lead pollution.
9. Comment on Acid rain.
10. What is meant by desertification?

(1 x 10 = 10 marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph

11. Comment on the types of abiotic components of an ecosystem.
12. Briefly describe the causes of biodiversity loss.
13. Point out how epiphytes are adapted to thrive in their habitat?
14. Mention the types of trophic levels in an ecosystem.
15. Differentiate environmental hazard and environmental disaster.
16. Explain the significance of mangrove vegetation.
17. What are the types of Forests in India.
18. Comment on the recent ecological issues in Kasargod.
19. Discuss the causes for global warming.
20. Explain the role of bacteria in ecosystem.
21. Mention any four examples for non-renewable natural resources.
22. Represent a food chain in a grass land ecosystem.

(2 x 8 = 16 marks)

SECTION –C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Describe diversity and beta diversity.
24. What are hot spots? Mention their significance and give an example from India.
25. Describe the types of ecological pyramids.
26. Mention the stages of succession in a dry habitat.
27. Mention the strategies for conservation of forest resources.
28. Give an account of environmental legislation.
29. Explain briefly on Environmental ethics. Comment on major issues and solutions.
30. Discuss the various options for water management.
31. Explain the role of information technology in environment management.

(4 x 6 = 24 marks)

SECTION – D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the types of vegetation and phytogeographic regions of India.
33. Discuss the concept of sustainable development. Explain with reference to global environmental status.
34. Discuss the impact of solid waste and point out the causes, effects and control measures of urban and industrial wastes.
35. Discuss the role of Forests in environment. Comment on the strategies enforced by Government of India for Forest management.

(15 x 2 = 30 marks)

Third Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination
Core Course

BB1341: PHYCOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

Time : 3 Hours **Max. Marks: 80**

SECTION – A

Answer all the questions in a word or one to two sentences. Each question carries one Mark. Draw diagrams wherever necessary.

1. What is a coenobium?
2. Mention the types of pigments in Phaeophyceae.
3. What are clamp connections?
4. What are the cell wall constituents present in fungi?
5. Why Lichens are considered as bioindicators?
6. Point out the composition of Bordeaux mixture.
7. Name the diploid stages in the life cycle of *Polysiphonia*.
8. Comment on the type of septum in basidiomycotina.
9. Name a heteroecious fungus.
10. What is a gonidium? **(1 x 10 = 10 marks)**

SECTION – B

Answer any eight questions. Each question carries 2 marks. (Answer not to exceed one paragraph)

11. Mention the mode of branching in *Cladophora*.
12. What are the nodal appendages found in *Chara*?
13. Specify the structure of fruit body in *Xylaria.*
14. Describe the methods of asexual reproduction in *Penicillium*.
15. What are auxospores? Mention their significance.
16. Briefly mention the thallus organization of a Lichen.
17. Mention the name of pathogen, symptoms and control measures of root wilt of pepper.
18. How the zoospores of *Oedogonium* and *Vaucheria* differ from each other?
19. Why Chlorella is used in space trips?
20. Differentiate aplanospore and chlmydospore.
21. Write on affinities of bacteria and cyanophyceae.
22. Discuss the economic importance of yeasts. **(2 x 8 = 16 Marks)**

SECTION – C

Answer any six questions. (Answer not to exceed 120 words). Each question carries 4 marks)

23. Describe the mode of reproduction in *Sargassum*.
24. With the help of labeled diagram, explain sexual reproduction in *Rhizopus*.
25. Differentiate macrandrous and nannandrous species of *Oedogonium*.
26. Give an account on economic importance of fungi.
27. Discuss the types of thallus organization in chlorophyceae.
28. Compare Acomycotina and basidiomycotina.
29. Give an account on thallus structure and mode of reproduction in *Nostoc*.
30. Describe the mode of reproduction in *Usnea*.
31. Explain the host-parasite interaction in pathological conditions **(4 x 6 = 24 Marks)**

SECTION – D

Answer any two questions. (Not more than three pages). Each question carries 15 Marks

32. Describe the structure and reproduction of *Polysiphonia*. Write notes on the type of life cycle.
33. With the help of diagrams, explain the life cycle of *Puccinia*.
34. Give an outline of the classification of Fungi by Ainsworth. Briefly mention the evolutionary trends among major groups.
35. What are fungicides? Give an account on the types of fungicides and their mode of action on pathogens.

(2 x 15 = 30 Marks)

Third Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology
Degree Examination
Core Course
BB1342 Horticulture, Mushroom Cultivation and Marketing

Time : 3 Hours **Max. Marks : 80**

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What is the binomial of Common milky mushroom?
2. Define steeping.
3. What is approach grafting?
4. Expand NPK.
5. What is a bonsai?
6. What is Spawning?
7. What is a trophy?
8. What are foliar sprays?
9. Name a rooting hormone.
10. What is the optimum pH for preparing button mushroom compost?

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. List out four poisonous mushrooms with binomial name.
12. Write a short account on Ikebana.
13. What is hydroponics? Mention the advantages.
14. Draw a labelled diagram of the basidiocarp of *Agaricus bisporus*.
15. What is vermicompost?
16. Describe the commercial importance of parthenocarpy.
17. Comment on the medicinal and nutritional value of Oyster mushroom.
18. What are roof gardens? Mention the components.
19. Describe T Budding with diagrams.
20. Describe the polythene bag cultivation method of mushrooms.
21. Comment on Olericulture.
22. Give the details of any two diseases of Mango.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Give an account of Paddy straw mushroom substrate preparation methods..
24. Describe the chemical control of insect pests.
25. Differentiate biofertilizers and chemical fertilizers.
26. Describe the various irrigation methods used for gardening.
27. Write notes on spawn making.
28. Give an account on the practical uses of Gibberellins in Horticulture.
29. Describe the methods of preservation of vegetables.
30. Comment on the production level and economic return of mushroom cultivation in India.
31. Write a brief account on garden tools and implements.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Write an essay on processing and storage of mushrooms.
33. What is layering? With neat labelled diagrams describe the various methods of layering.
34. Write detailed notes on white button mushroom cultivation. Add notes on its harvesting methods.
35. Explain the various methods of landscaping a garden.

(15 x 2 = 30 marks)

Fourth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Core Course

BB1441 BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS & PALEOBOTANY

Time : 3 Hours **Max. Marks : 80**

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What is the common name for *Equisetum*?
2. Define Diploxylic condition.
3. Name the class to which *Riccia* belongs.
4. What is meant by heterospory?
5. Give an example for a fossil pteridophyte.
6. What is a synangium?
7. What are sporocarps?
8. What is indusium?
9. What are gemmae?
10. Define plectostele. **(1 x 10 = 10 marks)**

SECTION – B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. Comment on the features of assimilatory zone of *Riccia*.
12. Briefly describe the physiological changes associated with senescence.
13. Describe the anatomical features of *Psilotum* stem.
14. Mention any four morphological features of *Equisetum*.
15. Differentiate perigynium and perichaetium.
16. Explain thallus morphology of *Marchantia*.
17. What are girdle traces?
18. Briefly describe the the structure of pollen grain of *Pinus*.
19. Describe the morphology of Rhizophore.
20. Explain the hydrophytic anatomical features of *Marselia* stem.
21. Mention any four affinities of gymnosperms to pteridophytes.
22. Write a brief account on carbon dating technique. **(2 x 8 = 16 marks)**

SECTION –C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Describe the structure of sporophyte of *Marchantia*.
24. Explain the anatomical features of *Funaria* stem.
25. Discuss the mechanism of fossil formation.
26. Mention the structure of *Pteris* sporophyll.
27. Why *Gnetum* is considered as an advanced Gymnosperm?
28. Give an account of the types of steles in species of *Lycopodium*.
29. Explain the anatomical features of *Cycas* leaflet.
30. Discuss the economic importance of Gymnosperms.
31. Explain the structure of *Lyginopteris*. **(4 x 6 = 24 marks)**

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the general characters of Bryophytes and give an outline of the classification of Bryophytes.
33. Describe the life cycle of *Selaginella.* Why is it considered as forerunner of seed plants?
34. Discuss affinities of Gymnosperms to other groups of plants.
35. Discuss the objectives of Paleobotany and give an account of the techniques of fossil study.

(15 x 2 = 30 marks)

Fourth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree examination
Core Course

BB 1442- Cell Biology, Plant Breeding & Evolutionary Biology

Time : 3 Hours **Max. Marks : 80**

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What are histones?
2. What is meant by euploidy?
3. Why lysosomes are called suicidal bags?
4. What is kinetochore?
5. Mention the names of agencies involved in plant introduction in India.
6. What is meant by composite variety?
7. Define a pureline.
8. Any two examples for inter generic hybrids.
9. What is genetic drift?
10. Who proposed use and disuse theory?

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. Differentiate heterochromatin and euchromatin.
12. Briefly mention the events during interphase.
13. What is synaptonemal complex? Mention its significance.
14. Differentiate paracentric and pericentric inversion.
15. How autopolyploids differ from allopolyploids?
16. Why deletions are considered as more deleterious than duplications?
17. Discuss the type of mutagens used in plant improvement.
18. What are B chromosomes? How they behave during cell division?
19. Mention the chemical composition of cell membrane.
20. What are peroxisomes? Comment on their functions.
21. Differentiate parallel and convergent evolution.
22. What is meant by quarantine? Point out its significance.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Write an account on different phases of cell cycle.

24. How clonal selection differs from other selection methods?

25. Give an account on micro and macro evolution.

26. Explain the types of anueploids and point out their cytological features.

27. With the help of relevant sketches, outline the events during Prophase I.

28. Explain the types of isolation mechanisms and point out their evolutionary significance.

29. Discuss the steps and principles of resistance breeding.

30. Describe the structure of Lamp brush chromosome. How it differs from a normal chromosome?

31. Explain Neo-Darwinism.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. With the help of diagrams, explain the types of structural aberrations in chromosomes. Point out the evolutionary significance of each.

33. Explain the various forces operating in evolutionary process. Illustrate with examples and evolutionary principles.

34. Explain heterosis and mention how is it exploited by plant breeders?

35. Give an account on ultra structure and functions of cell components and organelles.

(15 x 2 = 30 marks)

Fifth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Core Course

BB 1541 Plant Physiology

Time : 3 Hours **Max. Marks : 80**

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What is Kranz anatomy?
2. Define chemosynthesis.
3. Why cytochrome a_3 is called terminal oxidase?
4. Represent the overall equation of photosynthesis.
5. Cite two examples for C4 plants.
6. What is meant by thigmotropic movement?
7. What is tonicity?
8. Why the rate of photosynthesis decreases beyond 690 nm?
9. What is incipient plasmolysis?
10. How the stomata of CAM plants differ from that of C3 plants?

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. Give an account on raw materials of photosynthesis.
12. Briefly describe the physiological role of Abscisic acid in plants.
13. Differentiate apoplast and symplast.
14. How root pressure influences water movement in plants?
15. Define red drop. How it can be compensated?
16. Explain the physiology of senescence.
17. Discuss the concept of florigen.
18. Briefly describe the relation between OP, TP and WP in plants.
19. Comment on hydroponics.
20. Differentiate absorption spectrum and action spectrum.

21. Why fluorescent radiation has higher wavelength than phosphorescent radiation?

22. Point out the differences between photosynthesis in bacteria and higher plants.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Describe the vital and physical theories explaining ascent of sap.

24. How the principle of Limiting factors apply in photosynthesis?

25. Give an account on coenzymes and cofactors.

26. Explain how the relative day length influences flowering in plants?

27. Discuss the physiological consequences of water stress in plants.

28. Explain the mechanisms of mineral absorption in plants.

29. How anaerobic respiration differs from aerobic in terms of ATP yield?

30. Discuss the mechanism of photorespiration. Enumerate its advantages and disadvantages

31. Explain biological nitrogen fixation.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Discuss the various types of stomata and the mechanisms in stomatal movement.

33. Explain dark reaction and compare the photosynthetic mechanisms in C3 and CAM plants.

34. Discuss various types of movements exhibited by plants.

35. Give an account on structure, classification and nomenclature of enzymes.

(15 x 2 = 30 marks)

Fifth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Core Course

BB 1542 Angiosperm Morphology and Systematic Botany

Time: 3 Hours **Max. Marks: 80**

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. Name the family having lateral style.
2. What are the symbols used in a floral formula?
3. Point out any two contributions of Carolus Linnaeus.
4. What is a labellum?
5. Mention the binomial of any two pulses.
6. Name a family having petaloid staminodia.
7. What is OTU?
8. Differentiate simple raceme and spike.
9. What is resupination?
10. Name the order to which Apocynaceae belongs.

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

9. Differentiate hypogyny and epigyny.
10. Describe in brief the type of corolla in Papilionoideae.
11. Mention the types of roots in Orchidaceae.
12. Compare the gynoecium of Solanaceae and Acanthaceae.
13. Why Annonaceae is placed under Ranales?
14. Point out the economic importance of Rutaceae.
15. Discuss the floral characters of Euphorbiaceae.
16. Briefly mention adnation in solanaceae.
17. Comment on APG system of classification.
18. What difference do you notice in the corona of Asclepiadaceae and Apocynaceae?

19. What is a syconus?

20. What is meant by translator mechanism? Point out its significance.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

21. Describe the morphology of tendril in Cucurbitaceae.

22. Discuss the features of special types of inflorescence.

23. Evaluate the basic principles of cytotaxonomy.

24. Explain the type of inflorescence and floral characters of Poaceae.

25. Compare and differentiate the subfamilies of Leguminosae.

26. Discuss the basic rules of ICBN.

27. Discuss the types of placentation in angiosperms.

28. Outline the basics of molecular taxonomy.

29. Why Poaceae is regarded as an advanced family?

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

30. Explain the principles and steps in preparation of herbarium. Point out the significance of herbaria.

31. Discuss the various systems of classification. Compare and differentiate natural and phylogenetic systems.

32. Give an outline of the vegetative and floral characters of Lamiaceae. Discuss its advanced features.

33. Write an essay on various types fruits you have studied.

(15 x 2 = 30 marks)

Sixth Semester Career Related CBCSS Degree Programme in B.Sc. Botany and Biotechnology Degree Examination

Core Course

BB1641- GENETICS

Time : 3 Hours **Max. Marks : 80**

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What is meant by test cross?
2. Define a pureline.
3. What are allelomorphs?
4. What is meant by split genes?
5. Give an example for sex linked inheritance.
6. What are plasmagenes?
7. Define genotype.
8. Give the genotypic and phenotypic ratios in monohybrid incomplete dominance.
9. Who coined the term 'Genetics'?
10. Mention the first law of Mendel.

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph

11. Comment on non-epiststic interaction.
12. Briefly describe the principle of recessive epistasis.
13. What are the possible blood groups among offsprings of a marriage between O group man and AB group woman.
14. Mention any four characters studied by Mendel in Pisum sativum.
15. Differentiate multiple alleles and multiple genes.
16. What are holandric genes? Cite an example.
17. What are Complementary genes? Mention how it differs from Mendelian dihybrid ratio.
18. Give two examples for sex chromosomal abnormalities in Man.
19. Discuss the XX-XO mechanism of sex determination.

20. Point out the types of chemical bonds in a DNA molecule.

21. Mention the role of sigma factor.

22. Write a brief account on duplicate genes.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Differentiate complementary gene action from supplementary gene action.

24. Explain the Genic balance theory.

25. Discuss the mechanism of inheritance of skin color in man.

26. Mention the structure of t- RNA. Point out its function.

27. What is meant by linkage? How it influences independent assortment?

28. Give an account of the mechanism of transcription.

29. Differentiate quantitative and qualitative characters on basis their pattern of inheritace.

30. Discuss the properties of genetic code.

31. Explain Central dogma and critically evaluate it on basis of Teminism.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the types of inter allelic genetic interaction.

33. Describe the salient features of jumping genes and point out the mechanism of transposition.

34. Discuss the mechanisms involved in DNA repair.

35. Citing a relevant example explain sex linked inheritance. How it differs from autosomal inheritance?

(15 x 2 = 30 marks)

Sixth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Core Course

BB 1642-Economic Botany, Ethnobotany and Medicinal Botany

Time : 3 Hours **Max. Marks : 80**

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. Mention the binomial of cotton.
2. What are gourd vegetables?
3. Point out the binomial of any two plants used by tribes for shelter.
4. What is a totem plant?
5. Mention the binomial of Tapioca.
6. Who coined the term ethnobotany?
7. Why neem is used as insecticide?
8. Give the binomial of Sarpagandha
9. What is NMPB?
10. Name ae plant that yield crude drug from flowers.

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph

11. Briefly mention the scope of pharmacognosy.
12. Describe in brief the principle of Acupunture.
13. Mention the types of extraction methods in separation of herbal drugs.
14. What are folk medicines?
15. Comment on the medicinal value of Asoka
16. Point out the crude drugs obtained from corms.
17. Define ethnobotany.
18. Briefly mention types of drugs obtained from Adhatoda vasica.
19. Mention the ethnobotanical significance of Aegle.
20. Give the binomial of any two dye yielding plants.
21. What is shifting cultivation?
22. Give the names of any two tribes in Kerala.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Comment on ethnobotanical significance of *Ficus religiosa*.

24. Why ethnobotany is regarded as interdisciplinary? Illustrate with reasons.

25. Mention the binomial, family and morphology of pepper and cardamom.

26. Differentiate certeals and millets . Give binomials for each.

27. Discuss the significance of sacred groves.

28. What Is meant by drug adulteration? Comment on adulterants.

29. Discuss the agencies and their role in cultivation of medicinal plants

30. Explain the basics of Sidha and unani.

31. Give an account on crude drugs obtained from rhizomes.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the methods of cultivation of Paddy.

33. Discuss the various methods of collection of ethnobotanical data. Add a note on significance of ethnobotanical studies.

34. Give an account on the plants used by tribes. Mention the strategies for preservation and management of plant resources by tribes.

35. Describe in detail the common fruits and vegetables of Kerala. Mention their binomial and uses.

(15 x 2 = 30 marks)

Core course: Botany
Model Practical Question Paper

UNIVERSITY OF KERALA

Botany & Biotechnology (2a), Core practical Examination,
BB 1242 -PRACTICAL BOTANY – I
(**2019 admission onwards**)
(Angiosperm Anatomy, Reproductive botany, Palynology, Environmental studies and Phytogeography)

Time: 3 hours **Maximum Marks: 80**

1. Make a suitable micropreparation of **A** and **B**. Draw a labelled cellular diagram of each. Identify giving reasons. Leave the preparation for valuation.
(Preparation-3; Identification-1; Reasons-4; Labelled diagram-4) **12x2=24 Marks**

2. Make a suitable micropreparation of **C**. Draw a labelled cellular diagram. Identify the ecological group giving anatomical adaptations. Leave the preparation for valuation.
(Preparation-3; Ecological group-1; Anatomical adaptations-4; Labelled diagram-4) **12 Marks**

3. Identify the type of stomata in specimen **D.**
(Identification- 1, Diagram – 2, Reason - 2) **5 Marks**

4. Identify the ecological group and bring out the morphological adaptations of specimen **E**.
(Ecological group- 1 marks; Adaptations- 3 marks) **4 Marks**

5. Locate two phytogeographical regions **– F and G** of India in the map provided. **2 Marks**

6. Identify and describe the type of cellular inclusion in specimen **H**
(Identification- 1, Description-2, Diagram - 2) **5 Marks**

7. Identify **I** and draw a neat labelled diagram
(Identification- 1, Diagram – 2, Description - 2) **5 Marks**

8. Comment on **J**
(Major group – 1, Notes – 2) **3 Marks**

RECORD = 20 Marks (Content – 15 Marks; Neatness – 5 Marks)

GRAND TOTAL: 80 Marks

UNIVERSITY OF KERALA

Botany & Biotechnology (2a), core practical Examination,
BB 1242 -PRACTICAL BOTANY – I
(**2019 admission onwards**)
(Angiosperm Anatomy, Reproductive botany, Palynology, Environmental studies and Phytogeography)

KEY FOR MATERIALS

I. **A**- Primary structure of
Monocot stem (Grass, *Asparagus* or any normal type)
Monocot root (*Colocasia* or any normal type)
Dicot Stem – *Hydrocotyle, Eupatorium* or any normal type
Bicollateral (*Cephalandra*)
Normal Secondary structure of
Dicot Stem **–** *Vernonia* or any normal type
Dicot Root – *Carica papaya. Tinospora* or any normal type

B. Anomalous secondary thickening – *Bignonia, Boerhaavia, Dracaena*

2. C. Hydrophyte (*Hydrilla* stem, *Nymphaea* petiole) /Xerophyte (*Nerium* leaves, *Casuarina* stem, *Muehlenbeckia* phylloclade) /Epiphyte (Velamen root).

3. D - Any type of stomata mentioned below
(Anamocytic, Anisocytic, Paracytic, Diacytic).

4. **E -** Ecology - Fresh or preserved specimen or slide (from the centre) –Xerophytes (*Opuntia, Asparagus, Muehlenbeckia, Casuarina. Acacia, Euphorbia tirucalli*), Hydrophytes (Submerged-*Hydrilla*; Floating-*Eichhornia*, *Salvinia, Pistia*; Floating and rooted-*Nymphaea*; Amphibious- *Marselia*), Epiphytes (*Vanda, Drymoglossum, Drynaria*) and Parasites (*Loranthus, Cuscuta*).

5. **F and G-** Phytogeography – Any two phytogeographical regions of India as suggested by the examiner. (Map depicting phytogeographical zones of India should be provided by the centre).

6. H. Starch grain/Raphide/Cystolith/Aleurone grain etc. mentioned in the syllabus. Permanent slides can be used. Diagrams should be avoided.

7. I. Anther T.S./Dicot embryo L.S./Monocot embryo L.S.
Permanent slides can be used. Diagrams should be avoided.

8. **J.** Any one of the below. Fixative (FAA and Carnoy's Fluid), Stain (Acetocarmine, Saffranin, Haematoxylin), Mounting medium (Canada balsam, DPX).

Valuation of Records

Students should submit a Practical record duly certified by the Teacher in charge and Head of the Department. **(Content – 15 Marks; Neatness – 5 Marks)**

Record - 20 marks

UNIVERSITY OF KERALA

Career- Related First Degree Programme – CBCS System

Group (2a) **– B.Sc. BOTANY & BIOTECHNOLOGY**

Semester III & IV: Core Course **–** Botany Practical Examination**,**

BB1443 PRACTICAL BOTANY II

(2019 Admission Onwards)

Time: 3 hours Maximum Marks: 80

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1. Make an acetocarmine squash preparation of material **A**. Identify metaphase or anaphase with diagram and reasons.
   Preparation 3, Identification 1, Labelled sketch 2, Reasons 2 **8 Marks**

2. Prepare T.S. of materials **B, C and D.** Identify giving reasons. Draw a labelled diagram and leave the preparation for valuation.
   Preparation 2, Identification 1, Labelled sketch 3, Reasons 2 **8x3=24 Marks**

3. Demonstrate T-budding/Air layering/Grafting/Emasculation using material **E**. Submit for Valuation.
   Demonstration 3, Protocol 1 **4 Marks**

4. Identify and write notes on **F & G**
   Identification 1, Notes 3 **4x2=8 Marks**

5. Identify the disease in plant specimen **H** and give the name of the causative pathogen along with the important symptoms associated with it.
   (Disease - 1, Pathogen - 1, Symptoms - 2) **4 Marks**

6. Spot at sight **I, J, K** and **L**
   (Genus name- 1, Part of the plant - 1, Major Group- 1) **4 x 3 = 12 Marks**

TOTAL FOR PRACTICAL EXAM =60 Marks

RECORD =20 Marks (Contents 15; Neatness 5)

GRAND TOTAL 60+20=80 Marks

Group (2a) – B.Sc. BOTANY & BIOTECHNOLOGY
Semester III & IV: Core Course- Botany
BB 1443 **PRACTICAL BOTANY II**
(Practical OF BB1341, BB1342, BB1441 and BB 1442)

KEYS TO THE MATERIALS

1. **A** – Onion root tips to be provided by the centre.

2. **B** - Algae/Fungi (*Sargasum* Stipe, *Xylaria*, *Peziza*, *Puccinia* telial stage, *Agaricus* gill, *Cercospora*).

   C- Pteridophytes (*Psilotum* stem, *Selaginella* - Rhizophore and stem, *Equisetum* Stem, *Pteris* - petiole and sporophyll, *Marselia* - Rhizome and Petiole)

   D- Bryophytes/Gymnosperms (*Riccia* Thallus, *Marchantia* thallus, *Cycas* - leaflet, Coralloid root and Rachis, *Pinus*- Needle and Old stem).

3. **E**- T- budding/ Air layering/grafting/Emasculation – Required materials to be provided by the centre.

4. **F**- Horticulture- (Material/ Photograph/ Garden tools)

   G- Mushroom – (Fresh specimens / Photograph)

5. **H.** Plant pathology

6. **I** -Algae mentioned in the syllabus (Macro or Micro)
   J- Fungi/Lichen (Macro or Micro)
   K- Bryophyte/Paleobotany
   L- Pteridophyte/Gymnosperm

Valuation of Records

Students should submit a practical record duly certified by the Teacher in charge and Head of the Department

UNIVERSITY OF KERALA

Career Related First Degree Programme under CBCSS (Group 2a)

B.Sc. BOTANY AND BIOTECHNOLOGY PRACTICAL EXAMINATION

Semester VI

BB 1643: Practical Botany III

Time: 3 hours **Max.: 80 marks**

1. With a labelled diagram, explain the working of experiment **A**.
   (Aim-1; Working -2; Labelled diagram-2) **[5** marks]

2. Describe the specimen **B** in technical terms. Draw labelled diagram of the L.S. of flower. Construct a floral diagram and write the floral formula.
   (Description-2; Labelled diagram-2; Floral diagram-2; Floral formula-1) [**7** marks]

3. Refer the specimens **C** and **D** to their respective families, pointing out the class, subclass and series with reasons.
   (Reasons up to series-3; Family characters-2; Identification-1) [6x2=**12** marks]

4. Work out the problems **E** (3 marks) and **F**.(5 marks) [3+5=**8** marks]

5. Write the binomial and family of the given specimens **G** and **H**.
   (Binomial-1; Family- 0.5) [1.5 x 2 = **3** marks]

6. Identify the specimen **I** and write notes with labelled diagram.
   (Identification-1; Notes: 1; Labelled diagram-1) [**3** marks]

7. Write the binomial, family, morphology of the useful part and uses of the specimens **J** and **K**.
   (Binomial-1; Family - 0.5; Morphology of the useful part- 0.5; Uses-1) [3 x 2 = **6** marks]

8. Spot at sight **L, M, N** & **O**.
   (Binomial-1; Family-0.5) [1. 5x 4 = **6** marks]

9. Herbarium [**7** marks]

10. Field book and Tour report [**2+1=3** marks]

11. Record (Content-15; Neatness-5) [**20** marks]

UNIVERSITY OF KERALA

Career Related First Degree Programme under CBCSS (Group 2a)

B.Sc. BOTANY AND BIOTECHNOLOGY PRACTICAL EXAMINATION,

Semester VI

BB 1643: Practical Botany III

KEY TO THE MATERIALS

A	:	Plant physiology experiments mentioned in the syllabus
B	:	Flowers and buds from Polypetalae/Gamopetalae
C	:	Gamopetalae
D	:	Polypetalae/Monochlamydeae
E	:	Genetics problem- Monohybrid / Incomplete dominance
F	:	Genetics problem- Dihybrid / Gene interactions
G & H	:	Herbarium sheets
I	:	Morphology (Inflorescence or fruits mentioned in the syllabus)
J & K	:	Economic botany
L & M	:	Ethnobotany
N & O	:	Pharmacognosy (Medicinal plants)

Model Questions
Vocational Core: Biotechnology

First Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

Foundation Course I BB1121- METHODOLOGY AND PERSPECTIVES OF BIOTECHNOLOGY

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences.

1. What is Type 1 Error?
2. Mention the applications of MOOCS.
3. Name two nitrogen fixing microbes.
4. Name the first GM food.
5. Define patent.
6. What is plagiarism?
7. Define p value.
8. Define scientific experiment.
9. What is meant by secondary data?
10. What is Confident interval?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. What is GLP? List out two GLPs.
12. What is compulsory Licence?
13. Give an account on copyrights.
14. Define Scilab.
15. Write a short note on transgenesis in Bt Cotton.
16. What is a hypothesis? Explain with an example.
17. Explain the steps in experimental planning.
18. List out and describe any two experimental designs.
19. What is Green revolution?
20. What is effluent? Name two methods in effluent treatment.
21. Define Biopharming. What is the importance of this technique?
22. What are monoclonal antibodies? How are they produced?

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks.

23. Write a note on Cybercrime.
24. Explain the methods in collection of data.
25. Give a detailed account on probability.
26. How will you generate a herbicide resistant plant through genetic engineering?
27. Explain the parts and functions of fermenter.
28. List out the uses of internet.
29. Give any four applications of agricultural biotechnology.
30. Describe the features of IPR.
31. Give an account of Gene therapy.

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. Write in detail about Hybridoma technology with the help of illustrative figures.
33. What are the important applications of Medical/ Clinical Biotechnology in the modern world?
34. Explain in detail about experimental planning and designs.
35. Explain the applications of IT in various sectors.

(2 x 15 = 30 Marks)

First Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

Core Course II BB1171- MICROBIOLOGY

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. What is Cold Sterilization?
2. Define symbiosis.
3. Name two anaerobic culture methods.
4. Name the scientist who first discovered penicillin.
5. Define DPT.
6. What is a vaccine?
7. Name the causative organism of Typhoid.
8. What is an autoclave?
9. What is meant by transduction?
10. What is an alkalophile?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. What are extremophiles? Give 2 examples
12. What is the use of an inspissator?
13. Give an account on N2 Fixing bacteria.
14. Explain stages of Bacterial Growth curve.
15. Write a short note on bacteriophage.
16. What is a CFU?
17. Define Sexduction.
18. List out and describe any two physical sterilization methods.
19. What is McIntosh Filde Jar used for?
20. What are auxotrophs?
21. Define Downstream Processing. What is the importance of this technique?
22. Give the nutritional classification of bacteria.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Differentiate Gram positive and Gram negative Cell wall.
24. Summarize the steps involved in glycolysis.
25. Give a detailed account on Inclusion bodies found in bacterial cell.
26. Explain the Lysogenic life cycle of virus.
27. Define fermentation. Explain the process of acetic acid fermentation.
28. Explain types of bacterial mutations.
29. Explain the two mechanisms of transduction in bacteria.
30. Describe the features of extremophiles with examples.
31. Compare and contrast on sterilization and disinfection.

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. Describe the structural components of a bacterial cell.
33. Explain bacterial growth curve. What are the factors affecting growth of bacteria?
34. Explain in detail about anaerobic culture methods.
35. Elaborate on the methods involved in strain improvement in Industrial Microbiology.

(2 x 15 = 30 Marks)

Second Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

Foundation Course II BB1221- BIOPHYSICS AND INSTRUMENTATION

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark

1. Define Beer Lambert's Law
2. What is flourimetry?
3. Name two stains used in microscopy.
4. Define the first law of conservation of energy.
5. Define entropy.
6. What is autoradiography?
7. What is TEM?
8. Define absorption spectrum.
9. What is meant by electrochemical gradient?
10. What are hearing aids?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. Explain electron microscopy.
12. Give a note on correction of vision faults.
13. Explain chemi osmotic hypothesis.
14. Give an account of NMR.
15. Write a short note on X-ray crystallography.
16. What are the types of molecular interactions? Explain with an example.
17. Explain tracer techniques.
18. Write about heat conservation.
19. What is Gibb's Free Energy?
20. Write about generation and reception of sonic vibration.
21. Give an account of exothermic reactions in biological systems.
22. Differentiate entropy and enthalpy.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Write a note on ATP synthesis.
24. Explain Law of Conservation of energy.
25. Give a detailed account on principle and types of Centrifugation.
26. Write about light reception in microbes.
27. Explain the principle and functioning of pH meter.
28. List out the uses of radioisotopes in biological research.
29. Briefly explain phase contrast microscopy.
30. Describe the functioning and uses of spectrophotometer.
31. Give an account of mechanism of muscular movements.

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. Write in detail about the types and uses of Electron microscopy.
33. Give an account of mechanism of vision and hearing.
34. Explain in detail about mechanism of photosynthesis and light harvesting pigments.
35. Describe electrophoresis. Give a note on types of electrophoresis.

(2 x 15 = 30 Marks)

Second Semester Career Related CBCSS Degree Programme in B.Sc. Botany and Biotechnology Degree Examination

Vocational Course

Core Course BB1271- MICROBIAL METABOLISM, GENETICS AND DISEASES

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. What are chromatophores?
2. Which bacteria contain chlorophyll
3. What are phycobiliproteins?
4. Name a disease that affects lungs.
5. How is yellow fever transmitted?
6. What are auxotrophs?
7. What are resistance plasmids?
8. What are oxygenic phototropic bacteria?
9. Name a causative organism of tuberculosis.
10. What is col factor?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. What is botulism? How is the disease spread?
12. What body parts do the viscerotropic viral diseases affect? How they are transmitted?
13. What are leg haemoglobins?
14. Comment on Ames test.
15. What are fertility factors?
16. Differentiate between stringent and relaxed plasmids.
17. Give the nutritional classification of bacteria.
18. How solute uptake happening in bacteria?
19. How mutations can be induced?
20. Comment on Nipah outbreak in Kerala
21. What is transduction?
22. Comment on chicken pox.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Write a brief account on DNA repair mechanism in Bacteria.
24. Describe the structure of bacterial chromosomes.
25. Comment on the anaerobic respiration in bacteria.
26. Describe the steps involved in Glycolysis.
27. Give brief note on any two soil borne bacterial diseases.
28. Describe the role of plasmids in drug resistance.
29. Describe the photosynthetic pigments in bacteria.
30. Comment on Griffith's effect.
31. How bacteria can be isolated from spoiled food materials?

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. Write an essay on the viral diseases of Humans.
33. Describe the bacterial recombination methods in detail.
34. Describe the electron transport and oxidative phosphorylation in bacteria.
35. Write an essay on airborne bacterial diseases of Humans.

(2 x 15 = 30 Marks)

Third Semester Career Related CBCSS Degree Programme in B.Sc. Botany and Biotechnology Degree Examination
Vocational Course-III
BB 1371: PROTISTA AND ANIMAL DIVERSITY

Time: 3 hour Max Marks: 80

SECTION A

Very short answer type. Maximum two sentences. Answer all**.** **(10x1=10 marks)**

1. What are trichocysts?
2. Name an egg laying mammal.
3. Mention two flight adaptations of birds.
4. Define the term metamerism.
5. Define Gonochorism.
6. What is alternation of generation?
7. Secondary host of *Trypanosoma.*
8. What is Cnidoblasts?
9. Define Enterocoel.
10. What are contractile vacuoles?

SECTION B

Short answer questions. Not exceed in one paragraph. Answer any eight**.** **(8x2 = 16 marks)**

11. Write any two parasitic adaptations of *Fasciola.*
12. Salient features of phylum Porifera.
13. What is meant by pseudocoel?
14. Write any two desert adaptations of Ostrich.
15. Describe the special features of Molluscs.
16. Name two coral forming cnidarians.
17. Write the names of two arthropod pests.
18. What are the functions of statocyst?
19. Express mode of life in *Trychonympha*.
20. What are the parasitic adaptations of *Hirudinaria*?
21. Write a note on Axolotl larva.
22. Explain in brief the life cycle of *Entamoeba*

SECTION C

Short essay. Not to exceed 120 words. Answer any six. **(6x4=24 marks)**

23. Explain the adaptations of birds for its aerial mode of life.
24. Explain economic importance of Molluscans.
25. Elaborate the evolutionary significance of *Peripatus.*
26. Explain the digestive system in Cockroach.
27. Describe the functioning of vascular system of starfish.

28. Write notes on any two poisonous snakes.
29. Explain the different types of feathers in birds
30. Define metamorphosis with suitable examples.
31. Give a descriptive account of five kingdom classification.

SECTION D

Long essay. Answer any two questions. **(2x15=30 marks)**

32. Describe the adaptations of aquatic mammals.
33. Describe the Nervous system of Cockroach with suitable labelled diagram.
34. Write an essay on identification of poisonous and non-poisonous snakes.
35. Explain the life cycle of *Plasmodium vivax.*

Third Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course-IV

BB 1372: ANIMAL PHYSIOLOGY AND ANATOMY

Time: 3 hour Max Marks: 80

SECTION A

Very short answer type. Maximum two sentences. Answer all. (10x1=10 marks)

1. What are nephrons?
2. What is sanguivory?
3. Define tachycardia?
4. Expand ADH.
5. What is respiration?
6. Name the protein present in bones.
7. What are Schwann cells?
8. Name the hormone that promotes absorption of calcium from intestine.
9. What is corpus luteum?
10. What do you mean by open circulation?

SECTION B

Short answer questions. Not exceed in one paragraph. Answer any eight. (8x2 = 16 marks)

11. Write a note on formed elements of blood.
12. What is the role of liver in the metabolism of fats?
13. Explain ureotelism with one example.
14. Explain spermatogenesis.
15. Write a note on Blood Grouping.
16. Define pulmonary respiration.
17. Define amniocentesis.
18. What are neurotransmitters? Give example.
19. State All or None law.
20. What are lacteals? Mention its functions.
21. Explain the secretions of adrenal cortex.
22. Mention the functions of pineal gland.

SECTION C

Short essay. Not to exceed 120 words. Answer any six. (6x4=24 marks)

23. With the help of a labelled diagram describe the digestive system.
24. Explain the various mechanisms involved in the absorption of digested food.
25. Explain the structure and functions of skin.
26. Mention the hormones of the pituitary glands and their function.
27. Give an account of the excretory products of animals.

28. Write an essay on Spermatogenesis.
29. Explain the process of osmoregulation.
30. What is uterine cycle? Explain.
31. Explain cardiac cycle.

SECTION D

Long essay. Answer any two questions. (2x15=30 marks)

32. Write an essay on the mechanism of transmission of nerve impulses.
33. Give a detailed structure of human heart. Explain the functioning.
34. Explain the physiology of urine formation.
35. Write an essay on Gametogenesis.

Fourth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

Core Course BB1471- MOLECULAR BIOLOGY

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

What are transposons?

Define UTRs.

Name the different classes of RNA molecules.

Name the scientist who first discovered transposons.

Define point mutation.

Name the subunits of *E.coli* RNA Ploymerase holoenzyme.

Which are the three universal stop codons?

Who performed 'Blender Experiment'?

What is meant by an operon?

What is the function of reverse transcriptase enzyme?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

What is foot printing?

What are the physical forms of DNA?

Compare and contrast eukaryotic and prokaryotic ribosomes.

Explain the structure of prokaryotic mRNA.

Write a short note on 5'capping in eukaryotic mRNA.

What are enhancers and silencers?

What is meant by 'Shine Dalgarno' sequence.

List out any 4 post translational modifications.

How does the primer dependency of DNA Ploymerase is solved in bacteria?

What is replicon?

Define Promoter. What is the importance of promoters in gene expression?

Give the functional components of DNA Pol I.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

Describe the features of DNA structure proposed by Watson & Crick.

Summarize the steps involved in DNA replication in *E.coli.*

What are the basic steps in RNA synthesis?

Explain the need for discontinuous replication.

Define spliceosome. Narrate the process of RNA splicing.

Briefly explain regulation of eukaryotic gene expression.

Explain the stages of protein synthesis in bacteria.

Describe the features and types of transposons with examples.

Compare and contrast the structure of gene in prokaryotes and eukaryotes.

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

Describe the role of enzymes in DNA replication in prokaryotes and eukaryotes.

Narrate the molecular organisation of eukaryotic chromosomes.

Explain in detail about the Cytoplasmic genome.

Explain the mechanisms of gene regulation on bacteria with examples

(2 x 15 = 30 Marks)

Fourth Semester Career Related CBCSS Degree Programme in B.Sc. Botany and Biotechnology Degree Examination

Vocational Course

BB1472- IMMUNOLOGY

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. What are Chemokines?
2. Define self-MHC restriction.
3. What is an endogenous antigen?
4. Define paratope.
5. What is autoimmunity?
6. What are Haptens?
7. Define Vaccine.
8. Name the scientist who discovered Dendritic cells?
9. What are immunoglobulins?
10. What are Freund's incomplete adjuvents used for?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. What are monoclonal antibodies?
12. What is SCID?
13. Give an account on immune electrophoresis.
14. Explain the immune mechanism in Myasthenia gravis.
15. Write a short note on therapeutic antibodies.
16. What are the types of T cells in cell mediated immunity?
17. Define MHC.
18. Describe the mechanism of agglutination.
19. What is ELISA?
20. What are attenuated vaccines?
21. Explain the principle of RIA?
22. Give the significance of natural killer cells.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Give an account of types of immunity.
24. Explain the mechanism of antibody class switching.
25. Give a detailed account on autoimmune diseases with examples.
26. What are the primary lymphoid organs?
27. Give the structure of IgG.
28. Explain the term 'Immunological memory'.
29. What are DNA vaccines?
30. Describe the features of mononuclear phagocytes.
31. What is hypersensitivity? What are the types of Hypersensitivity?

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. Explain in detail on the production of MAb through Hybridonma technology.
33. What are the types of antibodies? Give a detailed account on antibody structure.
34. Explain in detail about the organs involved in the Immune system.
35. Explain the features and functions of cells of innate immunity.

(2 x 15 = 30 Marks)

Fifth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

BB 1571 Recombinant DNA Technology

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. What is Frame shift mutation?
2. Define Plasmid.
3. What is a ribozyme?
4. Define recombinant DNA.
5. How can the host cells be made competent?
6. What is transformation?
7. Name any two engineered plasmid vectors.
8. Name the scientist who demonstrated the chemical nature of nucleic acid?
9. What are restriction endonucleases?
10. What is Northern Blotting used for?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. What are microarrays?
12. What is the use of YAC?
13. Give an account on Gene therapy.
14. Explain the use of Southern Blotting.
15. Write a short note on M13 cloning vectors.
16. What is an expression vector?
17. Define Blue White screening.
18. Describe the importance of alkaline phosphatase in genetic engineering.
19. What is Genetic code?
20. Give examples of two TG plants?
21. Explain the principle of automated DNA sequencing?
22. Give the significance of shuttle vectors.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Give the structural features of pBR322. What are the useful properties of this vector?
24. Explain the mechanism of Sanger's Sequencing technique.
25. Give a detailed account on nucleic acid blotting.
26. Explain the significance of cosmids and phagmids in genetic engineering.
27. Give a note on bacteriophage cloning vectors.
28. Explain the method of construction of rDNA.
29. Give the outcome and significance of HGP.
30. Describe the features of plasmid vectors with examples.
31. What are the screening methods for recombinants in an rDNA experiment?

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. What are DNA Libraries? Describe the Types and construction of DNA Libraries.
33. Explain the technique of PCR. Give the application of PCR in various fields of biological research.
34. Explain in detail about mammalian vectors.
35. Explain the role of enzymes in rDNA Technology.

(2 x 15 = 30 Marks)

Fifth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

BB 1572 Plant Biotechnology

Time: 3 Hours **Max Marks: 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1.Define callus.

2.What are fusanogens?

3.Who is the father of Plant tissue culture?

4.Define somaclonal variation.

5.What are restriction enzymes?

6.What is transformation?

7.What is mean by differentiation?

8.What is Favr-Savr?

9.What are nopalines?

10.Define biopharming?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11.Write short note on somatic embryogenesis.

12.Describe the structure of Ti plasmid.

13.What are HEPA filters? Where it is used?

14.Differentiate between caulogenesis and rhizogenesis.

15.What are artificial seeds?

16.Mention the advantages of meristem culture.

17.How androgenic haploids can be produced?

18.Write short note on hairy root culture.

19.Describe the surface sterilization of explants.

20.Describe somatic hybridization.

21.Explain the basis of somaclonal variation.

22.Enumerate the disadvantages of in vitro methods of Secondary metabolite production.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23.Write notes on Golden Rice?

24.Enumerate the advantages of suspension culture over callus culture.

25.Discuss any two physical methods of gene transfer.

26.Give notes on Micropropagation.

27.Differentiate between hybrids and cybrids.

28.Explain the role of Plant growth regulators in tissue culture.

29.Describe the various methods of protoplast isolation.

30.What are transgenic plants? Provide examples of released varieties.

31.How Ti plasmid is customized for plant genetic transformation?

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32.Write an essay on the biological methods of gene transfer in plants.

33.Describe the composition and preparation of a plant tissue culture media. How media serialization is achieved?

34.Write an essay on the medical, industrial and agricultural applications of transgenic plants.

35.Write an essay on the basic techniques of plant tissue culture.

(2 x 15 = 30 Marks)

Fifth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

BB 1573 Animal Biotechnology

Time: 3 Hours **Max Marks: 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. What is mean by Secondary cell culture?
2. What is a cell strain?
3. Name two commonly used human cell lines?
4. Name the first drug produced through mammalian cell culture.
5. What is mean by transformed cell lines?
6. What is the boiling point of liquid nitrogen?
7. What is Factor VIII?
8. Name an animal commonly used in transgenic experiments.
9. Mention the role of glucose in culture media?
10. Name a cryo-protectant?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. Define embryonic stem cells.
12. What is an immortalized cell line?
13. What is gene therapy?
14. What are the procedures for reviving cryopreserved cells.
15. What are roller bottles?
16. Mention the role of fetal bovine serum in cell culture media.
17. Write note on cryopreservation of animal cultures?
18. Write short note on cell viability assay.
19. Enumerate the properties of stem cells.
20. Differentiate between autograft and allograft.
21. Describe the use of haemocytometer.
22. Write notes on the importance of trypsinization.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Write a note on instruments and equipment used in animal cell culture.
24. Describe the characterization of mammalian cell lines.
25. What are serum free media? Mention its advantages.
26. Give notes on interferons.
27. Describe the transport of animal cell cultures.
28. Write notes on transgenic animal technology.
29. What is the role of animal ethics committees in institutions performing animal research?
30. How animals are used as bioreactors?
31. Discuss the role of antibiotics in animal cell culture.

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. Write an essay on stem cell technology. Mention its applications in medicine.
33. Elaborate the various uses and products of animal cell culture.
34. Discuss in detail the composition of animal cell culture media. Add a note on the physical parameters to maintain cell culture.
35. Write an essay on the large scale cultivation of animal cells.

(2 x 15 = 30 Marks)

Fifth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Open Course

BB 1551.1- BIOINFORMATICS

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. What is an entry in a database?
2. Define BLASTp.
3. What was the contribution of Dayhoff to the field of Bioinformatics?
4. Define primary database.
5. What is Ecogene?
6. Name any two literature databases.
7. Which was the first published completed gene sequence?
8. What is metabolomics?
9. What are motifs? Name a motif identification bioinformatics tool.
10. What is tandem mass spectrometry used for?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. What is genomics?
12. What is the use of PHYLIP?
13. What is genetic fingerprinting?
14. Explain the structure of a genbank record.
15. What are split genes?
16. What is subtractive hybridisation?
17. Define PAM and BLOSUM.
18. Describe the importance of functional genomics over the traditional methods of gene cloning and analysis.
19. What is the role of bioinformatics in drug discovery?
20. What is a DNA microarray?
21. Explain the principle of molecular docking?

22. Give the difference between 'similarity' and 'homology' with respect to gene sequence analysis.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Explain the Needle man and Wunsch algorithm for global alignment.
24. Outline the structure and composition of prokaryotic and eukaryotic genome.
25. Describe the construction of phylogenetic tree using the UPGMA method.
26. Why is the proteome larger than the genome?
27. What is a motif? What is the use of aminoacid motifs?
28. Explain the basis of secondary structure prediction in proteins.
29. What are sequence elements? How are they used in Bioinformatics?
30. Describe the features of an annotated database.
31. What are the uses of NCBI- PUBMED?

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. What are the steps in protein prediction and modelling using bioinformatics?
33. What are protein microarrays? What are the different types of protein microarrays and what are they used for?
34. Explain in detail about multiple sequence alignment.
35. Briefly explain the tools of Bioinformatics for sequence alignment and homology search.

(2 x 15 = 30 Marks)

Sixth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

BB1671- Industrial Biotechnology

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark

1. Name the enzyme first immobilised for industrial use.
2. Give an example of a bio insecticide.
3. Name the method of sterilization of an antibiotic.
4. Name an antifoam agent
5. Define Bioleaching.
6. What is meant by moist heat sterilization?
7. Which are the methods of pasteurisation?
8. Which is the main organism used for industrial production of citric acid?
9. What is Yoghurt?
10. What is the fermented preparation of cabbage?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. What is probiotics?
12. What is the activated sludge process?
13. Compare and contrast respiration and fermentation.
14. Explain the qualities of a good industrial strain.
15. Write a short note on the structural components of a fermenter unit.
16. What is downstream processing?
17. What is meant by "solid substrate fermentation"?
18. What is Lagering?
19. What are the components of a good fermentation medium?
20. What are biofuels?
21. Define Bioremediation?
22. Give the utility of composting. **(2 x 8 = 16 Marks)**

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Elaborate on the various methods of food preservation.
24. Explain the steps involved in Cheese production.
25. What is SCP? Give the advantages of SCP.
26. Explain the production of silage.
27. Define Microbial spoilage. What are the factors affecting Microbial spoilage?
28. Briefly explain on the role of industrial Biotechnology in the production of healthcare products.
29. Explain the advantages of Bioinsecticides with examples.
30. Describe the features and types of trickling filters?
31. Narrate the usefulness of microbial enzymes in food industry.

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. Discuss on the methods of strain improvement in industrial microorganisms.
33. Narrate anaerobic waste water treatment.
34. Explain in detail about the different steps involved in wine production.
35. What are the types of Bioreactors used in Industrial Biotechnology? Explain the different parts of a fermenter with suitable diagram.

(2 x 15 = 30 Marks)

Sixth Semester Career Related CBCSS Degree Programme in BSc Botany and Biotechnology Degree Examination

Vocational Course

BB1672 Environmental Biotechnology

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. Name the microorganism that could be used for the bioaccumulation of silver.
2. Give an example of a bio insecticide.
3. Name any two popular chemical herbicides.
4. Give the utility of milbemycin.
5. Define Bioleaching.
6. What is the heavily polluted zone of a water reservoir called?
7. What are autotrophs?
8. Define BOD.
9. What is Bioremediation?
10. What is meant by biomass?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. State the general characteristics of Domestic waste.
12. What is the effect of high BOD on aquatic systems?
13. What does the term 'Biodiversity' means?
14. What is a herbicide? How can it be removed from the soil?
15. Write a short note on Biomineralisation.
16. What is Biodiesel?
17. What is meant by "artificial leaf"?
18. What are the uses of mycorrhiza?
19. What are the problems associated with using coal as a fuel?
20. How can sugarcane bargasse be used as a fuel?
21. Define Biosphere. What are the components of biosphere?
22. Give the utility of *B. thuringiensis* in environmental biotechnology.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Elaborate on the method of isolation of microbe from the environment.
24. Discuss the methods of controlling insect pests.
25. Comment on the effects of solid wastes in the environment.
26. Explain the method of isolation and culture of Nitrogen fixing bacteria.
27. Define Pollution. What are the methods of controlling pollution?
28. How can combustible fuels be obtained from lignocellulosic wastes?
29. Explain the advantages of Bioinsecticides with examples.
30. Describe the features and types of renewable energy sources.
31. Narrate the usefulness of energy crops.

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. What is Bioleaching? Describe how microbes can be employed in environment of ores.
33. What are the different types of ecosystems?
34. Explain in detail about Bioremediation. In what way is it good for environmental clean up?
35. What are Biofertilizers? In what way are they different from conventional fertilizers?

(2 x 15 = 30 Marks)

Sixth Semester Career Related CBCSS Degree Programme in B.Sc. Botany and Biotechnology Degree Examination

Elective Course

BB 1681.2- Genetic Engineering

Time : 3 Hours **Max Marks : 80**

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. What is RAPD?
2. Define Plasmid.
3. What is a ribozyme?
4. Define recombinant DNA.
5. How can the host cells be made competent?
6. What is transformation?
7. Name any two engineered plasmid vectors.
8. What is pBR322?
9. What are restriction endonucleases?
10. What is Northern Blotting used for?

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. What are DNA Libraries?
12. What is the use of YAC?
13. Give an account on bacteriophage vectors.
14. Explain the use of Southern Blotting.
15. Write a short note on M13 cloning vectors.
16. What is an expression vector?
17. Define Blue White screening.
18. Describe the importance of alkaline phosphatase in genetic engineering.
19. What is nucleic acid sequencing used for?
20. What is genetic code?
21. Explain the principle of automated DNA sequencing?
22. Give the significance of shuttle vectors.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Give the structural features of pBR322. What are the useful properties of this vector?
24. Explain the mechanism of Sanger's Sequencing technique.
25. Give a detailed account on nucleic acid blotting.
26. Explain the significance of cosmids and phagmids in genetic engineering.
27. Give a note on bacteriophage cloning vectors.
28. Explain the method of construction of rDNA.
29. Give the outcome and significance of HGP.
30. Describe the features of plasmid vectors with examples.
31. What are the screening methods for recombinants in an rDNA experiment?

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. What are DNA Libraries? Describe the Types and construction of DNA Libraries.
33. Explain the technique of PCR. Give the application of PCR in various fields of biological research.
34. Explain in detail about mammalian vectors.
35. Briefly explain the tools of rDNA Technology.

(2 x 15 = 30 Marks)

Model Practical Question paper

Vocational core: Biotechnology

UNIVERSITY OF KERALA
Career- Related First Degree Programme – CBCSS Examination
Group (**2a**) - **B.Sc. BOTANY & BIOTECHNOLOGY**
SEMESTER I & II: VOCATIONAL CORE COURSE -BIOTECHNOLOGY
BB 1272 : BIOTECHNIQUES- I
(**2019 admission onwards**)

Time: 3 hours **Maximum Mark: 80**

SECTION A- MAJOR EXPERIMENT

I. Using Gram staining technique identify the bacteria in the given sample **A**. Give the Principle and procedure of Gram staining. Leave the preparation for valuation.

Principle - 3 marks; Procedure – 6 marks; Demonstration– 8 marks; Result- 3 marks

(**20 Marks)**

SECTION B-MINOR EXPERIMENT

II. a) Demonstrate streak plate method for isolation and colony purification of sample **B.**
(T-streak/Quadrant streak /Zig Zag streak)

(Principle -3marks; Procedure – 6 marks; Demonstration- 4 marks; Aseptic Handling methods– 2 marks)

OR

II. b) Demonstrate the motility of bacteria in sample **B** by the Hanging drop method. Give the procedure

(Principle -3 marks; Procedure – 6 marks; Slide Preparation – 4 marks; Result- 2 marks)

OR

II. c) Determine the morphology of the bacterial sample **B** using methylene blue/ Crystal violet staining

(Principle -3 marks; Procedure – 6 marks; Slide Preparation – 4 marks; Result- 2 marks)

(**15 Marks)**

SECTION C

III. Identify**,** state the purpose and procedure of the given Experimental set up **'C'**

(Identification-1 marks; Purpose- 1 marks; Diagram-2; Working Procedure -6 marks)

(**10 Marks)**

SECTION D

IV. Write critical notes on D, E and F

(**3X5= 15 Marks)**

Total =60 Marks

RECORD = 20 Marks ***(Content- 15 marks; Neatness-5 marks)***

GRAND TOTAL = 80 Marks

UNIVERSITY OF KERALA
Career- Related First Degree Programme – CBCSS
Group (**2a**) - **B.Sc. BOTANY & BIOTECHNOLOGY**
SEMESTER I & II: VOCATIONAL COURSE -BIOTECHNOLOGY
BB 1245 BIOTECHNIQUES- I

Time: 3 hours Maximum Mark: 80

KEY FOR MATERIALS

SECTION A

I Sample **– A-** to be provided by centre (culture/ curd)

SECTION B

II (a/b/c). Choice of examiners. Centre should be ready for all.

SECTION C

III.

a) Serial dilution method
b) Spread plating method
c) Antibiotic disc diffusion method

SECTION D

IV. Critical notes **–** Choose any one from the following each three sections (photographs/glassware/slides/graphs/ materials can be given)

D - ***Tools and instruments:*** *Cavity slide, /: pH meter, Inoculation needle, Hot air oven, Microscope /parts of microscope, Incubator, Autoclave, LAF, Centrifuge, Shaker, Filtration unit.*

E - *Stains/Chemicals*- *Gram stain, Methylene blue, Nigrosin, Nutrient agar, EMB agar, MacConkey agar, Lactose broth etc*.

F – ***Cultures/plates:*** *Bacteriophage, Saccharomyces, Lactobacillus, Starch plate (for amylase), Growth curve graph, Agar slant/Stab/Plate etc*.

Valuation of Records

Students should submit a Practical Record duly certified by the **Teacher in charge and Head of Department.**

Record - 20 mark

UNIVERSITY OF KERALA

Career- Related First Degree Programme - CBCSS

Group (**2a**) - **B.Sc. BOTANY BIOTECHNOLOGY**

Semester III & IV: Vocational Course -Biotechnology Practical

BB 1473 BIOTECHNIQUES- II

(2019 Admission onwards)

Time: 3 hours Maximum Marks: 80

SECTION A

I. Demonstrate genomic DNA isolation from the given sample **A**. Write down the principle and protocol.

Principle-3; Protocol-6; Demonstration-8; Result- 3 **(Total Marks: 20)**

SECTION B

II. a) Dissect out, mount and label the mouth parts of Cockroach.

Dissection-5; Mounting-3; Identification-3; Labelled sketch-4

OR

II. b) Make a smear of the blood sample **B** using a suitable stain. Identify any two leucocytes giving labelled diagram. Submit the slide for valuation

Procedure-5; Slide preparation-5; Identification-2; Labelled sketch-3

OR

II. c) Enumerate the RBC of Human blood sample **B**. Give the procedure and calculation.

Procedure-5; Slide preparation -5; Calculation-3; Result -2

(Total Marks= 15)

SECTION C

III. Identify, give purpose and procedure of the given experimental set up **C**

Identification-1; Purpose-1; Diagram-1; Procedure-7 **(Total Marks= 10)**

SECTION D

IV. Write critical notes on **D, E, F**

D. Identification – 1 mark; Comments- 4marks

E & F. Taxonomic position -1 mark ; Comments- 4marks

(Total Marks= 3X5= 15)

Total =60 Marks

RECORD = 20 Marks ***(Content- 15 marks; Neatness-5 marks)***

GRAND TOTAL 60+20= 80 Marks

Group (**2a**) - **B.Sc. BOTANY BIOTECHNOLOGY**
Semester III & IV: Vocational course -Biotechnology Practical
BB 1473 BIOTECHNIQUES- II
(Practical of BB1371, BB1372, BB1471 and BB1472)

KEY FOR MATERIALS

I. Sample **A** to be provided by the centre.

II. Sample **B**

a. Cockroach to be provided by the centre.

b) Blood sample - to be given by the centre or managed by the students

c) Blood sample - to be given by the centre or managed by the students

III. Sample **C**

a) Blood grouping -Grouping kit/reagents & slides can be given.
b) WBC counting- WBC pipettes, counting chamber, diluting fluids *etc*. can be given
c) Agarose gel electrophoresis- Instrument or photograph

IV Critical notes **–** Choose any one from the following each three sections.
(photographs/slides/specimens/materials can be given)

D. Equipment / Chemicals

RBC/WBC Pipette, UV Transilluminator, Cooling centrifuge, PCR machine, ELISA Plate/ Reader **;** Acrylamide, TEMED, SDS, APS.

E - *Entamoeba, Paramecium, Obelia, Ascaris,* Earth worm, Pearl oyster, *Sycon, Scoliodon, Naja, Echidna.*

F- Parasitic adaptations **-** *Ascaris, Fasciola, Taenia solium,* Leech *(Hirudinaria), Leptocorisa, Sitophilus*

Valuation of Records

Students should submit a Practical record duly certified by the Teacher in charge and Head of the Department.

UNIVERSITY OF KERALA

Career Related First Degree Programme under CBCSS (Group 2a)

B.Sc. BOTANY AND BIOTECHNOLOGY PRACTICAL EXAMINATION

Semester VI

BB 1673: Biotechniques III

Time: 3 hours **Max.: 80 Marks**

SECTION A

[20 Marks]

I(a). Quantify the amount of DNA present in the given sample **A** by Diphenylamine method. Write the principle and procedure.

(Principle-4 marks; Procedure - 6 marks; Calculation/Graph-6 marks; Results- 4 marks)

OR

(b). Calculate the amount of dissolved oxygen in the given water sample **A**

(Principle - 4 marks; Procedure – 6 marks; Calculation- 6 marks; Results - 4 marks)

SECTION B

[15 Marks]

II (a). Quantify the amount of alcohol present in the given sample **B**. Write the principle and procedure.

(Principle - 3 marks; Procedure - 6 marks; Calculation/Graph - 4 marks; Results - 2 marks)

OR

(b). Demonstrate surface sterilization of the given plant material **B**, prepare explants and propagate on MS medium. Write down the principle and procedure.

(Principle - 3 marks; Procedure - 6 marks; Surface sterilization - 2 marks, explant preparation-2 marks, inoculation-2 marks)

SECTION C

[10 Marks]

III. Identify the given experimental set up **C.** Write the purpose and working procedure.

(Identification-1 mark, Purpose-1 mark, Diagram-1mark, Procedure-7 marks)

IV. Write critical notes on D, E and F. **[3x4=12 marks]**

Report on Industry, Institute visit **[3 Marks]**

RECORD: **20 marks** (Contents- 15; Neatness-5)

GRAND TOTAL: 60+20=80 marks

UNIVERSITY OF KERALA

Career Related First Degree Programme Under CBCSS (Group 2a)

B.Sc. BOTANY AND BIOTECHNOLOGY PRACTICAL EXAMINATION, JUNE 2018

Semester VI

BB 1673: Biotechniques III

INSTRUCTIONS TO THE EXAMINERS

I. Sample **A**:

a). DNA sample to be provided by the centre.

b). Water sample to be provided by the centre.

II. Sample **B**

a). Alcohol for quantification to be provided by the centre.

b). Plant materials for explant preparation to be given by the centre.

III. Sample **C**

a). Separation of ethanol by distillation- Distillation apparatus/Unit can be given

b). ELISA- ELISA plates/Photos/Diagram etc. can be given.

c). MPN technique **–** MPN tubes & Durham tubes/Photographs/Diagram can be given.

IV. Critical notes: Choose any ***one*** from the following sets.

D. UV Transilluminator, PCR machine (Equipment/Photograph), Sub marine electrophoresis apparatus, Agarose, Acrylamide, TEMED, SDS, APS. Diagrams of vectors like pBR 322 or pUC 18, Restriction enzymes- *Eco* R1/ *Bam* H1

E. Plant hormones; Sterilizing agents-Mercuric chloride, Sodium hypochlorite; Photographs or culture flask showing micropropagation, Laminar air flow, Filter sterilization unit/ membrane filter.

F. BOD incubator, Photograph of fermenter; Spoiled vegetable/ fruits/ bread *etc*.; Animal cell culture media such as RPMI, EMEM, DMEM etc., Root nodules.

Tour report: Detailed report on Industry/Institute visit undertaken during the courses.

Valuation of records

Students should submit a practical record duly certified by the Faculty in charge and Head of the Department.