



University of Kerala

Career-related First Degree program

Under CBCS System

Group 2 (a)

BOTANY & BIOTECHNOLOGY

Course Structure & Syllabus

(For those who joined the course from the academic year 2015 onwards)

**Foundation Courses, Core Courses Complementary Courses
and Open /Elective Courses**

2015

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 with out 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

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	Phycology, Mycology, Lichenology & Plant Pathology		2		
2	Bryology, Pteridology, Gymnosperms & Paleobotany		3		
3	Practical Botany I (Practical of 1 & 5)			2	
4	Angiosperm Anatomy and Reproductive Botany		3		
5	Environmental Studies		4		
6	Horticulture, Mushroom Cultivation & Marketing		2		
7	Cell biology, Plant breeding and evolutionary biology		2		
8	Practical Botany II (Practical of 2, 4, 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)	14			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	2		
11	Animal Biotechnology	1	3		
12	Food and Industrial Biotechnology	1	3		
13	Environmental Biotechnology	1	2		
14	Biotechniques III (Practical of 9,10,11,12 & 13)			2	
8	Open Courses of Vocational Subject	3		2	2
1	Bioinformatics	3	-		
2	Food and dairy Biotechnology	3			
3	Basics of Environmental Biotechnology	3			
5	Elective Courses of Vocational Subject	2			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 total of 42 courses including the language courses distributed in eight categories. They are language courses, foundation courses, Complementary courses, Core courses, Core course of Vocational subject, Open course of core subjects and vocational core subject and a project. The project is compulsory and the students may be assigned a topic for the project in the 5th 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
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	Phycology, Mycology, Lichenology & Plant Pathology	2	2	72	2	3Hrs.	20	80
BB 1171	Microbiology	2	1	54	4	3Hrs.	20	80
	Total		25	450	18			
SEMESTER II	Hour distribution: BT-3+3, BO-4, CC- 5, LC-5+5 =					25		
Course code	Course Title	Teaching hrs./week		Total Hrs	Total Credits	Duration of University	Marks for Evaluation	
		T	P				Exam	CE
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			
SEMESTER III	Hour distribution: BT-3+2, BO- 5, CC-5, LC-5+5 =					25		
Course code	Course Title	Teaching hrs./week		Total Hrs	Total Credits	Duration of University	Marks for Evaluation	
		T	P				Exam	CE
EN1311	English	5		90	3	3 Hrs	20	80
BB1331	Physiological aspects of Biochemistry	3	2	90	4	3 Hrs.	20	80
BB1341	Angiosperm Anatomy and Reproductive Botany	3	1	72	3	3 Hrs	20	80
BB1342	Bryology, Pteridology, Gymnosperms & Paleobotany	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			
SEMESTER IV	Hour distribution: BT-7, BO-8, CC-5, EN-5 = 25							
<i>Course code</i>	<i>Course Title</i>	<i>Teaching hrs./week</i>		<i>Total Hrs</i>	<i>Total Credits</i>	<i>Duration of University</i>	<i>Marks for Evaluation</i>	
		<i>T</i>	<i>P</i>				<i>Exam</i>	<i>CE</i>
EN1411	English	5		90	3	3 Hrs.	20	80
BB1431	Metabolism	3	2	90	2	3 Hrs.	20	80
BB1432	Practical Biochem IV (Practicals of BB1131, BB1231, BB1331, & BB1431)				2	3 Hrs.	20	80
BB1441	Horticulture, Mushroom Cultivation & Marketing	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			
SEMESTER V	Hour distribution: BT-7, BO-8, CC-5, EN-5 = 25							
<i>Course code</i>	<i>Course Title</i>	<i>Teaching hrs./week</i>		<i>Total Hrs</i>	<i>Total Credits</i>	<i>Duration of University</i>	<i>Marks for Evaluation</i>	
		<i>T</i>	<i>P</i>				<i>Exam</i>	<i>CE</i>
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
BB1581	Open course Bioinformatics	3		54	2	3 Hrs	20	80
BB1582	Food and Dairy Biotechnology	3		54	2	3 Hrs	20	80
BB1583	Basics of Environmental Biotechnology	3		54	2	3 Hrs	20	80

Total 19 6 450 20

SEMESTER	VI	Hour distribution: BT-11+EC2, BO-12 = 25								
		Course code	Course Title	Teaching hrs./week		Total Hrs	Total Credits	Duration of University	Marks for Evaluation	
				T	P				Exam	CE
BB1641	Genetics	4	3	126	3	3 Hrs.	20	80		
BB1642	Economic Botany, Ethanobotany & 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	Food and Industrial Biotechnology	3	2	90	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	Elective Course Bioinformatics and Nanobiotechnology	2		36	2	3 Hrs.	20	80		
BB 1682	Genetic Engineering	2		36	2	3 Hrs.	20	80		
BB 1683	Food & Dairy Biotechnology	2		36	2	3 Hrs.	20	80		
BB1661	Project on Biotechnology Tutorial 1			18	4	3 Hrs.	20	80		
		25		450	20					
		Hour distribution: BT-10+EC2, BO-7+6 =25								
		Total work Load in Hours								
	<i>Subjects</i>					<i>Work Load in Hours</i>				
	Main Core-Botany					900				
	Vocational core –Biotechnology					900				
	Complementary –Biochemistry					360				
	English					360				
	Second Language					180				
	Total					2700				

Semester I
Foundation Course
BB 1121 Methodology and Perspective of Biotechnology

Credits 3

Contact hours- 54

Aim and Objective of the course

- 7 -

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, research problem, Importance of reviewing the literature, Hypothesis formulation (Null and alternate hypothesis), 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, Basics of Hypothesis testing (excluding problems)

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, internet as a knowledge repository- google scholar, science direct. Application of IT in medicine, healthcare Business, Commerce, Industry, Defence, Law, crime detection, publishing, communication, resource management, weather forecasting, education, film and media. 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).

Industrial Biotechnology, Environmental Biotechnology, Genetic engineering -gene cloning; applications in forensic science. Medical Biotechnology- Safer and cheaper medicines by biotechnology; Agriculture Biotechnology; Genetically Modified crops; Genetically modified Livestock and poultry; 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 &ennifer 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 & biotechn9ology, Nair, A.J., Infinity Science Press, USA.
10. Introduction to Information Technology, V.Rajaraman., Prentice Hill.
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 every one should know about science, Collins H. and T. Pinch, Cambridge University Press, 1993.

Semester 1

Core Course

BB1141 Phycology, Mycology, Lichenology & Plant pathology

Credit 2

Contact hours 72 (Theory 36 + Practical 36)

Aim and Objective: 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.

- 9 -

Module-I 14 hrs Phycology

1. Introduction – Range of thallus structure – Phylogenetic 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*
 - b. Chlorophyceae - *Chlorella, Volvox, Oedogonium, Cladophora, and Chara*
 - c. Xanthophyceae – *Vaucheria*
 - d. Bacillariophyceae – *Pinnularia*
 - e. Phaeophyceae – *Sargassum*
 - f. Rhodophyceae - *Polysiphonia*

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

12 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

6 hrs

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

Practicals

36 hrs

Phycology

16 hrs

1. Make micro preparations of vegetative and reproductive structures of the types mentioned in the syllabus.
2. Identify the algal specimens up to the generic level and make labelled sketches of the specimens observed

Mycology

10 hrs

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

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

Lichenology

4 hrs

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

Plant Pathology

6 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.

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. Dr. G. Gunasekharan - Laboratory Manual of Microbiology – New Age Pub:
5. Fritsch F. B 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.
12. Singh V., Pandey P.C and Jain D.K 1998, A Text book of Botany for Undergraduate Students, Rastogi Publications.
13. Smith G.M 1955, Cryptogamic Botany, Vol.I McGraw Hill.
14. Vashishta B.R. 1990, Botany for Degree Students, Fungi, S.Chand & Co.
15. Vasishta B.R 1990, Botany for Degree Students, Algae, S.Chand & Co.
16. Webster J 1970, Introduction to Fungi, Cambridge University Press.

Semester-I
Complementary Course
BB1131 Introduction to Biochemistry

Credits: 3

Total Contact Hours: 90
(Theory 54 + practical 36)

Aim and Objective: To give basic awareness about the concepts and physical aspects in biochemistry and to develop analytical skills in students in order to prepare them to use instruments.

Module I

Structural features of water molecule, dissociation of water, ionic product of water, acids and bases, concepts of pH, pOH, theoretical calculations of pH and pOH, dissociation of weak acids, buffers buffer action and buffer capacity, buffers in biological system, Henderson – Hasselbalch equation, simple numerical problems involving application of this equation.

Module II

Solutions: Meaning of normality, molality, molarity, percentage solution, mole fraction, parts per million, simple numerical problems from the above, fundamental principles of diffusion, osmosis, osmotic pressure, Vant Hoff's laws of osmotic pressure, simple numerical problems, definition of isotonic, hypotonic and hypertonic solutions, biological importance of osmosis, surface tension, viscosity.

Module III

Colloids: Definition of true solutions, suspensions, colloids and crystalloids, distinction between lyophilic and lyophobic colloids, properties of colloids, biological significance of colloids, emulsions and emulsifying agents, Donnan membrane equilibrium, Donnan equation and its significance.

Module IV

Colorimetry and Spectrophotometry: Beer-Lambert's law, molar extinction coefficient, colorimeter, spectrophotometer.

Centrifugation: Principle of sedimentation technique, principle and procedure and application of differential centrifugation, density gradient centrifugation, ultra centrifugation, rate zonal centrifugation, Isopycnic centrifugation pH meter: Principle and working.

Module V

Chromatography: Principle procedure and application of paper, TLC, ion-exchange, affinity and gel filtration chromatography.

Electrophoresis; Principle, procedure and application of zone electrophoresis paper electrophoresis, gel electrophoresis (native PAGE, SDS - PAGE).

Module VI

Bio-organic chemistry: (Common functional groups and their significance in biomolecules – OH, -SH, -CHO, -C=O, -COOH, -NH₂, -NH. Intra and Intermolecular interactions in biological system: Hydrogen bond, Covalent bond, hydrophobic interaction, disulphide bond, Peptide bonds, glycosidic bond, Phosphodiester linkage, Watson- Crick base pairings, Vander Wall's force. Classification of isomerism with examples.

Practicals

1. Weighing in Chemical balance
2. Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution etc.
3. Demonstration of dialysis
4. Demonstration of PAGE
5. Demonstration of Paper Chromatography
6. Demonstration of Thin Layer Chromatography
7. Colorimetry and Spectrophotometry techniques
8. Verification of Beer Lambert's law
9. Verification of molar extinction coefficient of any known compound

Suggested Readings

1. Physical Biochemistry by David Freifelder Publisher: W.H.Freeman & Co Ltd. (September 1976)
2. A Biologist's Guide to Principles and Techniques of Practical Biochemistry by Bryan L. Williams, Keith Wilson Hodder Education,
3. Principles and Techniques of Practical Biochemistry by Keith M. Wilson, John M. Walker Cambridge University Press.
4. The Tools of Biochemistry by Cooper, T. G. 1977. Publisher: John Wiley & Sons
5. Biophysical Chemistry Principles & Techniques Handbook (2003) by Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath Publisher: Himalaya Publishing House.
6. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGraw Hill Publishing Company LTD, New Delhi p 10- 15.
7. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi.
8. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi.
9. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd.
10. Text Book of Medical Biochemistry by MN Chatterjea and R Shinde, 3rd edition, JAYPEE Publishers, New Delhi.

11. Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2.
12. Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill
13. Practical Biochemistry Principles and Techniques, Keith Wilson and John Walker, 4th Edition.

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 were 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

6 hrs

Classification of microorganisms: bacteria, virus, fungi, protozoa; concept of microbial species, strains, biovars, serovars. Introduction to Bergey's manual

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

Module III

Bacterial nutrition

6 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, Culture techniques of anaerobes (any two)

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, viral culture, Structure of viruses, Bacteriophages, Structure of T4 bacteriophage; Lytic and Lysogenic cycles

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 glasswares
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, Acid fast staining, 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 various types of water including commercial and ordinary drinking water
14. Quantification of fungi and actinomycetes

Suggested Readings

1. A Textbook of Microbiology – P. Chakraborty, 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 (7th 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. Bergeys Manual of Determinative bacteriology. (9th ed). Williams & Wilkins, Baltimore

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); Action potential generation in neurons; Mechanism of vision, vision faults and their correction; muscular movements; hearing, generation and reception of sonic vibrations, hearing aids; fluorescence and phosphorescence; Isotopes and radioisotopes, radioactive tracer technique.

Module II

Biophysics of Respiration

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 8 hrs Bioinstrumentation

Basic principles and working of instruments-pH meter, spectrophotometer (UV and Visible) and colorimeter- Beer-Lambert law. Brief account of densitometry, fluorimetry, atomic absorption spectroscopy, IR, NMR and X-ray crystallography and Mass spectrometry, differential and density gradient centrifugation.

Module V

6 hrs

Electrophoresis-Principle of electrophoresis, Components of Polyacrylamide gels, native gel electrophoresis, SDS PAGE, immuno electrophoresis, isoelectric focusing, Submarine electrophoresis, Autoradiography

Practicals

Familiarizing the working of the following instruments

1. pH Meter – Use of pH Meter, Familiarization of the instrument and Preparation Phosphate buffers and determination of pH.
2. Spectrophotometer – Familiarization of the working of the instrument , Quantitative estimation of Sugars by Dinitrosalysilic acid and Proteins by Lowry's Method
3. Development of absorption spectra of chlorophyll or any other biological sample
4. Electrophoresis – demonstration of PAGE and Agarose Gel Electrophoresis

Suggested Readings

1. A Textbook of Biophysics- R N Roy, New central Book Agency Pvt. Ltd, Calcutta.
2. Biochemistry ., Voet,D & Voet, J.G
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, Watson et al.
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

BB1241 -Environmental Studies

Credits 4

Contact Hours 72 (T 54+P 18)

Aim and Objective: Students should acquire a basic understanding about the structure function of the environment and its interaction with the living systems. It will impart the geographical distribution of plants and 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 and human environment. 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, Man induced land slides, soil erosion and desertification.
8. Role of an individual in conservation of natural resources.

Module II 6 hrs Ecosystems

9. Ecosystems-Concept of an ecosystem- structure and function of an ecosystem-
10. Biotic and abiotic components- Energy flow in an ecosystem.
11. Ecological succession-Definition & types.
12. Food chains -Food web & ecological Pyramids.
13. Introduction- types, characteristic features, structure and functions of the following ecosystems (Brief study only).
 - A 1. Forest ecosystem 2. Grassland ecosystem 3. Desert ecosystem 4 .Aquatic ecosystems- Ponds, Streams, Rivers, Oceans, Estuaries.
 - B. Morphological, anatomical& physiological adaptations of –Hydrophytes, Xerophytes, Halophytes, Epiphytes, Parasites.

Module III 14 hrs Biodiversity and its conservation

1. Introduction
2. Definition- genetic, species and ecosystem diversity.
3. Bio-geographical classification of India.
4. Value of bio-diversity: social, ethical, aesthetic and option values.
5. Biodiversity at global, National and local levels. India as mega-diversity nation
6. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wild life, man-wild life conflicts.
7. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. National Parks and Wildlife sanctuaries. Ecological niche, ecotypes & ecological indicators.

Environmental pollution

1. 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 7. Nuclear hazards.
2. Solid waste Management- (Brief account only) : Causes, effects and control measures of urban and industrial wastes.
3. Disaster management (Brief account only): Floods, earthquake, cyclone and land slides

Module IV 14 hrs Social issues and the Environment

1. From unsustainable to sustainable development. Urban problems related to energy. Water conservation, Rain water
2. Harvesting, water shed management. Environmental ethics: Issues and possible solutions.
3. Climate change. Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
4. 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.
5. Public awareness .Forest Management.
6. Brief study of the major forests in India. Influence of forest on environment. Social forestry.
7. Mangrove vegetation of Kerala
8. Need of protection of mangrove vegetation .

Module V

Phytogeography

6 hrs

Principles and vegetational types of India-tropical rain forest, sholas and deciduous forest-sand dunes and mangroves, scrub jungle, phytogeographical regions of India.

Practical

18 hrs

1. Study of ecological and anatomical modifications of Xerophytes, Hydrophytes, halophytes, epiphytes and Parasites.
2. Study of plant community by quadrat method.
3. Observation and study of different ecosystems mentioned in the syllabus.
4. Phytogeographical regions of India.

Suggested Reading

1. Ahluwalia VK and Sunitha Malhotra 2009, Environmental science, Ane Books Pvt. Ltd.
2. Ambasht R.S. – Text book of Plant Ecology, Students and Friends & Co. Varanashi.
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 Courses, Universities Press, University Grants Commission
5. Erach Bharucha – Text book of environmental Studies for undergraduate
6. Kumaresan B. – *Plant Ecology & Phytogeography* – Rastrogi Pub:
7. Misra SP and Pandey SN, 2009, Essential Environmental studies, Ane Books Pvt. Ltd.
8. Odum Eugene P – Fundamentals of Ecology, Edn. Philladelphia & 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.

Semester II
Core Course
BB1242 Practical Botany- I
(Practical of BB1141 & BB 1241)

Credit 2 **Practical of BB 1141 Contact Hours: 54** **36 hrs**

Phycology **16 hrs**

1. Make micro preparations of vegetative and reproductive structures of the types mentioned in the syllabus.
2. Identify the algal specimens up to the generic level and make labelled sketches of the specimens observed

Mycology **10 hrs**

1. A detailed study of structure and reproductive structures of types given in the syllabus and submission of record.
2. *Rhizopus, Saccharomyces, Penicillium, Xylaria, Peziza. Puccinnia. Agaricus* and *Cercospora*

Lichenology **4 hrs**

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

Plant Pathology **6 hrs**

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

BB1241 Environmental Studies and Phytogeography **18 hrs**

1. Study of ecological and anatomical modifications of Xerophytes, Hydrophytes, halophytes, epiphytes and Parasites.
2. Study of plant community by quadrat method.
3. Observation and study of different ecosystems mentioned in the syllabus.
4. Phytogeographical regions of India

Semester-II
Complementary Course
BB1231 General Biochemistry

Credits: 3

Contact Hours: 90 (T 54 + P 36)

Aim and Objective: To familiarize the students with the building blocks of living matter, the biomolecules, their structure, components, reactions, their derivatives, biological significance and the basic tests to identify them.

Module I

Chemistry of carbohydrates: Classification, optical isomerism, D and L series, epimers, aldoses and ketoses, structural relationships of aldoses, ring structure of monosaccharides, anomers, mutarotation, chemical reactions of glucose, glycosides, deoxy sugars, amino sugars, sugar alcohols and sugar acids, O-acyl O-methyl derivatives of monosaccharides, ozazone, disaccharides, structure and important properties of sucrose, maltose, isomaltose, lactose and cellobiose, Trisaccharide (examples only), structure and important properties of polysaccharides- starch, glycogen, cellulose, and chitin. Qualitative test for carbohydrates.

Module II

Chemistry of Lipids: Classification, fatty acids, structure and properties, reactions of fatty acids, triglycerides- general structure and properties, acid number, Saponification number and iodine number fats, glycerol, Acrolein test. Phospholipids- structure and function of phosphatidyl choline and phosphatidyl ethanolamine. Sphingolipids,- structure and function of cerebrosides and gangliosides. Steroids- structure of cholesterol and ergosterol. Colour reactions of sterols.

Module III

Chemistry of Amino acids and proteins: Classification of amino acids, amino acids occurring in proteins, optical activity, UV absorption, Zwitterions, chemical reactions of amino acids, proteins, biological significance, classification – fibrous proteins, globular proteins, conjugated proteins, hydrolysis of proteins and separation of amino acids.

Module IV

Proteins: Physical properties, solubility, isoelectric point and isoelectric precipitation, elementary study of primary secondary, tertiary and quaternary structure of proteins, colour reactions, precipitation reactions, denaturation, oligopeptides, amino acid analysis of proteins, hemoglobin- functions and components of plasma proteins.

Module V

Chemistry of Nucleic acids: Base compositions, structure of purines and pyrimidines, ribose

and deoxy ribose, nucleoside structure , nucleotides- nomenclature, structure of polynucleotide – DNA,RNA primary structure and inter nucleotide linkage. Watson and Crick double helix model of DNA, different types of RNA.

Module VI

Enzymes: Classification and nomenclature, units of enzyme activity, progress curve, effect of enzyme concentration, substrate concentration, temperature and pH on reaction velocity of enzyme catalyzed reactions. Michaelis - Menten constant, enzyme affinity, Michaelis - Menten equation (Derivation not expected), Enzyme specificity, different types, enzyme activation, enzyme inhibition-competitive and non-competitive , Line weaver – Burk plot, application of LB plot, allosteric regulation (Brief study). Coenzymes.

Practical

1. General reactions of Carbohydrates and Lipids

Carbohydrates-Glucose, Fructose , Xylose, Sucrose, Maltose, Starch & Dextrin Carbohydrates-Molisch's test, Anthrone test, Fehling's test, Benedict's test, Picric acid test, Barfoed's test, Bial's test, Seliwanoff's test, Iodine test, Hydrolysis of Sucrose and Starch, Ozazone test. Fatty acids: Stearic acid/ Oleic acid. Tests- Solubility, Translucent spot tests, Test for Unsaturation Glycerol Tests- Acrolein test, Borax fusion test, Solubility. Cholesterol Tests- Solubility, Salkowski reaction, Liebermann-Burchard reaction

Suggested Readings

1. Lehninger Principles of Biochemistry, 4th Edition by David L. Nelson
2. E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974.
3. Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc
4. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: McGraw-Hill Book Company – Koga
5. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd.
6. Text Book of Biochemistry, 5th edition by DM Vasudevan and Sreekumar S, JAYPEE Publishers, New Delhi,.
7. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGraw Hill Publishing Company LTD, New Delhi p 10- 15.
8. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi.
9. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi.

Semester II

Core Course Vocational

BB1271 Microbial Metabolism, Genetics and Diseases

Credits: 3

Contact hours- 54 (T 36+ P 18)

Aim and Objective: This course is designed to get an in-depth knowledge in 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

Overview of metabolism, Energy and ATP; 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 bacteriochlorophyll, carotenoids, phycobiliproteins, leghaemoglobin, mechanism of photosynthesis in 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, Staphylococcal food poisoning; Food borne and waterborne infections- Typhoid fever, salmonellosis, 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.

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.
5. Examination of microbial flora of the skin
6. Examination of the microbial flora of mouth.
7. Inhibition of microorganisms by antibacterial agents by disc diffusion method
8. Isolation of Plaque-forming Bacteriophage from sewage samples
9. Growth kinetics of bacteria or yeast.

Suggested Readings

1. A Textbook of Microbiology – P. Chakraborty, 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
- Principles of Biotechnology – A. J. Nair Laxmi Publications New Delhi 23 -
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 (7th Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester II

Core Course Vocational

BB1272 Biotechniques- I (Practical of BB1171 & BB1271)

Credit 2

Contact hours: 36

Practical of BB1171

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 glasswares
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, Acid fast staining, 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 various types of water including commercial and ordinary drinking water
14. Quantification of fungi and actinomycetes

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
5. Examination of microbial flora of the skin
6. Examination of the microbial flora of mouth.
7. Inhibition of microorganisms by antibacterial agents by disc diffusion method
8. Isolation of Plaque-forming Bacteriophage from sewage samples
9. 9. Growth kinetics of bacteria or yeast.

Semester III

Core Course

BB1341 Angiosperm Anatomy and Reproductive Botany

Credits 3

Contact Hours 72 (T 54+P 18)

Aim and objective: 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.

Module- I

Angiosperm Anatomy

8 hrs

1. Objective and scope of plant anatomy
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, by products.

Module –II

15 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

13 hrs

7. Primary structure – Root, stem and leaf [Dicot & Monocot].
8. Secondary growth - Root and stem- cambium (structure and function) annular 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

14 hrs

1. Introduction to angiosperm embryology
2. Micro sporogenesis - structure and functions of wall layers.
3. Development of male gametophyte - Dehiscence of anther.
4. Megasporogenesis - Development of female gametophyte - Embryo sac - Development and types - Monosporic – *Polygonum* type, Bisporic - *Allium* type, Tetrasporic – *Adoxa* type.
5. Pollination - Fertilization - Barriers of fertilization - Germination of pollen grains – Double

fertilization.

6. Structure of Embryo- Dicot [*Capsella*], Monocot [*Sagittaria*] Endosperm types, its development and functions.

Module V

4 hrs

Palynology: Pollen structure, pollen morphology, pollen allergy - viability test for pollen grains, Economic importance and its importance in taxonomy

Practical

Anatomy

18 hrs

1. Non living inclusions - Cystolith, Raphide, Sphaero-raphide, Aleurone grains.
2. Starch grains (Eccentric, concentric, compound)
3. Simple permanent tissue-Parenchyma, Chlorenchyma, Aerenchyma, Collenchyma and Sclerenchyma
4. Primary structure – Dicot stem: *Hydrocotyle*, *Eupatorium*.
5. Monocot stem: Grass and *Asparagus*.
6. Dicot root: Pea and *Limnanthemum*
7. Monocot root: *Colocasia* or any monocot root.
8. Secondary structure - Stem [Normal type]- *Vernonia*
9. Secondary structure - Root [Normal type]- *Tinospora*, *Carica papaya*, or any normal type
10. Secretory tissue: Resin canal, Nectary, Latex vessel, Lysigenous and Schizogenous cavities. Laticifers – Articulated and non articulated.
11. Epidermal structures –Stomata.
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 and embryo (Permanent slides can be used)

Palynology

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. (1985) - Plant Anatomy – Pergamon Press, Oxford.
3. Maheswari P. - Embryology of Angiosperms - Vikas Pub:
4. Nair PKK Palynology of Angiosperms
5. Pandey, B .P. (1997) - Plant Anatomy - S.Chand and co. New Delhi Biology - McGraw Hill Co, New York.
6. Prasad and Prasad (1972) Out lines of Botanical Micro technique, Emkay publishers, New Delhi
Coutler E. G. (1969) Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.

7. Vashista .P. C (1984) - Plant Anatomy – Pradeep Publications – Jalandhar

Semester III

Core Course

BB1342 Bryology, Pteridology, Gymnosperms & Paleobotany

Credit: 2

Contact hours: 90 (Theory 54 + Practical 36)

Aim and Objective: Students should be trained in basic botany such as lower plants like Bryophytes, Pteridophytes, Gymnosperms, etc. to get an in-depth knowledge in the 4 various aspects of Biotechnology. This is the main purpose of this course.

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 8 hrs 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, Lycopodium, Selaginella, Equisetum, Pteris* and *Marsilea*.

Module- III

8 hrs

3. General Topics: Stellar evolution in Pteridophytes, heterospory and seed habit, relationships of pteridophytes with bryophytes and gymnosperms, economic importance of pteridophytes.

Module- IV 22 hrs Gymnosperms

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

Module-V

Plaeobotany

4 hrs

1. Fossil formation – Techniques of study.
2. Geological time scale. Evolutionary trends

3. Fossil pteridophytes – *Rhynia* , *Lepidodendron*, *Lepidocarpon*. Fossil Gymnosperm - *Lygenopteris*.
4. Applied aspects of Palaeobotany - Exploration of fossils 22

Practical

36 Hrs

Bryology

10 hrs

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

12 hs

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

Gymnosperms

10 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.
Pinus - Branch of indefinite growth, spur shoot, T. S of old stem and needle R .L .S andT. L. S. of stem, male and female cone, V .S. of male and female cone. 18 -
2. *Gnetum* -: Habit, stem T. S (young and mature), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed

Plaeobotany

4 hrs

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

Suggested Reading

1. Andrews H.N. (1967) - Studies on Palaeobotany – C .J. Felix.
2. Arnold C. A (1947) - Introduction to Palaeobotany - 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. Alahabad
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

Semester-III

Complementary Course

BB1331 Physiological aspects in Biochemistry

Credits: 4

Contact Hours: 90 (Theory 54, Practical 36)

Aim and Objective: The course is intended to introduce the student to the basics of physiological aspects and to familiarize the students with the basics of human nutrition.

Module I

10 Hrs.

Biochemistry of Blood: Physical properties and constituents of blood, types of blood cells-RBC, WBC, lymphocytes and platelets. Hemoglobin: Structure and function of hemoglobin, types of hemoglobin, abnormal hemoglobin, bile pigments formation, iron metabolism- absorption and transport. Blood clotting: Mechanism of blood clotting (Intrinsic and extrinsic pathway), clotting factors, anticoagulants, bleeding time, clotting time, hemopoiesis, - blood forming organs, erythropoiesis, leucopoiesis. Blood groups: Classification, chemical basis for blood group specificity.

Module II

10 Hrs.

Nutrition: Vitamins-Definition, classification- fat soluble and water soluble, source, chemical nature (without structure) functions of vitamins. Deficiency diseases. Nutrition: Caloric value, BMR, Carbohydrates, fats and proteins. Minerals: Outline study of sources and functions of Ca, Na, K, I and Fe.

Module III

7 Hrs

Detoxification: Metabolism of foreign compounds in the liver - oxidation, conjugation, hydrolysis, reduction, examples of each type. Liver function test. Structure of nephron, formation of urine, renal function test, renal threshold, constituents of urine.

Module IV

9 Hrs

Respiration and Acid- Base balance: Respiration: Partial pressure of gases, chemical and physiological events affecting the diffusion of O₂ and CO₂, exchange of CO₂ during respiration, transport of gases in blood, carbonic anhydrase, chloride shift, oxygen dissociation curve, Bohr effect. Acid Base balance: Body water balance, buffers in blood, respiratory acidosis and alkalosis, metabolic acidosis and alkalosis.

Module V

9 Hrs

Clinical Biochemistry and Endocrinology: Elementary study of: Diabetes, hypercholesterolemia, Hemophilia, Artherosclerosis, Obesity and Jaundice.

Endocrinology: Organization of endocrine system, classification and functions of adrenalin, nor adrenalin, cortisone, Cortisol, corticosterone, deoxycorticosterone, Estradiol, thyroxine, TSH, ACTH, Gonadotropin, GH, Oxytocin and vasopressin, peptide hormones.(Structure of adrenalin, nor-adrenalin, cortisone, T₃ and T₄ alone required)

Module VI

9 Hrs

Photosynthesis: Outlines of cyclic and non-cyclic photophosphorylation, photosystems I and II, Path of carbon in dark reaction-Calvin cycle, photorespiration and C₄ pathway (basic study), nitrogen cycle, nitrogen fixation-nitrogenase complex, nitrogen assimilation -role of glutamate dehydrogenase and synthetase (outline study only).

Practicals 36 Hrs General reactions of Amino acids & Proteins

Amino acids-Tests- Solubility, Ninhydrin reaction, Xanthoproteic reaction, Millons test, Morners test, Glyoxalic acid test, Ehrlich's test, Nitroprusside test, Lead acetate, Test for Methionine, Aldehyde test, Sakaguchi reaction, Isatin test (any four)

Proteins-Tests-Solubility, Ninhydrin reaction, Xanthoproteic reaction, Folin's, Lowry, Heat denaturation, TCA precipitation, Alcohol precipitation.

Demonstration experiments

Enzyme Assays

- Urease/Trypsin
- Kinetics of Urease / Trypsin (Effect of pH, substrate Concentration, enzyme concentration and temperature)
- Progress curve of Urease/Trypsin
- Digestion of carbohydrates –action of salivary amylase

Suggested Readings:

1. Advanced Text Book on Food and Nutrition, Vol I and II, Dr. MS Swaminathan.2nd edition.The Bangalore Printing and Publishing Co Ltd.
2. Arthur Vander, James Sherman, and Dorothy Luciano Vander et al.: Human Physiology: The Mechanism of Body Function, Eighth Edition © The McGraw-Hill Companies.
3. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi,
4. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGraw Hill Publishing Company LTD, New Delhi p 10- 15.
5. Human Physiology (2001) by Andrew Davies, GH Blakeley, Cecil Kidd Publisher: Churchill Livingstone
6. Human Physiology (2001) by Bipin Kumar Publisher: Campus Books International
7. Human Physiology (2001) by KC Sawant Publisher: Dominant Publishers & Distributors
8. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi,
9. Plant Biochemistry by Hans-Walter Heldt Professor Em (3ed 2004) Publisher: Academic
10. Principles Of Biochemistry, 6e (1959) by Abraham White, Philip Handler Publisher: Tata McGraw-hill Publishing Company Limited
11. Textbook of Medical Biochemistry for Medical Students by DM Vasudevan and Sreekumari S. 5th edition, Japee Brothers, Medical Publishers,
12. Textbook of Medical Physiology, 11/e with Student Consult Access (2005) by Arthur C Guyton, John E Hall Publisher

Semester III

Core Course Vocational

BB1371 Protista and Animal Diversity

Credits 4

Contact Hours 72 (Theory 54+Practical 18)

Aim and Objective: 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

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; External features, adaptations and economic importance of examples cited

Phylum Porifera

Class Calcarea eg. *Sycon*; Class Hexactinellida ; Class Demospongiae

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. *Pia*; Class Cephalopoda eg. *Sepia*; Class Scaphopoda eg. *Dentalium*

Phylum Onychophora eg. *Peripatus*

Phylum Arthropoda

Subphylum Trilobitomorpha-Class Merostomata eg. *Limulus*; Class Arachnida eg. *Scorpion*; Class Pycnogonida.

Subphylum Mandibulata-Class Crustacea eg. Prawn (*Penaeus*); Class Chilopoda eg. *Scolopendra*; Class Symphyla eg. *Scutigera*; 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* and *Spodoptera mauritia* (2) Stored food grains: *Sitophilus oryzae* and *Tribolium*

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 III

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. *Amphioxus*; **Subphylum Vertebrata**; Superclass Agnatha eg. *Petromyzon*; Superclass Pisces eg. *Scoliodon*; Superclass Tetrapoda
Class Amphibia: Frog (*Rana*) – general characters; detailed study on Nervous system 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 4.
2. Porifera - any 2.
3. Coelenterata - any 5.
4. Aschelminthes - any 2.
5. Platyhelminthes - any 4 (adaptations of parasitic forms to be stressed)
6. Annelida - any 4.
7. Minor phyla - any 2.
8. Arthropoda - any 10 (including at least 5 insect pests of paddy/banana plant/stored food grains and 2 beneficial insects).
9. Mollusca - any 8 (including any 2 beneficial and any 2 harmful species).
10. Echinodermata - any 5 (representing one each from five different classes).
11. Prochordates - Ascidia, Branchiostoma (Amphioxus).
12. Pisces-any 8 (including 2 cartilaginous fishes, 2 fishes with accessory respiratory organs, 4 common food fishes).
13. Amphibia - any 3 (representing the orders Apoda, Urodela and Anura).
14. Reptilia - any 5 (including at least one poisonous and one non-poisonous snake of Kerala).
15. Aves - any 3 common birds of Kerala (based on museum specimens or field observations).
16. Mammalia - any 5 (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

16. Brusca R.C. and Brusca G.J. (1990) Invertebrates. Sinauer Associates, Sunderland,MA.
17. Pearse V and Pearse J, Buchsbaum M and Buchsbaum R. (1987) Living Invertebrates Blackwell Scientific Publications, California.
18. Chandler, A.C. and Read. Parasitology.
19. Dhama, P. S. and Dhama, J. K. Invertebrate Zoology. R. Chand and Co.
20. Dhama, P. S. and Dhama, J. K. Vertebrate Zoology. R. Chand and Co.
21. Ekambaranatha Ayyar, M. and Ananthakrishnan, T. N. A Manual of Zoology. Vol I
22. Invertebrate Zoology- Chand publications, New Delhi
23. Manual of Zoology – Ekambaranatha Iyer; Chand Publications, New Delhi
24. 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 Objective: 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

5 hrs

Animal cell, Tissues, organs and organ systems

Nutrition: feeding mechanisms, digestion- types of digestion, basic mechanisms of digestion, digestive system and its function, 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

Module V

5 hrs

Excretory system: Excretion and its significance, excretory products of body, Excretory organs of invertebrates, excretory organs of vertebrates,

Nephrones- structure and function, Kidneys –structure and function, Formation of urine, Dialysis,

Accessory excretory organs- skin, its structure and function.

Module VI **4 hrs**

Bioregulatory system: Glands, Hormones, Endocrine glands and feedback mechanism

Module VII **5 hrs**

Nervous system: Neurons- structure and function, nervous system of invertebrates and vertebrates, Human Nervous system

Module VIII **3 hrs**

Skeletal and muscular system- Human skeleton and muscular system

Practical **18 hrs**

Minor Practicals

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

Major practicals

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. Dhama, P. S. and Dhama, J. K. Invertebrate Zoology. R. Chand and Co.
5. Dhama, P. S. and Dhama, 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
Complementary Course
BB1431 Metabolism

Credits: 2

Contact Hours: 90 (Theory 54, Practical 36)

Aim and Objective: The course aims at providing an overview of energy production by explaining the general principles of cellular energy metabolism and schematizing the different metabolic pathways.

Module I

Metabolism of carbohydrates: Digestion of carbohydrates and absorption (outline study). Glycolysis- Reactions, fate of pyruvate, regulation of glycolysis, Gluconeogenesis-reaction pathway, reciprocal regulation of gluconeogenesis and glycolysis. Cori cycle. Pentose Phosphate Pathway-reactions, biological significance, regulation of pathway. Glycogen metabolism-glycogenesis, glycogenolysis, control of glycogen metabolism-allosteric and hormonal regulation. (Only pathway outlines without structures).

Module II

Metabolism of Lipids: Digestion and absorption of lipids, composition and function of bile, enterohepatic circulation (outline study). Scheme of β -oxidation, ATP yield in β -oxidation (Stearate & Palmitate as examples) and regulation. Basics of β - and α -oxidation. Ketone body formation. Cytoplasmic system of fatty acid biosynthesis and regulation of the pathway. Essential fatty acids.

Synthesis of Triacylglycerols (outline study). Outline study of biosynthesis of cholesterol and bile acids. Physiological functions of phospholipids (Structure of intermediates of metabolic pathway not required).

- 36 -

Module III

Metabolism of Aminoacids and Proteins: Zymogen activation of proteolytic enzymes of GI tract. Digestion of proteins and absorption of amino acids-role of glutathione cycle. Reactions involved in the metabolism of amino acids- deamination, transamination and decarboxylation-coenzymes involved in these reactions. Urea cycle.

Module IV

Bioenergetics: Redox reactions, redox potential and free energy, mitochondrial electron transport chain, coenzymes and prosthetic groups of respiratory chain enzymes- sites of ATP production, P/O ratio, inhibitors of electron transport chain, oxidative phosphorylation- chemiosmotic hypothesis (outlines only), uncouplers of oxidative phosphorylation. Formation of ATP- oxidative and substrate level phosphorylation. High energy compounds with structures (ATP, ADP, Creatine phosphate, 1, 3 bisphosphoglycerate, PEP etc.). Role of high energy phosphate groups.

Module V

Genetic aspects of Metabolism: DNA structure-nucleosomes, 30nm fibers and radial loops. Prokaryotic DNA replication-DNA polymerases, replication forks, Okazaki fragments and

accessory proteins. Brief study of structure and types of RNA and their functions. Prokaryotic transcription process. Genetic code-properties of genetic code. Protein biosynthesis in prokaryotes-synthesis of aminoacyl tRNA, initiation-Shine Dalgarno sequence, elongation- aminoacyl tRNA binding, peptide bond formation, translocation followed by termination.

Practical

18 Hrs

Quantitative Analysis of Amino acids and Proteins Estimation of Tyrosine by Folin-Lowry method. Estimation of Protein by Biuret method. Estimation of Protein by Folin-Lowry method.

Quantitative Analysis of Nucleic Acids Estimation of DNA by diphenylamine method. Estimation of RNA by Orcinol method *Demonstration experiments*

Enzyme Assays

- Urease/Trypsin
- Kinetics of Urease / Trypsin (Effect of pH, substrate Concentration, enzyme concentration and temperature)
- Progress curve of Urease/Trypsin
- Digestion of carbohydrates – action of salivary amylase

Suggested Readings

1. Lehninger Principles of Biochemistry, 4th Edition by David L. Nelson David L. Nelson Michael M. Cox Michael M. Cox (Author) , Publisher: W. H. Freeman; Fourth Edition (April 23, 2004)
2. E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford - 37
- and IBH Publishing Co., New Delhi, 1974
3. Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc
4. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: McGraw-Hill Book Company – Koga
5. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K Publisher: Pearsarson
6. Biochemistry (2008) by Rastogi Publisher: McGraw Hill.
7. Plant Biochemistry by Hans-Walter Heldt Professor Em (3ed 2004) Publisher: Academic.
8. Text Book of Biochemistry, 5th edition by DM Vasudevan and Sreekumar S, JAYPEE Publishers, New Delhi.

Semester-IV

Complementary Course

BB1432 Practical Biochemistry

(Practical of BB1131, BB1231, BB1331, & BB1431)

Credits: 2 Contact Hours: 144 (4 x 36 + 144) Practical of BB 1131 36 hrs

- Weighing in Chemical balance
- Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution etc.
- Demonstration of dialysis
- Demonstration of PAGE

- Demonstration of Paper Chromatography
- Demonstration of Thin Layer Chromatography
- Colorimetry and Spectrophotometry techniques
- Verification of Beer Lambert's law
- Verification of molar extinction coefficient of any known compound

General reactions of Carbohydrates

Qualitative analysis of Carbohydrates.

Carbohydrates-Glucose, Fructose, Xylose, Sucrose, Maltose, Starch & Dextrin

Tests- Molisch's test, Anthrone test, Fehling's test, Benedict's test, Picric acid test, Barfoed's test, Bial's

- 38 -

test, Seliwanoff's test, Iodine test, Hydrolysis of Sucrose and Starch, Osazone test.

Quantitative Analysis of carbohydrates Estimation of glucose by Nelson-Somogyi method
Estimation of reducing sugar by anthrone method. Estimation of pentose by Orcinol method.
Estimation of ketose by Roe-Papedopaulose method.

Practical of BB 1231 36 hrs Qualitative analysis of Lipids

Fatty acids: Stearic acid/ Oleic acid. Tests- Solubility, Translucent spot tests, Test for Unsaturation

Glycerol

Tests- Acrolein test, Borax-fusion test, Solubility.

Cholesterol

Tests- Solubility, Salkowski reaction, Liebermann-Burchard reaction

Quantitative Analysis of Lipids

Estimation of Cholesterol by Carr-Drektor method. Estimation of Cholesterol by Zak's method.
Determination of Acid Value. Determination of Saponification value. Determination of Iodine number of oil

Practical of BB 1331 36 Hrs Amino acids and Proteins

Qualitative analysis of Amino acids and

Proteins Amino acids- (any 4 amino acids)

Tests- Solubility, Ninhydrin reaction, Xanthoproteic reaction, Millons test, Morners test, Glyoxalic acid test, Ehrlich's test, Nitroprusside test, Lead acetate, Test for Methionine, Aldehyde test, Sakaguchi reaction, Isatin test

Proteins-

Tests-Solubility, Ninhydrin reaction, Xanthoproteic reaction, Folin's test, Lowry's test, Biuret test, Heat denaturation, TCA precipitation, Alcohol precipitation.

Practical of BB1431

36 hrs

Quantitative Analysis of Amino acids and Proteins Estimation of Tyrosine by Folin-Lowry method. Estimation of Protein by Biuret method.

Estimation of Protein by Folin-Lowry method.

Quantitative Analysis of Nucleic Acids

Estimation of DNA by diphenylamine method. Estimation of RNA by Orcinol method

Demonstration experiments

Enzyme Assays

- Urease/Trypsin
- Kinetics of Urease / Trypsin (Effect of pH, substrate Concentration, enzyme concentration and temperature)
- Progress curve of Urease/Trypsin
- Digestion of carbohydrates – action of salivary amylase

Suggested Readings

1. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.
2. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
3. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (Ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
4. Hawks Physiological Chemistry, Bernard L.Oser (ed).TATA McGRAW Hill Publishing Company LTD, New Delhi.
5. ES West, WR Todd, HS Mason and JT van Bruggen. A text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974.

Semester IV

Core Course

BB1441 Horticulture, Mushroom Cultivation & Marketing

Credits: 2

Contact hours: 72 (T 54+ P 18)

Aim and Objective: This course will give an idea about the application of biological science particularly plant science in business generations and self employment. This focuses on the horticulture, Mushroom cultivation, its marketing and also in forest depended economy and its impact on society.

Module I Horticulture 12 hrs 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 **Propagation methods-** Cuttings, Layering – Air layering, Ground layering (Tip, Trench and Compound)

Budding – T- budding, Grafting – Approach grafting, Bridge grafting, whip and tongue grafting., Garden tools and implements (pruning shears, secateurs, spade, trowel, garden rake, hand rake, sprinklers/sprayers, shovel and lawn mower)

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

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

Flower Arrangement- Containers and requirements for flower arrangements, Free style, Shallow and Mass arrangement, Japanese – Ikebana, Bouquet and garland making, Dry flower arrangement **Harvesting-** Methods, Storage, Marketing of Fruits, vegetables and flowers, Preservation and processing of fruits and vegetables

Module III **10 hrs**

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

Plant protection- Common diseases of fruits and vegetable crops, Weedicides, Fungicides, Pesticides

Practical **18 hrs**

- Propagation methods- Layering, Budding and grafting
- Flower arrangement

Field Study: Visit to a Botanical garden under the guidance of the teacher is encouraged.

Semester IV

Core Course

BB1442 Cell Biology, Plant Breeding and Evolutionary Biology

Contact hours: 72 (Theory 54 + Practical 18)

Credits 2

Aim and Objective: 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)-Cell wall; The cell membrane, Endoplasmic reticulum, Ribosomes, Golgi apparatus, Lysosomes, Peroxisomes, Vacuole, Mitochondria, Chloroplast & Nucleus
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: Transmission of genetic information - cell cycle : 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** – method – achievements in India.
7. **Breeding for pest**, diseases and stress 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. Study of Microscopes- different magnification of light microscopes
2. Examination of different types of cells- single celled and multicellular systems
3. Make acetocarmine squash preparation of onion root tip and to identify different stages of mitosis
4. Determination of Mitotic Index
5. Make squash preparation of the flower buds of any of the following plants. *Rhoeo*, *Capsicum* (To identify Meiosis)
6. Preparation of Karyotype
7. Microscopical examination and assessment of starch granules from potato, rice, tapioca etc
8. Fixation of specimens for cytological studies, Preparation of cytological stains like acetocarmine and safranin.

Suggested Readings

1. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
2. Allard RW (1960) Principles of Plant Breeding. John Willey and Sons. Inc. New York
3. BD Singh (2003) Plant Breeding. Kalyani Publishers

4. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, New Delhi
5. Darnel, J.Lodish, Hand Baltimore, D. (1991) Cell and molecular biology. Lea and Fibiger, Washington.
6. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology Scientific American books.
7. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New York
8. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
9. Gerald Karp (1985) Cell biology, Mc Graw Hill company..
10. Lewin, B, (1994) Genes, Oxford University Press, New York.
11. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
12. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
13. Roy S.C. and Kalayan kumar De (1997) Cell biology. New central Boos Calcutta
14. Sandhya mitra,(1998)Elements of molecular biology. Macmillan, India Ltd.
15. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi
16. Sharma, A.K and Sharma a (1980) Chromosome technique Theory and practice, Aditya Books, New York
17. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, NewYork.
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

Semester IV

Core Course

BB 1443 Practical Botany II

(Practical of BB1341, BB1342, BB1441 & BB1442)

Credits: 2

Contact Hours: 90

BB1341 Angiosperm Anatomy and Reproductive Botany

18 Hrs

Anatomy

1. Non living inclusions - Cystolith, Raphide, Sphaero-raphide, Aleurone grains.
2. Starch grains (Eccentric, concentric, compound)
3. Simple permanent tissue – Parenchyma, Chlorenchyma , Aerenchyma , Collenchyma and Sclerenchyma
4. Primary structure – Dicot stem: *Hydrocotyle*, *Eupatorium*.
5. Monocot stem: Grass and *Asparagus*.
6. Dicot root: Pea and *Limnanthemum*
7. Monocot root: *Colocasia* or any monocot root.
8. Secondary structure - Stem [Normal type]- *Vernonia*
9. Secondary structure - Root [Normal type]- *Tinospora*, *Carica papaya*, or any normal type

10. Secretory tissue: Resin canal, Nectary, Latex vessel, Lysigenous and Schizogenous cavities. Laticifers – Articulated and non articulated.
11. Epidermal structures –Stomata.
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 and embryo (Permanent slides can be used)

Palynology

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

Practical BB1342

Bryology, Pteridology, Gymnosperms & Paleobotany

36 Hrs

Bryology

10 hrs

4. *Riccia* – Habit - Internal structure of thallus – V. S. of thallus through archegonia, antheridia and sporophyte
5. *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 .
6. *Funaria* - Habit, V. S. of archegonial cluster, V .S. of antheridial cluster, Sporophyte V. S.

Pteridology

12 hs

7. *Psilotum* : External features , stem T .S . , synangium T. S.
8. *Lycopodium* : Habit, stem T. S. , stobilus V. S.
9. *Selaginella* : Habit , rhizophore T. S , stem T . S, axis with strobilus, V .S. of strobilus, Megasporephyll and microsporephyll.
10. *Equisetum* - Habit, rhizome and stem T .S. and V. S. of strobilus.
11. Pteris - Habit, Petiole T. S., sporophyll T. S. , prothallus
12. *Marsilea* - Habit, Rhizome and petiole T. S., sporocarp T.S, V. S. & R.L .S.

Gymnosperms

10 hrs

2. *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.
Pinus - Branch of indefinite growth, spur shoot, T. S of old stem and needle R .L .S andT. L. S. of stem, male and female cone, V .S. of male and female cone. 18 -
3. *Gnetum* -: Habit, stem T. S (young and mature), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed

Plaeobotany

4 hrs

3. Fossil pteridophytes – *Rhynia* Stem, *Lepidodendron*, *Lepidocarpon*.
4. Gymnosperm - *Lygenopteris*

BB1441 Practical

Practical of Horticulture, Mushroom Cultivation & Marketing

18 hrs

1. Familiarization and use of tools in Horticulture
2. Practice of Horticultural methods –
3. Cuttings , Layering – Air layering, Ground layering
4. Budding – T- budding, Grafting – Approach grafting, Bridge grafting, whip and tongue grafting., Garden tools and implements
5. Preparation of Farmyard manure, compost, vermicompost and biofertilizers.
6. Flower arrangement
7. Study of the Common Indian mushrooms- *Agaricus* and *Pleurotus*
8. methods of cultivation of selected edible mushrooms using paddy straw as substrate

Field Study: Visit to a Botanical garden under the guidance of the teacher is

encouraged. **Field Study:** Visit to a mushroom cultivating Laboratory

BB1442 Cell Biology, Plant Breeding and Evolutionary Biology

18 Hrs

1. Study of Microscopes- different magnification of light microscopes
2. Examination of different types of cells- single celled and multicellular systems
3. Make acetocarmine squash preparation of onion root tip and to identify different stages of mitosis
4. Determination of Mitotic Index
5. Make squash preparation of the flower buds of any of the following plants. *Rhoeo*, *Capsicum* (To identify Meiosis)
6. Preparation of Karyotype
7. Microscopical examination and assessment of starch granules from potato, rice, tapioca etc
8. Fixation of specimens for cytological studies, Preparation of cytological stains like acetocarmine and safranin.

Semester IV

Core Course Vocational

BB1471 Molecular Biology

Credits 3

Total contact hours 72 (Theory 54 + Practical 18)

***Aim and Objective:** 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, his 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

Module VI

6 hrs

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

Practical

18 hrs

Experiments for Molecular biology

1. Instruments and equipments 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. Demonstration of PCR

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 VIII- Benjamin Lewin; Offord University Press.
5. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston,USA.
6. Introduction to Molecular biology- P. Paoella; 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 (7th 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 Objective: 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; haematoposis; 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; Brief account on complement system and MHC

Module V

Immunoglobulin gene

6 hrs

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

Immunity to infections of diseases:, Immunology of AIDS; Brief account on Vaccines and toxoids

Module VI

4 hrs

Autoimmune disease and hypersensitivity: Hashimoto's thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia 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. Principle Cellular and Molecular Immunology- Jonathan M Austyn 7 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 Hours of the above courses)

Practical of **BB1371**

Protista and Animal Diversity

18 hrs

Identification and assigning the systematic position of the following specimens:

1. Protozoa - any 4.
2. Porifera - any 2.
3. Coelenterata - any 5.
4. Aschelminthes - any 2.
5. Platyhelminthes - any 4 (adaptations of parasitic forms to be stressed)
6. Annelida - any 4.
7. Minor phyla - any 2.
8. Arthropoda - any 10 (including at least 5 insect pests of paddy/banana plant/stored food grains and 2 beneficial insects).
9. Mollusca - any 8 (including any 2 beneficial and any 2 harmful species).
10. Echinodermata - any 5 (representing one each from five different classes).
11. Prochordates - Ascidia, Branchiostoma (Amphioxus).

12. Pisces - any 8 (including 2 cartilaginous fishes, 2 fishes with accessory respiratory organs, 4 common food fishes).
13. Amphibia - any 3 (representing the orders Apoda, Urodela and Anura).
14. Reptilia - any 5 (including at least one poisonous and one non-poisonous snake of Kerala).
15. Aves - any 3 common birds of Kerala (based on museum specimens or field observations).
16. Mammalia - any 5 (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.

Practical of BB 1372

Animal Physiology and Anatomy

18 hrs

Minor Practicals

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

Major practicals

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

Practical of BB1471

Experiments for Molecular biology Practical

18 Hrs

1. Instruments and equipments 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. Demonstration of PCR

Practical of BB1472

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)

Semester V

Core Course

BB1541 Plant Physiology

Credit 4

Contact Hours 108 (Theory 72 + Practical 36)

Aim: 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 6 hrs Enzymes

1. Structure- coenzymes, cofactor
2. Properties
3. Nomenclature
4. Classification - IUB system
5. Enzyme action
6. Competitive inhibition and non competitive inhibition

Module V 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 VI 12 hrs Respiration

1. Definition and general equation
2. Significance
3. Respiratory substrates
4. Mechanism - Glycolysis, Kerb's 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 VII 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 VIII 4 hrs Translocation of solutes

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

Module IX 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, Kinins, Abscissic acid, Ethylene and their practical applications
6. Photoperiodism
7. Vernalization

Module X

5 hrs

Plant Movements and Stress Physiology

Tropic and nastic movements, Circadian rhythm

General account on Stress physiology(brief study) -

Practicals

36 hrs

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

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. Malic 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 4e, 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 3

Contact hrs 108 (Theory 72+ Practical 36)

Aim and Objective: 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 Thyrus) 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 sexual system
2. Natural - Bentham and Hooker (detailed account)

3 Phylogenetic- Engler and Prantl (Brief account only)

Module -III

7 hrs

Basic rules of Binomial Nomenclature and International Code of Botanical nomenclature (ICBN). Importance of Herbarium, Herbarium techniques and Botanical gardens. A brief account on the modern trends in taxonomy; Chemotaxonomy, Numerical Taxonomy, Cytotaxonomy and Molecular taxonomy

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	16	Acanthaceae
2	Nymphaeaceae	10	Rubiaceae	17	Verbenaceae
3	Malvaceae	11	Asteraceae	18	Amaranthaceae
4	Rutaceae	12	Sapotaceae	19	Euphorbiaceae
5	Anacardiaceae	13	Apocynaceae	20	Orchidaceae
6	Leguminosae	14	Asclepiadiaceae	21	Liliaceae
7	Myrtaceae	15	Solanaceae	22	Arecaceae
8	Cucurbitaceae			23	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.
5. Field trips are to be conducted for three days either as continuous or one day trips.

Suggested Readings

1. Davis, P.H. 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 Angiosperous; 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 Objective: 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:

Tools of recombinant DNA technology- Restriction endonucleases- Classification and general characteristics of Endonucleases; Other enzymes used in the recombinant DNA technique- DNA ligase, Alkaline phosphatase

Module II

15 hrs

Vectors, the vehicle for cloning: Special features needed for a vector, Various types of cloning vectors- plasmid cloning vectors- pBR322, pUC series Bacteriophage cloning vectors -phage λ cloning vectors, M13 based vectors, Phagmids and Cosmid vectors, Yeast Artificial vectors (YACs), Bacterial artificial Vectors (BACs), Application for YAC and BAC, Gene Therapy

Module III 15 hrs Cloning of genes

Host cells, Competent cell preparation, Construction of recombinant DNA, screening and selection of transformed cells. DNA libraries: Genomic libraries and cDNA libraries. Application of genomic libraries and cDNA libraries, Various methods of gene transfer - Direct gene transfer 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 Bar Coding, Nucleic acid sequencing (Maxam and Gilbert method, Sangers method). Gene expression analysis – Southern hybridization, Immuno Blotting, 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 (7th 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 Objective: 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 this aspects.

Module I 6 hrs Introduction to plant tissue culture

Brief history of plant tissue culture. Fundamental principles of *in vitro* plant cultures: use of plant growth regulators, Basic technique of plant tissue culture, components of tissue culture media, preparation and its functions; Sterilization of explants.

Module II 8 hrs Types of *in vitro* cultures

Callus cultures, Cell culture, cell suspension cultures, organ cultures- root cultures, embryo cultures, meristem culture, axillary bud and shoot tip culture, Production of gynogenic and androgenic 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

Embryogenesis and organogenesis -a brief understanding; 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

Transgenic crops, Impact of transgenic plants in agriculture and Horticulture, Non Agricultural applications of transgenic plants- Biopharming- production of therapeutic proteins in transgenic plants, edible vaccines, disease resistant, salt tolerant, pest resistant and stress tolerant crop and medicinal plants

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. Protoplast isolation and culturing – Demonstration
8. Production of artificial seeds (encapsulation method)

Suggested readings

1. An Introduction to Plant Tissue Culture – M K Raxdan; 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 Objective: 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, factorVIII, 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 depended 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 and tissue grafting; 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
4. MTT assay of cells
5. Protein purification by ion exchange chromatography from serum

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

Semester V

Open course for Non –Biotechnology students

BB1581 Bioinformatics

Credits: 2

Contact hours: 54

Aim and Objective: To introduce the subject of bioinformatics to the students of biology. Students should be familiarized to 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

Practicals in Bioinformatics

1. Use of Computers in Biological science- Data base creation, Data base retrieval – Online use of Computational tools.
2. Identification of a given sequence as DNA, RNA or Proteins
3. To analyze the sequence of a given DNA and find out sequence composition
4. To find out the number of times a sequence is repeated in a given DNA sequence
5. To find out the complementary sequence of a given nucleotide sequence

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 V

Open course for Non –Biotechnology students

BB1582 Food & Dairy Biotechnology

Credit 2

Contact hours: 54

Aim and Objective: This course is for non biotechnology students. Students from other disciplines are also can undergo 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 & 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- 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 (2nd Ed)- George J. Banwart, CBS publishers and distributors, New Delhi
6. A modern introduction to food microbiology - Board RC., Blackwell scientific publishers, Oxford.
7. Microbiology (7th Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Open course for Non –Biotechnology students

BB1583 Basics of Environmental Biotechnology

Credits: 2

Contact hours 54

Aim and Objective: This course is aimed to bring an enthusiasm on environmental protection and it should give the contribution of biotechnology techniques to keep the environment clean and healthy. As well it should highlight the economic aspects in the application of biotechnology in protecting the environment from pollution.

Module I 15 hrs Introduction

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 15 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 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 – Spellergerg 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 (7th Ed) Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester VI
Core Course Vocational
BB1671 Food and Industrial Biotechnology

Credits: 4

Contact Hours: 90 (T 54 + P 36)

Aim and Objective: The students will be introduced to the industrial application of Food Biotechnology and Bioprocess technology through this course. Students should be trained to understand commercial importance of biotechnology through its industrial aspects.

Module I

6 hrs

Concepts and development-Microbes in industry- Industrially important microorganisms, screening and isolation; Important industrial fermentation products

Module II 8 hrs Fermentation

The biological process of fermentation- various types of fermentation, alcohol fermentation, scale up of biological reactions in to bioprocess; Bioreactors-types of bioreactors / Fermentors, 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, chemostatic cultures

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

Module IV

10 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- B₁₂, amino acids- Glutamic acid; Organic acid- Citric acid; Beverages- beer; solvents- butanol

Module VI 14 hrs Food Biotechnology

Microorganism in food spoilage, types of spoilage, microbes in the spoilage of canned foods, meat, fish Hazardous effect of food spoilage- food poisoning, mycotoxins; food borne diseases and intoxications. Food preservation- principles of preservation of foods, methods of food preservation:

Dairy Biotechnology-Microbes in dairy industry, contamination, spoilage, dairy products, Pasteurization, Industrial process of cheese making, milk borne diseases.

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 Adamas & 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 (7th Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester VI

Core Course

BB1542 Genetics

Credits 4

Contact Hours: 126(T 90+ P 30)

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

Module: I

Classical Genetics

32 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. Epistasis - Recessive. 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

34 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

20 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- House keeping genes (constitutive genes), Luxury genes (non constitutive genes), interrupted genes (Split genes) - introns, overlapping gene.
6. **Transposable genetic elements-** General account, Characteristic, Transposons (jumping genes), Cellular oncogenes (general account only).

Module IV 4 Hrs Population Genetics

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

Practical

36 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

2. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
3. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New York
4. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
5. Gardner, E.J and Snustad, D.P (1984) Principles of Genetics. John Wiley, New York.
6. Gupta P. K. – Genetics (Rastogi publications).
7. Gupta, P. K. Genetics, Rastogi Publications.
8. John Ringo (2004) Fundamental Genetics. Cambridge University Press India Pvt. Ltd.
9. Lewin, B, (1994) Genes, Oxford University Press, New York.
10. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
11. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
12. Sharma, A.K and Sharma a (1980) Chromosome technique Theory and practice, Aditya Books, New York
13. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, New York.
14. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd
15. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd

Semester VI

Core Course

BB1642 Economic Botany, Ethnobotany & Medicinal Botany

Credit 2

Contact hours 108 (Theory 72 + Practical 36)

Aim and Objective: 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

5 hrs

Economic botany

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

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	
Fibre yielding plant	- Cotton
Dye Yielding plants	- Henna and <i>Bixa orellana</i>
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*, *Cynadon dactylon*, *Ocimum sanctum* and *Trichopus zeylanicus*
5. Ethnobotanic aspect of conservation and management of plant resources
6. Preservation of primeval forests in the form of sacred groves of individual species

Module III

15 hrs

Medicinal botany

1. Importance and the need for its conservation- Sacred groves. Role of ICAR, NMPB. BSI, NBGRI in conservation and cultivation of medicinal plants
2. A general account of the medicinal value of the following plants-Rhizome-*Curcuma* and *Gingiber*; Bulb-*Allium cepa* and *A. sativa*; Root-*Asparagus*, *Hemidesmis*, *Acorus calamus*; *Adhatoda vasica*, *Ctharanthus roseus*, *Phyllanthus amarus*, *Andrographis paniculata*; Leaves-*Aloe vera*, *Centella asiatica* Asoka (*Saraca indica*) and Brahmi (*Bacopa monnieri*) Aswagandha (*Withania somnifera*), Sarpagandha (*Rauvolfia serpentina*)
3. Production of herbal drugs. Extraction procedure-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 and study the cultivation, extraction and its medicinal application.
5. Observe the plants of ethno botanical importance in your area
6. Visit to an Ayurveda college or Ayurvedic

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.11. and Haywood, V.H, 1963. Principles of Angiosperm Taxonomy, Oliver and Royd, 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: 150

Practical of BB1541

Plant Physiology

36 Hrs

1. Water potential of onion peel, Rheo peel by plasmolytic method
2. Separation of plant pigments by paper chromatography Demonstration of the following Experiments
 1. Thistle funnel experiment
 2. Tissue tension
 3. Root Pressure
 4. Suction force due to transpiration
 5. Foliar transpiration by using bell jar
 6. Transpiring surface - 4 leaf experiment
 7. Potometer — Farmer and Ganong's,
 8. Water balance — Relation between transpiration and absorption.
 9. Evolution of oxygen during photosynthesis
 10. Necessity of chlorophyll, CO₂ and light in photosynthesis
 11. Measurement of photosynthesis.
 12. Simple respiroscope

13. Resperometer of R.Q.
14. Anaerobic respiration
15. Fermentation
16. Geotropism and phototropism — Klinostät
17. Hydrotropism
18. Measurement of growth — Arc and Liver Auxonometer

Practical of BB1542

Genetics

42 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.

Practical of BB1641

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

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

8 Cucurbitaceae

23 Poaceae

Practical of BB1642

Economic Botany, Ethanobotany & 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 and study the cultivation, extraction and its medicinal application.
5. Observe the plants of ethno botanical importance in your area
6. Visit to an Ayurveda college or Ayurvedic Research Institute / Hospital

Semester VI

Core Course Vocational

BB1672 Environmental Biotechnology

Credits: 2

Contact hours 72 (T 36 + P 36)

Aim and Objective: This course is aimed to bring an enthusiasm on environmental protection and it should give the contribution of biotechnology techniques to keep the environment clean and healthy. As well it should highlight the economic aspects and bioprocess technology in the application of biotechnology in protecting the environment from pollution.

Module I 4 hrs Introduction

Environment Basic concepts- Atmosphere, hydrosphere, lithosphere, biosphere Scope and 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 – Spellergerg 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 (7th Ed)- Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Semester VI

Elective course for Biotechnology students

BB1681 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

BB1682 Genetic Engineering

Credit 2

Contact hours: 36

Aim and Objective: This course is for non biology or non biotechnology students, who are interested 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

BB1683 Food & Dairy Biotechnology

Credit 2

Contact hours: 54

Aim and Objective: This course is for non biotechnology students. Students from other disciplines are also can undergo 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

Food spoilage and poisoning

15 hrs

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 & 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- 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(2nd 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 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. Protoplast isolation and culturing – Demonstration
8. 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 die exclusion method and cell counting
4. MTT assay of cells

5. Protein purification by ion exchange chromatography from serum

Practical of BB1671

Experiments for Food and 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

University of Kerala

BOTANY & BIOTECHNOLOGY

Model Questions

(For those who joined the course from the academic year 2013 onwards)

**Foundation Courses, Core Courses Complementary Courses and Open
& Elective Courses**

2015
Model Question Papers
Core Course
BOTANY

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

Core Course

BB1141 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. What is 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 chlamyospore.
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 nanrandrous species of *Oedogonium*.
26. Give an account on economic importance of fungi.
27. Discuss the types of thallus organization in chlorophyceae.
28. Compare Ascomycotina 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 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 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 *Polytrichum* stem.
25. Discuss the mechanism of fossil formation.
26. Mention the structure of *Adiantum* 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 Palaeobotany and give an account of the techniques of fossil study.

(15 x 2 = 30 marks)

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

Core Course

BB 1341-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. What are bulliform cells?
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

10. Comment on the types of non-living inclusions in a plant cell.
11. Briefly describe the kinds of vascular arrangements.
12. Point out how the age of a tree is determined?
13. Mention the types of stomata found in plants.
14. Differentiate heart wood and sap wood.
15. Explain the components of periderm.
16. How will you differentiate shoot apex and root apex?
17. Briefly describe the structure of anther wall.
18. Describe the types of pollen aperture.

19. Explain the structure of cambium.
20. Mention any four differences between dicot and monocot leaf.
21. 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.
34. 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 BSc Botany and
Biotechnology
Degree Examination**

Core Course

BB 1241-ENVIRONMENTAL STUDIES

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

10. Comment on the types of abiotic components of an ecosystem.
11. Briefly describe the causes of biodiversity loss.
12. Point out how epiphytes are adapted to thrive in their habitat?
13. Mention the types of trophic levels in an ecosystem.
14. Differentiate environmental hazard and environmental disaster.
15. Explain the significance of mangrove vegetation.
16. What are the types of Forests in India.
17. Comment on the recent ecological issues in Kasargod.
18. Discuss the causes fo global warming.
19. Explain the role of bacteria in ecosystem.

20. Mention any four examples for non-renewable natural resources.
21. 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)

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

- a. Differentiate heterochromatin and euchromatin.
- b. Briefly mention the events during interphase.
- c. What is synaptonemal complex? Mention its significance.
- d. Differentiate paracentric and pericentric inversion.
- e. How autopolyploids differ from allopolyploids?
- f. Why deletions are considered as more deleterious than duplications?
- g. Discuss the type of mutagens used in plant improvement.
- h. What are B chromosomes? How they behave during cell division?
- i. Mention the chemical composition of cell membrane.
- j. What are peroxisomes? Comment on their functions.
- k. Differentiate parallel and convergent evolution.
- l. 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

- m. Write an account on different phases of cell cycle.
- n. How clonal selection differs from other selection methods?
- o. Give an account on micro and macro evolution.
- p. Explain the types of aneuploids and point out their cytological features.
- q. With the help of relevant sketches, outline the events during Prophase I.
- r. Explain the types of isolation mechanisms and point out their evolutionary significance.
- s. Discuss the steps and principles of resistance breeding.
- t. Describe the structure of Lamp brush chromosome. How it differs from a normal chromosome?
- u. Explain Neo-Darwinism.

(4 x 6 = 24 marks)

SECTION - D

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

- v. With the help of diagrams, explain the types of structural aberrations in chromosomes. Point out the evolutionary significance of each.
- w. Explain the various forces operating in evolutionary process. Illustrate with examples and evolutionary principles.
- x. Explain heterosis and mention how is it exploited by plant breeders?
- y. 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.
13. How root pressure influences water movement in plants?
14. Define red drop. How it can be compensated?
 1. Explain the physiology of senescence.
 2. Discuss the concept of florigen.
 3. Briefly describe the relation between OP, TP and WP in plants.
 4. Comment on hydroponics.
 5. Differentiate absorption spectrum and action spectrum.

6. Why fluorescent radiation has higher wavelength than phosphorescent radiation?
7. 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

8. Describe the vital and physical theories explaining ascent of sap.
9. How the principle of Limiting factors apply in photosynthesis?
10. Give an account on coenzymes and cofactors.
11. Explain how the relative day length influences flowering in plants?
12. Discuss the physiological consequences of water stress in plants.
13. Explain the mechanisms of mineral absorption in plants.
14. How anaerobic respiration differs from aerobic in terms of ATP yield?
15. Discuss the mechanism of photorespiration. Enumerate its advantages and disadvantages
16. 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.

17. Discuss the various types of stomata and the mechanisms in stomatal movement.
18. Explain dark reaction and compare the photosynthetic mechanisms in C₃ and CAM plants.
19. Discuss various types of movements exhibited by plants.
20. 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. Mention the names of any two Botanic gardens in Kerala.
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. Define a multiple fruit
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.
11. Compare the gynoecium of Solanaceae and Acanthaceae.
12. Why Annonaceae is placed under Ranales?
13. Point out the economic importance of Rutaceae.
14. Discuss the floral characters of Euphorbiaceae.
15. Briefly mention adnation in solanaceae.
16. Mention the features of scorpioid cyme.
17. What difference do you notice in the corona of Asclepiadaceae and Apocynaceae?
18. What is a syconous?
19. 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 the types of placentation in angiosperms
28. Outline the basics of molecular taxonomy.
29. Why Apiaceae 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 Asteraceae. Discuss its advanced features
33. Give an account on fossil angiosperms. How they help in tracing the origin and evolution of modern Angiosperms?

(15 x 2 = 30 marks)

**Sixth Semester Career Related CBCSS Degree Programme in BSc 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 plasmagones?
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-epistatic 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.
13. Mention any four characters studied by Mendel in *Pisum sativum*.
14. Differentiate multiple alleles and multiple genes.
15. What are holandric genes? Cite an example.
16. What are Complementary genes? Mention how it differs from Mendelian dihybrid ratio.
17. Give two examples for sex chromosomal abnormalities in Man.
18. Discuss the XX-XO mechanism of sex determination.

19. Point out the types of chemical bonds in a DNA molecule.
20. Mention the role of sigma factor.
21. 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 inheritance.
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 a 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 Acupuncture.
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 cereals 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)

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. Each question carries **one** mark
(1 x 10 = 10 Marks)

1. What is Type 1 Error?
2. Mention three applications of MATLAB.
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?

SECTION – B

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

(2 x 8 = 16 Marks)

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?

SECTION – C

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

(4 x 6 = 24 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 4 applications of agricultural biotechnology.
30. Describe the features of IPR.
31. Give an account of Gene therapy.

SECTION – D

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

(2 x 15 = 30 Marks)

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.

**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 x 10 = 10 Marks)

1. Define Beer Lambert's Law
2. What is fluorimetry?
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?

SECTION – B

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

(2 x 8 = 16 Marks)

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.

15. What are the types of molecular interactions? Explain with an example.
16. Explain tracer techniques.
17. Write about heat conservation.
18. What is Gibb's Free Energy?
19. Write about generation and reception of sonic vibration.
20. Give an account of exothermic reactions in biological systems.
21. Differentiate entropy and enthalpy.

SECTION – C

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

(4 x 6 = 24 Marks)

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.

SECTION – D

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

(2 x 15 = 30 Marks)

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. Describe electrophoresis. Give a note on types of electrophoresis

**Thired 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 x 10 = 10 Marks)

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?

SECTION – B

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

(2 x 8 = 16 Marks)

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.

SECTION – C

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

(4 x 6 = 24 Marks)

23. Differentiate Gram positive and Gram negative Cell wall.
24. Summarise 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.

SECTION – D

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

(2 x 15 = 30 Marks)

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 .

**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

- 110 -

SECTION – A

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

(1 x 10 = 10 Marks)

1. What are transposons?
2. Define UTRs.
3. Name the different classes of RNA molecules.
4. Name the scientist who first discovered transposons.
5. Define point mutation.
6. Name the subunits of E.coli RNA Polymerase holoenzyme.
7. Which are the three universal stop codons?
8. Who performed 'Blender Experiment'?
9. What is meant by an operon?
10. What is the function of reverse transcriptase enzyme?

SECTION – B

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

(2 x 8 = 16 Marks)

11. What is foot printing?
12. What are the physical forms of DNA?
13. Compare and contrast eukaryotic and prokaryotic ribosomes.
14. Explain the structure of prokaryotic mRNA.
15. Write a short note on 5'capping in eukaryotic mRNA.

16. What are enhancers and silencers?
17. What is meant by 'Shine Dalgarno' sequence.
18. List out any 4 post translational modifications.
19. How does the primer dependency of DNA Ploymerase is solved in bacteria?
20. What is replicon?
21. Define Promoter. What is the importance of promoters in gene expression?
22. Give the functional components of DNA Pol I.

SECTION – C

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

(4 x 6 = 24 Marks)

23. Describe the features of DNA structure proposed by Watson & Crick.
24. Summarise the steps involved in DNA replication in E.coli.
25. What are the basic steps in RNA synthesis?
26. Explain the need for discontinuous replication.
27. Define Spliceosome. Narrate the process of RNA splicing.
28. Briefly explain regulation of eukaryotic gene expression.
29. Explain the stages of protein synthesis in bacteria.
30. Describe the features and types of transposons with examples.
31. Compare and contrast the structure of gene in prokaryotes and eukaryotes.

SECTION – D

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

(2 x 15 = 30 Marks)

32. Describe the role of enzymes in DNA replication in prokaryotes and eukaryotes.
33. Narrate the molecular organisation of eukaryotic chromosomes.
34. Explain in detail about the Cytoplasmic genome.

Explain the mechanisms of gene regulation on bacteria with examples

**Fourth Semester Career Related CBCSS Degree Programme in BSc 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 x 10 = 10 Marks)

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 adjuvants used for?

SECTION – B

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

(2 x 8 = 16 Marks)

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.

15. What are the types of T cells in cell mediated immunity?
16. Define MHC.
17. Describe the mechanism of agglutination.
18. What is ELISA?
19. What are attenuated vaccines?
20. Explain the principle of RIA?
21. Give the significance of natural killer cells.

SECTION – C

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

(4 x 6 = 24 Marks)

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?

SECTION – D

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

(2 x 15 = 30 Marks)

32. Explain in detail on the production of MAb through Hybridoma 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.

**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 x 10 = 10 Marks)

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?

SECTION – B

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

(2 x 8 = 16 Marks)

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.

SECTION – C

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

(4 x 6 = 24 Marks)

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?

SECTION – D

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

(2 x 15 = 30 Marks)

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.

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

Open Course

BB 1581- 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 x 10 = 10 Marks)

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?

SECTION – B

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

(2 x 8 = 16 Marks)

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.

SECTION – C

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

(4 x 6 = 24 Marks)

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?

SECTION – D

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

(2 x 15 = 30 Marks)

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.

**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 x 10 = 10 Marks)

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?

SECTION – B

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

(2 x 8 = 16 Marks)

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.

- What is downstream processing?
16. What is meant by “solid substrate fermentation”?
 17. What is Lagering?
 18. What are the components of a good fermentation medium?
 19. What are biofuels?
 20. Define Bioremediation?
 21. Give the utility of composting.

SECTION – C

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

(4 x 6 = 24 Marks)

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.

SECTION – D

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

(2 x 15 = 30 Marks)

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.

**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 x 10 = 10 Marks)

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?

SECTION – B

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

(2 x 8 = 16 Marks)

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.

SECTION – C

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

(4 x 6 = 24 Marks)

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.

SECTION – D

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

(2 x 15 = 30 Marks)

32. What is Biobleaching? 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?

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

Elective Course

BB 1682- 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 x 10 = 10 Marks)

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?

SECTION – B

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

(2 x 8 = 16 Marks)

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.

SECTION – C

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

(4 x 6 = 24 Marks)

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?

SECTION – D

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

**(2 x 15 = 30
Marks)**

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.

Model Question Papers
Core Course
BOTANY PRACTICALS

BB 1242-PRACTICAL BOTANY – I

(Practical of BB 1141, BB1241)

**(Phycology, Mycology, Lichenology, Plant Pathology, Environmental science
and Phytogeography)**

Time: 3 hours

Maximum Mark: 80

I. Make a suitable micropreparation of **A, B, and C**. Draw a labelled cellular diagram of each. Identify giving reasons. Leave the preparation for valuation.

(Preparation – 3 marks; Identification - 1 mark; Reasons- 4; Labelled diagram-4

(Total mark 12x3=36)

II. Write critical note on **D**

(Total Mark =1x4=4)

III. Mention the ecological group to which the specimen **E** belongs. Mention its ecological ((Ecological group : 2 mark; Adaptations : 2 marks) **(Total Mark =1x4=4)**

IV. Write the pathological interest of **F**

(Name of disease-1; Causative organism-2; Symptoms-2)

(Total Mark = 5)

V. Locate two phytogeographical region –**G and H** of India in the map provided.

(Total 1x2=2 marks)

VI. Spot at sight , **I, J and K**

(Generic name -1; Part of plant-1; Major group-1)

(Total Mark - 3x 3=9)

(RECORD = 20 Mark (Content – 15 Marks; Neatness – 5 Marks) GRAND TOTAL – 60+20= 80 marks

KEY FOR EXAMINERS

I.A-Ecology-

Hydrophyte//Xerophyte/mentioned in
the syllabus.

B- Macroscopic Algae -mentioned in the
syllabus

C- Fungi -mentioned in syllabus

II. D -Algae / Fungi excluding material given for C

III. E - Ecology - Fresh or preserved specimen or slide (from the centre) – Xerophyte
Hydrophyte/epiphyte/parasite

IV. F –Pathology- /fresh/Herbarium material may be given (as per syllabus)

V. G and H- Phytogeography – Any two phytogeographical regions of
India

VI. I, J,K -Macroscopic specimen from Algae (**I**), Fungi (**J**),Lichen(**K**)

Valuation of Records

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

Record - 20 mark

Core Course

BB 1443 PRACTICAL BOTANY II

(Practical of BB1341, BB1342, BB1441 and BB1442)

**Angiosperm Anatomy, Reproductive Botany, Palynology; Bryology, Pteridology,
Gymnosperms, Palaeobotany; Horticulture, Mushroom cultivation; Cell Biology,
Plant breeding and Evolutionary Biology**

Time: 3 Hours

Total Marks : 80

I. Prepare a Transverse section of material A and identify giving reasons. Draw a labelled diagram.

- Leave the preparation for valuation.
(Preparation – 4 Marks; Identification – 1 Mark; Reasons – 3 Marks, Labelled Diagram – 4 Marks)
 (Total = 12 Marks)
- II Make a suitable micropreparation of **B**. Draw a labelled cellular diagram. Identify giving reasons. Leave the preparation for valuation.
(Preparation – 3 marks; Identification - 1 mark; Reasons- 3; Labelled diagram- 3 marks)
 (Total = 10 Marks)
- III Make an acetocarmine squash preparation of material C. Identify with sketches any two stages of cell division (Metaphase and Anaphase)
(Preparation : 4 Marks;
Identification with reasons : 4 Marks
Labeled Diagram : 4 Marks) (Total = 12 Marks)
- IV/ Demonstrate T budding/ air Layering/grafting / Emasculation using material D. Submit for valuation
Demonstration – 4 Marks
Protocol – 4 Marks (Total = 8 Marks)
- V Write critical notes on E and F
 (Identification = 1 Mark; Notes = 3 Marks)
 (Total 4 x 2 = 8 Marks)
- VI Comment on G. H. I and J
 (Identification = 1 Mark; Comment = 1.5 Marks)
 (Total 2.5 x 4 = 10 Marks)

TOTAL FOR PRACTICALS	=	60 Marks
RECORD	=	20 Marks
GRAND TOTAL	=	80 Marks

KEY TO SPECIMENS

A- Anatomy

Primary structure -

Monocot stem (Grass, *Asparagus*);

Monocot root - *Colocasia*;

Dicot stem- *Hydrocotyle.*, *Eupatorium*

Normal Secondary structure -

Stem - *Vernonia*;

Root - *Tinospora, Ficus, Carica papaya*

Anomalous secondary thickening - *Bignonia, Dracaena, Boerhaavia*

B – Bryophyte/ Pteridophyte/ Gymnosperm

C - Root tips - to be given by the centre

D – Horticulture

E – Palaeobotany (Fossil skide/Diagram)

F – Reproductive Botany (Anther T.S/ Embryo - Dicot or Monocot- Slide or Diagram)

G, H, I, J – Specimen/Digrams/ Photographs- (G - Palynology – pollen types mentioned in syllabus; H – Mushroom; I - Bryophyte//Pteridophyte/Gymnosperm material, not supplied under material B; J -Evolution)

Valuation of Records

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

CORE COURSE

BB-1643- PRACTICAL BOTANY III

(Practical of BB1541, BB1542, BB 1641, 1642)

**Plant Physiology, Angiosperm Morphology and Systematic Botany. Genetics,
Economic Botany, Ethno botany and Medicinal Botany**

Time: 3 Hours

Total Marks: 80

I. Identify and describe the morphological features of A and B.

(Identification: 1 mark; Morphology: 2 marks)

(Total = 3 x 2 = 6 marks)

II. Identify C and D to their respective families with reasons. Write down the systematic position up to series.

[Systematic position with reasons : 2 marks; Family characters (vegetative and floral) :

1.0 + 3.0 = 4.0 marks; Identification of family: 1 mark]

(Total = 7 x 2 = 14 marks)

VI. Give the binomial, family and exact morphology of useful part of H and I.

(Binomial – 1 mark; Family : 1 Mark; Morphology : 1 mark)

(Total = 3 x 2 = 6 marks)

VII. Write the binomial and Ethnobotanical significance of J.

(Binomial : 1 mark; significance : 2 marks)

(Total = 3 marks)

VIII. Identify the herbarium specimens K and L

(Generic name : 1 mark; Family : 1 Mark)

(Total 2.0 x 2 = 4 Marks)

III. Draw a labeled sketch of the L.S of the flower E. Construct a floral diagram and represent its floral formula.

(Labelled sketch : 2.0 marks; Floral diagram : 2.0 marks; Floral formula : 1 mark)

(Total = 5 marks)

IV. Work out Problem F

Explanation : 3 Marks;

Derivation : 3 Marks

(Total = 9 Marks)

Result : 3 Marks)

V. With the help of a labeled diagram, explain the working of the experiment G

Aim : 1 mark

Labelled sketch : 3 marks

Principle and working : 4 marks

(Total = 8 marks)

Record : 20 Marks (Content- 15 marks; Neatness – 5 marks)

Herbarium : 5 Marks

KEY TO SPECIMENS

A and B - Morphology – Inflorescence/ Fruit/ Placentation

C and D - Systematic Botany - Any two Dicot families - Polypetalae/ Gamopetalae /

Monochlamydeae – any one from each group

E - Systematic Botany – (Any dicot flower mentioned in syllabus – Flower and Bud)

F- Genetics-Mendelian Ratios/Incomplete Dominance/Gene interaction

G- Physiology experiment mentioned in the syllabus

H and I- Economic Botany – Direct products (mentioned in the syllabus)

J- Ethno botany – Plants used by Tribes as medicine (As mentioned in syllabus)

K and L- Herbarium sheets

Valuation of Records

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

Model Question Papers
Vocational Core Course
BIOTECHNOLOGY PRACTICALS

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 PRACTICAL

(Practical of BB1171, BB1272,)

Time: 3 hours

Maximum Mark: 80

SECTION A- MAJOR EXPERIMENT

Ia. 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 -5 marks; Protocol – 8 marks; Preparation – 7 marks; Identification- 5 marks

OR

I b) Determine the growth curve of the bacteria/yeast in the given sample A

Procedure – 5 marks; Demonstration -10; Results -5; Graphical representation-5

(Total mark = 25)

SECTION B-MINOR EXPERIMENT

II. a) Demonstrate streak plate method for isolation and colony purification (**B**). (T-streak/Quadrant streak /ZigZag streak)

Principle -5 marks; Procedure – 5 marks; Aseptic Plate handling – 5 marks ; Result- 5marks OR

II. b) Demonstrate the motility of bacteria in sample **B** by the Hanging drop method. Give the procedure

Principle -5 marks; Procedure – 5 marks; Slide Preparation – 5 marks; Result- 5 marks OR

II. b) Determine the morphology of the bacterial sample **B** using methylene blue staining

Principle -5 marks; Procedure – 5 marks; Slide Preparation – 5 marks; Result- 5 marks

(Total Mark = 20)

SECTION C

111) Write critical notes on C, D and E

(Total Mark = 3X5= 15)

RECORD = 20 Marks

GRAND TOTAL – 60+20= 80marks

Time: 3 hours

Maximum Mark: 80

KEY FOR EXAMINERS

I. A- Sample to be provided by centre

II. B- Sample to be provided by centre

III. SECTION C-

C - Durham's tube, Cavity slide, /Tools and instruments: pH meter, Inoculation needle, Hot air oven, Microscope /parts of microscope,

D - Stains/Chemicals- Acid fast, Gram stain, Methylene blue, Nigrosine, Nutrient agar, EMB agar, Potato Dextrose agar, MacConkey Agar, Lactose broth etc.

E - Streak plate, Antibiotic disc, Growth curve graph etc, Spoilage of bread, Bacteriophage, Saccharomyces, Lactobacillus

Valuation of Records

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

Record - 20 marks

Model Question Paper

Complementary Course

BIOCHEMISTRY

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

Complementary Course

BB 1331: Physiological aspects in Biochemistry

Time: 3hours

Maximum Marks: 80

Section I

**(Very Short Answer Type- maximum two
sentences) (Answer all questions)**

(10x1=10 marks)

1. What is Rubisco?
2. Which are the fat soluble vitamins?
3. Name the 3 organelles involved in photorespiration.
4. What are high energy compounds? Give 2 examples
5. Deficiency disease of vit C
6. Name the ions involved in the photolysis of water
7. Which gland secretes gonadotropin
8. What is BMR?
9. Give the name of 4 co- enzymes.
10. What is nitrogenase complex?

Section-II

(Short Answer Questions-not to exceed one paragraph)

Answer any **eight** questions

(8 x 2 = 16 marks)

11. What are the constituents of blood?
12. Give the structure of nephron.
13. Give a note on obesity
14. Explain respiratory acidosis and alkalosis
15. What is hemophilia?
16. What are the functions of calcium?
17. Give the functions and sources of vitamin E
18. What is a photosynthetic unit?
19. What are the constituents of urine?
20. Give a note on jaundice
21. What are functions of adrenalin?
22. What is glucose tolerance test?

Section-III

(Short Essay-not to exceed 120 words)

Answer any **six** questions

(6 x 4 = 24 marks)

23. Write about C4 pathway
24. Discuss liver function tests
25. Write a note on Diabetes
26. Structure and function of Hemoglobin
27. Deficiency diseases of Vit A
28. Explain oxygen dissociation curve
29. Give a note on Atherosclerosis
30. Outline cyclic and non-cyclic photophosphorylation
31. Classification of blood groups

Section-IV

(Long Essay)

Answer any **two** questions

(15 x 2 =30 marks)

32.

Explain Calvin cycle.

33. **Detail blood clotting**
34. **Discuss the formation of various blood cells.**
35. **Coenzyme forms of vitamins with examples of reaction.**