KANNUR UNIVERSITY

(Abstract)

B.Sc.BiotechnologyProgramme-Scheme, Syllabus and Pattern of Question Papers of Core, Complementary Elective and Generic Elective Course under Choice Based Credit and Semester System (Outcome Based Education System-OBE) in Affiliated colleges with effect from 2019 Admission-Implemented-Orders issued.

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Academic Branch

No.Acad.C2/13051/2019 Civil Station P.ODated 21/06/2019

Read:- 1. U.O.No.Acad.C2/429/2017 dated 10-10-2017
2. The Minutes of the Meeting of the Curriculum Restructuring Committee held on 28-12-2018.
3. U.O No. Acad.C2/429/2017 Vol.II dated 03-06-2019
4. The Minutes of the Meeting of the Board of Studies in Biotechnology (Cd) held on 07/06/2019
5. Syllabus of B.Sc. Biotechnology Programme Submitted by the Chairperson, Board of Studies in Biotechnology (Cd) dated 20/06/2019

ORDER

1. A Curriculum Restructuring Committee was constituted in the University vide the paper read (1) above to co-ordinate the activities of the Syllabus Revision of UG programmes in Affiliated colleges of the University.

2. The meeting of the Members of the Curriculum Restructuring Committee and the Chairpersons of different Boards of Studies held, vide the paper read (2) above, proposed the different phases of Syllabus Revision processes such as conducting the meeting of various Boards of Studies , Workshops and discussion.

3. The Revised Regulation for UG programmes in Affiliated colleges under Choice Based Credit and Semester System (in OBE-Outcome Based Education System) was implemented with effect from 2019 Admission as per paper read (3) above.

4. Subsequently, as per paper read (4) above, the Board of Studies in Biotechnology (Cd) finalized the Scheme, Syllabus & Pattern of Question Paper for Core, Complementary Elective & Generic Elective Course of B.Sc. Biotechnology Programme to be implemented with effect from 2019 Admission.

5. As per paper read (5) above, the Chairperson, Board of Studies in Biotechnology (Cd) submitted the finalized copy of the Scheme, Syllabus & Pattern of Question Papers of B.Sc. Biotechnology Programme for implementation with effect from 2019 Admission.

6. The Vice Chancellor after considering the matter in detail and in exercise of the powers of the Academic Council conferred under Section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with accorded sanction to implement the Scheme, Syllabus & Pattern of Question Paper(Core/Complementary Elective/Generic Elective Course) of B.Sc. Biotechnology Programme under Choice Based Credit and Semester System(in OBE-Outcome Based Education System) in the Affiliated colleges under the University with effect from 2019 Admission, subject to reporting before the Academic Council.

7. The Scheme, Syllabus & Pattern of Question Paper of B.Sc. Biotechnology Programme are uploaded in the University website (www.kannuruniversity.ac.in)

Orders are issued accordingly.

Sd/-
DEPUTY REGISTRAR (ACADEMIC)
For REGISTRAR

To

The Principals of Colleges offering B.Sc. Biotechnology Programme

Copy to: -
1. The Examination Branch (through PA to CE)
2. The Chairperson, Board of Studies in Biotechnology (Cd)
3. PS to VC/PA to PVC/PA to Registrar
4. DR/AR-I, Academic
5. The Computer Programmer (for uploading in the website)
6. SF/DF/FC

Forwarded/By Order

SECTION OFFICER

KANNUR UNIVERSITY * CIVIL STATION P.O. KANNUR Pin-670 002 * THAVAKKARA

KANNUR UNIVERSITY

BOARD OF STUDIES, BIOTECHNOLOGY (Cd)

SYLLABUS

OF CORE COURSES (INCLUDING GENERAL AWARENESS COURSES) FOR

B.Sc. BIOTECHNOLOGY PROGRAMME

AND

BIOTECHNOLOGY COMPLEMENTARY ELECTIVE COURSES AND GENERIC ELECTIVE COURSES FOR OTHER DEPARTMENTS

CHOICE BASED CREDIT AND SEMESTER SYSTEM

(2019 ADMISSION ONWARDS)

KANNUR UNIVERSITY

VISION AND MISSION STATEMENTS

Vision: To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasargode and Kannur Revenue Districts and the Manandavady Taluk of Wayanad Revenue District.

Mission:

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher educationand to cater to the modern notions of equity, social justice and merit in all educational endeavors.
- To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative and infrastructural standards in such institutions.
- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as non-governmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

KANNUR UNIVERSITY
PROGRAMME OUTCOMES (PO)

PO 1. Critical Thinking:

1.1. Acquire the ability to apply the basic tenets of logic and science to thoughts, actions and interventions.
1.2. Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.
1.3 Develop self-critical abilities and also the ability to view positions, problems and social issues from plural perspectives.

PO 2. Effective Citizenship:

2.1. Learn to participate in nation building by adhering to the principles of sovereignty of the nation, socialism, secularism, democracy and the values that guide a republic.
2.2. Develop and practice gender sensitive attitudes, environmental awareness, empathetic social awareness about various kinds of marginalisation and the ability to understand and resist various kinds of discriminations.
2.3. Internalise certain highlights of the nation's and region's history. Especially of the freedom movement, the renaissance within native societies and the project of modernisation of the post-colonial society.

PO 3. Effective Communication:

3.1. Acquire the ability to speak, write, read and listen clearly in person and through electronic media in both English and in one Modern Indian Language
3.2. Learn to articulate, analyse, synthesise, and evaluate ideas and situations in a well-informed manner.
3.3. Generate hypotheses and articulate assent or dissent by employing both reason and creative thinking.

PO 4. Interdisciplinarity:

4.1. Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.
4.2. Understand the issues of environmental contexts and sustainable development as a basic interdisciplinary concern of all disciplines.
4.3. Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective.

PREFACE

Bachelor of Science in Biotechnology is a three-year undergraduate program offered under the choice-based credit semester system. The whole program is divided into six semesters, with about five month's duration for each semester. The curriculum has been revised in tune with the concept of 'Outcome Based Education'. Outcome Based Education is an approach, in which decisions about the curriculum and instruction are driven by the learning outcome. 'Learning outcome' is the ability the students are expected to acquire at the end of a program or a course. The syllabus of the B.Sc. Biotechnology program has been designed to give a basic understanding of Biotechnology, a fast-developing interdisciplinary area in Science. It is revised after evaluating the existing syllabus and in consultation with teachers who are experts and well experienced in the subject.

A number of courses are offered within the B.Sc. Biotechnology program. The syllabus of each course has been divided into a number of instructional units. The program specific outcome and course outcomes are explicitly stated in the syllabus. There are four types of courses offered: common courses, core courses, complementary elective courses and generic elective courses. Details such as the semester in which the course is offered, credit for the course, books for study/reference and the pattern of evaluation are also given in the syllabus.

Chairperson
Board of Studies, Biotechnology (Cd)
Kannur University

Kannur University

Programme Specific Outcomes of B.Sc. Biotechnology Programme

PSO1	Understand the organization, structure and functions of living cells, cell organelles, biological macromolecules and interaction of organism with its surroundings.
PSO2	Understand the genes, heredity, flow of genetic information and reaction pathways in biological system.
PSO3	Understand the methods of modification of genes and biological macromolecules and large scale production of useful products by making use of cell/tissue culture, microbes, plants and animals.
PSO4	Perform laboratory experiments that help to understand the biological processes, manipulation and the production and isolation of useful products.

INDEX

KANNUR UNIVERSITY

B. SC. BIOTECHCOLOGY PROGRAMME

WORK AND CREDIT DISTRIBUTION STATEMENT

	Courses	Credit	Total
Common Courses (including Ability Enhancement and Skill Enhancement Courses)	English	4+3+4+3	14
	Additional language	4+4	8
	General Awareness Courses	4+4+4+4	16
Core Courses	Biotechnology		56
Complementary Elective Courses	Biochemistry Microbiology	2+2+2+2+4 2+2+2+2+4	24
Generic Elective Courses		2	2
			120

Semester	**Course Title***	**Credits**	**Marks**	**Hours per week**	**Total Credits**	**Total Hours**
I	COMMON ENGLISH COURSE 1	4	50	5	19	25
	COMMON ENGLISH COURSE II	3	50	4		
	ADDITIONAL LANGUAGE COURSE I	4	50	4		
	COMPLEMENTARY ELECTIVE COURSE: BIOCHEMISTRY COURSE I	2	50	4		
	COMPLEMENTARY ELECTIVE COURSE: MICROBIOLOGY COURSE I	2	50	4		
	CORE COURSE I	4	50	4		
II	COMMON ENGLISH COURSE III	4	50	5	19	25
	COMMON ENGLISH COURSE IV	3	50	4		
	ADDITIONAL LANGUAGE COURSE II	4	50	4		
	COMPLEMENTARY ELECTIVE COURSE: BIOCHEMISTRY COURSE II	2	50	4		
	COMPLEMENTARY ELECTIVE COURSE: MICROBIOLOGY COURSE II	2	50	4		
	CORE COURSE II	4	50	4		
III	GENERAL AWARENESS COURSE I	4	50	4	19	25
	GENERAL AWARENESS COURSE II	4	50	4		
	COMPLEMENTARY ELECTIVE COURSE: BIOCHEMISTRY COURSE III	2	50	3		
	COMPLEMENTARY ELECTIVE COURSE: BIOCHEMISTRY - PRACTICAL		**	2		
	COMPLEMENTARY ELECTIVE COURSE: MICROBIOLOGY COURSE III	2	50	3		
	COMPLEMENTARY ELECTIVE COURSE:		**	2		

	MICROBIOLOGY - PRACTICAL					
	CORE COURSE III	3	50	3		
	CORE COURSE IV (PRACTICAL)	4	50	4		
IV	GENERAL AWARENESS COURSE III	4	50	4	27	25
	GENERAL AWARENESS COURSE IV	4	50	4		
	COMPLEMENTARY ELECTIVE COURSE: BIOCHEMISTRY COURSE IV	2	50	3		
	COMPLEMENTARY ELECTIVE COURSE: BIOCHEMISTRY- PRACTICAL	4	50	2		
	COMPLEMENTARY ELECTIVE COURSE: MICROBIOLOGY COURSE IV	2	50	3		
	COMPLEMENTARY ELECTIVE COURSE: MICROBIOLOGY- PRACTICAL	4	50	2		
	CORE COURSE V	3	50	3		
	CORE COURSE VI (PRACTICAL)	4	50	4		
V	CORE COURSE VII	3	50	5	18	25
	CORE COURSE VIII	3	50	4		
	CORE COURSE IX	3	50	5		
	CORE COURSE X	3	50	4		
	CORE COURSE XI (PRACTICAL)	4	50	5		
	GENERIC ELECTIVE COURSE	2	25	2		
VI	CORE COURSE XII	3	50	4	18	25
	CORE COURSE XIII	3	50	4		
	CORE COURSE XIV	3	50	4		
	CORE COURSE XV	3	50	4		
	CORE COURSE XVI (PRACTICAL)	4	50	5		
	CORE COURSE XVII (PROJECT)	2	50	4		
	Total				120	150

** Complementary elective course practical examinations may be conducted at the end of 4th semester

First Complementary Elective: BIOCHEMISTRY

Second Complementary Elective: MICROBIOLOGY

PART A:

CORE COURSES AND GENERAL AWARENESS COURSES
WORK AND CREDIT DISTRIBUTION

(2019 ADMISSION ONWARDS)

COURSE CODE	COURSE TITLE	SEMESTER	HOURS PER WEEK	CREDIT	EXAM HRS	MARKS
1B01BTC	CELL BIOLOGY	I	4	4	3	50
2B02BTC	GENETICS	II	4	4	3	50
3A01BTC	BIOPHYSICS (GENARAL AWARENESS COURSE)	III	4	4	3	50
3A02BTC	BASIC CONCEPTS OF ECOLOGY (GENERAL AWARENESS COURSE)	III	4	4	3	50
3B03BTC	IMMUNOLOGY	III	3	3	3	50
3B04BTC	BIOTECHNOLOGY PRACTICAL I	III	4	4	3	50
4A03BTC	BIOSTATISTICS (GENERAL AWARENESS COURSE)	IV	4	4	3	50
4A04BTC	BIOINFORMATICS (GENERAL AWARENESS COURSE)	IV	4	4	3	50
4B05BTC	MOLECULAR BIOLOGY	IV	3	3	3	50
4B06BTC	BIOTECHNOLOGY PRACTICAL II	IV	4	4	3	50
5B07BTC	ANIMAL PHYSIOLOGY	V	5	3	3	50
5B08BTC	PLANT PHYSIOLOGY	V	4	3	3	50
5B09BTC	GENETIC ENGINEERING	V	5	3	3	50
5B10BTC	PLANT BIOTECHNOLOGY	V	4	3	3	50
5B11BTC	BIOTECHNOLOGY PRACTICAL III	V	5	4	3	50
6B12BTC	ANIMAL CELL BIOTECHNOLOGY	VI	4	3	3	50
6B13BTC	INDUSTRIAL BIOTECHNOLOGY	VI	4	3	3	50

6B14BTC	ENVIRONMENTAL BIOTECHNOLOGY	VI	4	3	3	50
6B15BTC	DEVELOPMENTAL BIOLOGY	VI	4	3	3	50
6B16BTC	BIOTECHNOLOGY PRACTICAL IV	VI	5	4	3	50
6B17BTC	PROJECT	VI	4	2	-	50

EVALUATION

ASSESSMENT	WEIGHTAGE
EXTERNAL	4
INTERNAL	1

CONTINUOUS INTERNAL ASSESSMENT (FOR THEORY)

COMPONENT	WEIGHTAGE	REMARKS
PERIODIC CLASS TESTS	60%	MINIMUM TWO CLASS TESTS AND AVERAGE OF THE BEST TWO
ASSIGNEMENT /SEMINAR	40%	ASSIGNEMENT OR SEMINAR (SAME CRITERIA SHOULD BE APPLIED UNIFORMLY TO ALL STUDENTS IN THE CLASS)

(FOR PRACTICAL)

COMPONENT	WEIGHTAGE
LAB INVOLVEMENT	50%
INTERNAL TESTS	30%
RECORD	20%

CORE COURSE I : CELL BIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	1B01BTC	4	4	3

COURSE OUTCOME

CO1	Understand the theories of origin of life and cell as the basic unit of life
CO2	Understand different cell types and levels of organization
CO3	Understand the structure and functions of cell membrane
CO4	Understand the structure and functions of various cell organelles
CO5	Understand the chromosome organization and the types
CO6	Understand about cell division, locomotion and apoptosis

Unit I

Cell as a basic unit of life- cell theory - general organization of cell – origin of life (8 hrs)

Unit II

Broad classification of cell types- PPLOs, bacteria, eukaryotic microbes, plant and animal cells – cell, tissue, organ and organism as different levels of organization. (10 hrs)

Unit III

Ultra structure of cell membrane - unit membrane model, fluid mosaicmodel - functions of cell membrane - passive and active transport,cytoplasmic matrix – properties. (12 hrs)

Unit IV

Structure and functions of cell organelles - Golgi bodies, endoplasmicreticulum (smooth and rough), mitochondria, chloroplast, lysosome,peroxisome, cytoskeletal structures - (actin, microtubules), ribosome,nucleus(nuclear membrane, nucleoplasm, nucleolus, chromatin) (16 hrs)

Unit V

Chromosome structure, organization of chromatin, nucleosome model,nucleoproteins - histone and non histone, special types of chromosome -salivary gland chromosome and lamp brush chromosomes. (12 hrs)

Unit VI

Cell cycle and cell division - mitosis and meiosis - significance, cell locomotion (amoeboid, flagellar and ciliar), apoptosis (brief account) . (14 hrs)

Book for study

1. Cytology,Verma P S and Agarwal V.K,1999, S. Chand Publications,New Delhi
2.Cell Biology and molecular biology, N Arumugam, 2002, Saras publications, Kanyakumari

Books for Reference:

1. Cell and molecular biology- Concepts and experiments. Gerald Karp.John Wiley and sons. Inc.
2. Molecular biology of the Gene. James D Watson, Tania A Baker, StephenP Bell, Alexander Gann, Michael Levine, Richard Losick. PearsonEducation.
3. Genes IX. Benjamin Lewin. Jones and Bartlett Publishers.
4. Molecular cell biology. Lodish, Berk, Matsudara, Kaiser, Krieger, Scott,Zipursky, Darnell. W H Freeman& Co. New York.

Marks including choice:

Unit	Marks
I	4
II	4
III	10
IV	20
V	10
VI	12

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE II : GENETICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	2B02BTC	4	4	3

COURSE OUTCOME

CO1	Understand the Mendelian Laws of Inheritance and its modifications.
CO2	Understand the concept of Inter-genetic interactions and atavism.
CO3	Understand the phenomenon of Multiple alleles.
CO4	Understand Linkage and Crossing over
CO5	Understand the inheritance of sex linked genes and extrachromosomal inheritance.
CO6	Understand numerical and structural chromosomal aberrations.
CO7	Understand the concept of population genetics.

Unit I

Mendel's work – selection of experimental plant, procedure, experimental observations and results, monohybrid and di-hybrid crosses, law of segregation, law of independent assortment, back cross, test cross. Modification of mono-hybrid and di-hybrid ratio – incomplete, dominance, co-dominance, lethality, penetrance – complete and incomplete penetrance, expressivity, pleiotropism, polygenetic effect (12 hrs)

Unit II

Inter genetic interactions – epistasis – dominant epistasis, recessive epistasis, duplicate genes with cumulative effect, complementary genes, atavism or reversion. (10 hrs)

Unit III

Multiple allelism – examples coat colour in rabbits, blood group inheritance in man (ABO and Rh-antigen) (6 hrs)

Unit IV

Linkage and crossing over - complete and incomplete linkage, linkage groups, significance of linkage, factors affecting crossing over, two point cross, three point cross, linkage map. (14 hrs)

Unit V

Sex linked genes and its inheritance, inheritance of XY linked genes, X- linked genes, Y-linked genes, sex limited genes, sex influenced genes. Extra chromosomal inheritance in mitochondria and chloroplast (12 hrs)

Unit VI

Numerical and structural chromosomal aberrations – euploidy, aneuploidy, non-disjunction in autosomes and sex chromosomes (example from humans) (10 hrs)

Unit VII

Population genetics – hardy-Weinberg equilibrium, gene frequencies and genotype frequencies (8 hrs)

Books for study:

1. Genetics, P.S.verma and V.K.Agarwal, S.Chand publishers.
2. CellbiologyMolecularbiologyandGenetics - K. VijayakumaranNair, M. Jayaprakash.

Books for References:

1. Genetics-BenjaminA. Pierce.
2. Genetics from genes to genomes, Leland H. Hartwell et al., Mc Graw Hill.
3. Genetics, Monroe W. Strickberger, Prentice Hall of India.
4. Principles of Genetics, Sinnot, E.W., Dunn, LC and Dobzhansky.
5. Principles of Genetics, Gardner, E.J. and Snustad, D.P. John Wiley.

Marks including choice:

Unit	Marks
I	8
II	8
III	5
IV	10
V	10
VI	9
VII	10

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

GENERAL AWARENESS COURSE I: BIOPHYSICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3A01BTC	4	4	3

COURSE OUTCOME

CO1	Understand the concept of surface tension, diffusion, adsorption, osmosis and dialysis and their application to biological system.
CO2	Understand the concept of thermodynamics and chemical kinetics.
CO3	Understand the structural and bioelectric properties of cell membranes.
CO4	Understand the structural aspects of nucleic acids and supercoiling of DNA.
CO5	Understand the structural hierarchy of proteins and DNA-protein interactions.

Unit I

Introduction to Biophysics : Biological importance of surface tension, diffusion, adsorption, colloids and dialysis, Osmosis - osmotic pressure, iso-, hypo- & hypertonic solutions and their influence on cell. (15 hrs)

Unit II

Thermodynamics & Chemical kinetics: Open, closed & isolated system. Laws of thermodynamics, thermodynamic equilibrium, concept of enthalpy, entropy & free energy. Chemical kinetics - rate, order and molecularity of reactions, energy of activation. (10 hrs)

Unit III

Structure of biological membrane: Fluid mosaic model, modern membrane theories, membrane transport - active & passive, bioelectric property of cell membranes. (12 hrs)

Unit IV

Structure of nucleic acid: Components of DNA, nucleotide and nucleoside, Watson-Crick, Hoogsteen & Reverse Hoogsteen base pairing, Double helical structure of DNA, Watson-Crick model, triplex and quadruplex DNA, Structural polymorphism, DNA super coiling, Secondary and tertiary structure of t-RNA. (20 hrs)

Unit V

Structural hierarchy of proteins - Primary, secondary, tertiary and quaternary structures. Irregular and random structures in proteins, motifs and domains. DNA - Protein interactions. (15 hrs)

Books for study

1.Lehninger- Principles of Biochemistry.
2. Roy R.N-Textbook of Biophysics.
3. Narayana.P- Principles of Biophysics

Books for reference

1. Thomas E Creighton-The Biophysical Chemistry of Nucleic acids and Proteins
2. Biophysical chemistry - James P Allen

Marks including choice:

Unit	Marks
I	10
II	8
III	14
IV	16
V	12

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

GENERAL AWARENESS COURSE II: BASIC CONCEPTS OF ECOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3A02BTC	4	4	3

COURSE OUTCOME

CO 1	Understand biotic and abiotic factors affecting the distribution and abundance of species
CO 2	Understand the concepts of habitat and niche
CO 3	Understand the types of species interactions and their consequences for population dynamics
CO 4	Understand ecological succession
CO 5	Understand the concept of climax
CO 6	Understand population characteristics and regulation
CO 7	Understand the structure and function of ecosystem
CO 8	Understand the energy flow and biogeochemical cycle

Unit I
Basic concepts-definition, scope and significance of ecology; environment and its components, abiotic factors, edaphic factors, biotic factors- interspecific interactions. (14 hrs)

Unit II
Habitat and Niche- concept, ecotone and edge effect, factor compensation and ecotypes, ecological indicators, ecological successions- types and process of successions, concept of climax. (14 hrs)

Unit III
Population ecology- characteristics, population dynamics, dispersion and population regulation, life history strategies (r and K selection), concept of metapopulation. (14 hrs)

Unit IV
Ecosystem-structure and function, energy flow, ecological pyramids, biogeochemical cycles (C,N,O,S and P), aquatic and terrestrial ecosystem-biomes. (16 hrs)

Unit V
Conservation biology-principles of conservation, major approaches to management, studies on conservation- Project Tiger, Biosphere reserve. (14 hrs)

Books for study

1. Verma PS, Agarwal VK., Cell Biology, genetics, molecular biology, evolution and ecology, 1996, S Chand and Company Ltd.

2. Sharma PD., Ecology and Environment, 1990, Rastogi Publications, Meerut.

3. N Arumugam, Concepts of ecology, 2000,Saras Publications, Kanyakumari.

4. H D Kumar General ecology,2002,Vikas publishing house ,New Delhi.

Books for Reference

1. Chapman JL., Reiss MJ., Ecology: Principles and Applications, 2nd Edition, CambridgeUniversity press.

2. Clarke GI., Elements of Ecology, 1954, Wiley, New York.

3. Odum EP., Fundamentals of Ecology, 1971, WB Saunders Company, Philadelphia.

4. Stiling Peter D., Ecology : Theories and Applications, 4th edition, 2002, Prentice Hall.

Marks including choice:

Unit	Marks
I	8
II	15
III	15
IV	10
V	12

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE III: IMMUNOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3B03BTC	3	3	3

COURSE OUTCOME

CO1	Understand the organs of immune system and their functions
CO2	Understand types of immunity. Innate, acquired, passive, active, natural, induced, humoral and cell mediated immunity
CO3	Understand the structure, function and classification of antigen and antibody and interaction between them.
CO4	Understand mechanism of cell-mediated immunity and complement pathways.
CO5	Understand types of hypersensitivity reactions
CO6	Understand concept of autoimmunity, transplantation antigen, tumor antigen and vaccines

Unit I

Historical perspective, cells and organs of immune system and their functions. (8 hrs)

Unit II

Types of immunity – innate immunity – components of innate immunity, adaptive or acquired immunity – passive and active immunity – natural and induced, humoral and cell mediated immunity. primary and secondary humoral immune response. (12 hrs)

Unit III

Antigen – nature of antigen - factors affecting immunity, epitopes, haptens. Antibody – structure, classification, antigen-antibody interactions – forces involved, functions of antibody- inflammatory response, antibody mediated opsonization, ADCC.Monoclonal and polyclonal antibodies, production and applications of monoclonal antibodies. (14 hrs)

Unit IV

Cell mediated immunity – MHC molecules, antigen processing and presentation – different pathways. complement activation – pathways –cell lysis, opsonization, immune clearance (10 hrs)

Unit V

Hypersensitivity reactions, autoimmunity, transplantation (brief account), tumor antigen (brief account), vaccines. (10 hrs)

Books for Study:

1.Immunology, Richard A. et al., Kuby, W.H. Freeman and company
2.Immunology, Tizard, Thomson publishers

Books for Reference:

1. Immunology, Roitt, Brostoff, Male, Mosb
2. Medical immunology, Tristram G. Parslow et al., Mc Graw Hill

Marks including choice:

Unit	Marks
I	12
II	10
III	13
IV	12
V	13

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE IV: BIOTECHNOLOGY PRACTICAL I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3B04BTC	4	4	3

COURSE OUTCOME

CO1	Understand the technique of cell size measurement
CO2	Understand different stages in mitosis and meiosis
CO3	Understand Polytene chromosome and Barr body
CO4	Understand the human karyotype
CO5	Understand the chromosomal aberrations
CO6	Understand Dihybrid cross, Incomplete dominance and Multiple allelism using genetic problems
CO7	Apply the principle of Beer Lambert's law

1. Microscopy
2. Micrometry – calibration of ocular micrometer, cell size measurement
3. Identification of Polytene chromosome
4. Demonstration of Barr body
5. Mitosis
6. Meiosis
7. Study of human karyotype
8. Chromosomal aberrations
9. Understand Di-hybrid cross, Incomplete dominance and Multiple allelism using genetic problems
10. Verification of Beer Lambert's law

Books for Study:

1. Cell Biology, Molecular Biology and Genetics – Vijayakumaran Nair
2. Roy. RN - Textbook of Biophysics.

Books for Reference:

1. Cell and Molecular Biology- Concepts and experiments – Gerald Karp – John Wiley and Sons. Inc
2. Molecular Biology of the Gene. James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine and Richard Losick – Pearson Education

Pattern of questions (Model)

Time: 3hrs **Maximum marks: 40**

1.	Perform mitosis from root tip and identify the stages	(10 marks)
2.	Measure diameter of the given specimen using micrometer	(6 marks)
3.	Identify Barr body by preparing buccal epithelial smear	(6 marks)
4.	Solve the given genetic problems	(4 marks)
5.	Identify and write short notes on the given spotters	(4 x 2 = 8 marks)
6.	Viva-Voce	(3 marks)
7.	Record	(3 marks)

GENERAL AWARENESS COURSE III: BIOSTATISTICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4A03BTC	4	4	3

COURSE OUTCOME

CO1	Understand the classification of statistical data, concept of population and sample and various approaches used in sampling.
CO2	Understand the classification, tabulation and presentation of data.
CO3	Understand different measures of central tendency.
CO4	Understand different measures of dispersion.
CO5	Understand different types of correlation and methods to calculate them.
CO6	Understand Tests of significance.
CO7	Understand the concept of probability.

Unit I

Data : Types of data - primary and secondary data, qualitative and quantitative data, grouped and ungrouped data, discrete and continuous data. Sources of data, collection of data, population and sample, sampling - random and non-random sampling. (12 hrs)

Unit II

Presentation of data : Classification and tabulation of data, tables - different types. Graphical and diagrammatic representation of data - bar diagram, pie diagram, pictogram, histogram, frequency polygon, frequency curve, line chart, stem and leaf diagram, Frequency distribution - frequency table, relative and cumulative frequency distribution, cumulative frequency table - less than and more than cumulative series. . (14 hrs)

Unit III

Measures of central tendency : Mean - arithmetic mean, geometric mean, harmonic mean, Median, Mode - method of calculation for grouped and ungrouped data, normal distribution curve - symmetric and asymmetric, kurtosis and skewness. . (12 hrs)

Unit IV

Measures of dispersion : Absolute and relative measures - range, quartile deviation, mean deviation, standard deviation, variance, coefficient of variation, standard error (with examples from grouped and ungrouped data) (12 hrs)

Unit V

Correlation : Bivariate data, types of correlation between variables, scatter diagram, Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient. (8 hrs)

Unit VI

Test of significance : t-test, Z-test, test for goodness of fit - chi-square test. (7 hrs)

Unit VII

Probability : random experiment, sample space, events - elementary event, compound event, equally likely events, mutually exclusive events, exhaustive events, dependent and independent events. Addition and Multiplication Laws of probability. (7 hrs)

Books for study:

1. Fundamentals of biostatistics, Khan and Khanum - Gupta S.C. and V.K. Kapoor. Ukaaz publications.
2. Anintroductiontobiostatistics- N.Gurumani. 2002, MJP Publishers.
3. An introduction to statistical methods, C.B.Gupta and Vijay Gupta. Vikram publishing house pvt. Ltd.

Books for Reference:

1. Principles of biostatistics, Pagano M. & Kimberley G. Duxbury Press
2. Statistical methods in biology, Bailey N.T.J. Cambridge Uni. press
3. Biostatistical analysis, Zar, J.H. Pearson Education

Marks including choice:

Unit	Marks
I	8
II	10
III	10
IV	9
V	7
VI	8
VII	8

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)

- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)

- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)

- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

GENERAL AWARENESS COURSE IV: BIOINFORMATICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4A04BTC	4	4	3

COURSE OUTCOME

CO1	Understand the importance, scope and uses of bioinformatics.
CO2	Understand the major biological databases and bioinformatics tools
CO3	Understand the concept of similarity and homology and methods of sequence alignment.
CO4	Understand brief history, goals and significance of Human Genome Project
CO5	Understand genomics and proteomics at introductory level.

Unit I:
Introduction to bioinformatics : Brief history, Importance and uses of bioinformatics, Biological data, Biological data acquisition, Types of DNA sequences, Sequence to structure relationships. (14 hrs)

Unit II:
Biological Databases : Sequence databases and Structure databases,Primary, secondary and composite databases, General overview of NCBI, GenBank, DDBJ, EMBL, PIR, SWISS PROT, PROSITE, PFAM, CATH, SCOP, PDB, GDB, SGD, KEGG. Bioinformatics tools - BLAST and FASTA. (20 hrs)

Unit III:
Sequence Similarity Searches: Measurement of sequence similarity, Similarity and homology. Sequence alignment, Methods of Sequence Alignment, Pairwise sequence alignment - Global and Local alignment, Multiple Sequence alignment (MSA) - Clustal W, Clustal X. (20 hrs)

Unit IV:
Human genome project : History, nucleic acids, genes, genomes, introduction and need of human genome project (HGP), goals of the HGP, contribution of various countries, National Human Genome Research Institute (NHGRI), rough and final draft of human genome project. Overview of genomics and proteomics. Nucleic acid sequencing and Protein sequencing. (18 hrs)

Books for Study:

1. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery- S.C. Rastogi, N. Mendiratta, P. Rastogi. 2004, PHI Learning.

2. Informatics Bioinformatics - K. Vijayakumaran Nair. 2015, Academia.

3. Basic Bioinformatics, S. Ignacimuthu.2005, Alpha Science International.

Books for Reference:

1. Introduction to bioinformatics - T.K. Altwood, D.J. Parry-Smith and S. Phukan.
2. Bioinformatics: Sequence and genome analysis, David W. Mount.
3. Bioinformatics: Genes, Proteins, and Computers, C.A. Orengo, D.T. Jones and J.M. Thornton.

Marks including choice:

Unit	Marks
I	8
II	20
III	14
IV	18

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)

- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)

- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)

- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE V: MOLECULAR BIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4B05BTC	3	3	3

COURSE OUTCOME

CO1	Understand the structure of Nucleic acids (DNA and RNA)
CO2	Understand the mechanism of DNA replication and repair
CO3	Understand the mechanism of transcription and post transcriptional modification
CO4	Understand the mechanism of translation
CO5	Understand the principles of gene regulation in prokaryotes and eukaryotes

Unit I

Evidences for DNA as the Genetic Material (Griffith, Avery, Lederberg and Hershey-Chase experiments). Nucleic acids – DNA and RNA. Structure of Nucleic acids- Nucleosides and Nucleotides – DNA double helix. tRNA, mRNA and rRNA.. (12 hrs)

Unit II

DNA replication: Semi conservative DNA replication – The Meselson-Stahl experiment – DNA polymerases- Molecular mechanism of DNA replication in prokaryotes – DNA replication in Eukaryotes.DNA repair: Mismatch repair – Repair of thymidine dimmers- Light induced repair – Excision repair – Recombination repair- SOS repair. (16 hrs)

Unit III

Transcription in Prokaryotes: Initiation, elongation and termination. Prokaryotic promoter structure and RNA polymerase. Transcription in eukaryotes: 5' capping, polyadenylation and mRNA splicing. Transcription of ribosomal RNAs and transfer RNAs. . (10 hrs)

Unit IV

Translation in prokaryotes and eukaryotes: Aminoacylation of tRNA, formation of initiation complex, elongation and elongation factors and termination. . (8 hrs)

Unit V

Regulation of gene expression in prokaryotes – Operons – negative and positive control – lac operon. Chromatin activity and gene regulation in eukaryotes . . (8 hrs)

Books for study

1. Genetics A Conceptual Approach: Benjamin A Pierce. W.H. Freeman
1. iGenetics – A molecular Approach: Peter J. Russell. Pearson education

Books for references

1. Molecular Biology of the Gene – James D Watson, Tania A Baker, Stephen P Bell, Alaxander Gann, Michael Levine, Richard Losick. Pearson education
2. Genes IX- Benjamin Lewin. Jones and Bartlett Publishers.

Marks including choice:

Unit	Marks
I	8
II	14
III	13
IV	10
V	15

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)

- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)

- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)

- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE VI : - BIOTECHNOLOGY PRACTICAL II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4B06BTC	4	4	3

COURSE OUTCOME

CO1	Understand the organs of immune system
CO2	Understand different types of WBCs
CO3	Understand the blood grouping technique
CO4	Understand ELISA technique
CO5	Understand Radial Immunodiffusion technique
CO6	Understand the running SDS-PAGE and agarose gel electrophoresis
CO7	Apply the principle of spectrophotometric quantitation of DNA &
CO8	Understand the methodology of RNA extraction from plant

1. Study of permanent slides of organs of immune system
2. Blood smear to study different WBCs
3. Blood grouping using antiserum A, B and Rh
4. Enzyme linked immunoassay
5. Radial immunodiffusion
6. Protein extraction from serum
7. SDS-PAGE of proteins
8. Isolation of DNA from plant
9. Spectrophotometric quantitation of DNA
10. Agarose gel electrophoresis of DNA
11. RNA isolation from Plant
12. Analysis of water and soil

Books for Study:

1. Gene cloning and DNA analysis. T.A Brown. Balckwell publishing
2. Practical Biotechnology- S Janarthanan & S Vincent

Books for Reference:

1 Molecular cloning Vol 1-3. Sambrook and Russell, CSHL press
2 Recombinant DNA. James D. Watson, Scientific American Books

Pattern of questions (Model)

Time: 3hrs **Maximum marks: 40**

1. Prepare a stained blood smear and identify any two types of WBCs (10 marks)
2. Isolate Genomic DNA from the given sample. Write the principle and procedure (10 marks)
3. Conduct Radial Immunodiffusion of the given antigen samples. (8 marks)
4. Identify and comment on the following spotted items A,B, and C (3 x 2 = 6 marks)
5. Viva-Voce (3 marks)
6. Record (3 marks)

CORE COURSE VII : ANIMAL PHYSIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B07BTC	5	3	3

COURSE OUTCOME

CO1	Understand the mechanism of muscle contraction
CO2	Understand the mechanism of gas exchange during respiration
CO3	Understand the structure and function of circulatory system
CO4	Understand the concept of homeostasis and nephron structure
CO5	Understand the concept of sensory receptors and their mode of action
CO6	Understand the structure of neuron and mechanism of impulse transmission
CO7	Understand the classification and mode of action of hormones
CO8	Understand concept of major human endocrine glands and mechanism of endocrine control

Unit I

Molecular basis of muscle contraction- Energetics of muscle contraction - Vertebrate muscle types- neuronal control of muscle. (10 hrs)

Unit II

Respiration-Fundamentals of gas exchange- respiratory pigments- structure, biological properties, functions, O2 and CO2 transport. Factors that determine oxygen binding to haemoglobin-PO2, pH, temperature, DPG level. (12 hrs)

Unit III

Blood vascular system-structure and function, closed and open circulatory system, mechanism of blood circulation in man-peripheral circulation, microcirculation and capillary function, haemodynamics, cardiac rhythms ,factors modifying cardiac rhythm-mechanical, chemical, thermal, nervous. (16 hrs)

Unit IV

Homeostasis-regulation of body fluid composition in invertebrates and vertebrates, renal function- ultra filtration, absorption, secretion, plasma clearance, counter current mechanism- counter current multiplier, factors regulating homeostasis. (14 hrs)

Unit V

Sensory receptors - visual systems, mechanoreceptors, proprioceptors, hearing, chemoreceptor, olfactory receptors. Cutaneous receptors – touch, pressure, pain & thermal. (12 hrs)

Unit VI

Nervous system-Synapses, electrically mediated transmission and chemical transmission, synaptic potential, synaptic polarity. (10 hrs)

Unit VII

Endocrinology-Introduction- Classification of hormones based on chemical nature (peptides and proteins, amino acid derivatives and steroid hormones) and their mode of

action with examples. Major human endocrine glands (pituitary, adrenal, pineal, thyroid, parathyroid and pancreas), their hormones and disorders. Neuroendocrine secretions, regulation of endocrine factors – hypothalamus, hypophysial axis, feedback mechanisms. (16 hrs)

Books for Study:

1. Rastogi S.C.-Essentials of Animal Physiology-New Age International Publications.
2. N Arumugam - Animal Physiology, Saras Publications.

Books for Reference:

1. Guyton and Hall-Textbook of Medical Physiology-Elsevier.
2. Richard W. Hill, Gordan A.Wyse-Animal Physiology-Harper and Row Publishers, New York.
3. William F. Ganong - Review of Medical Physiology, International edition-The Mc Graw-Hill Companies

Marks including choice:

Unit	Marks
I	12
II	6
III	7
IV	8
V	6
VI	9
VII	12

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)

- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)

- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)

- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE VIII: PLANT PHYSIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B08BTC	4	3	3

COURSE OUTCOME

CO1	Understand the concept of plant-water relations
CO2	Understand nutrient requirement of plants and it's assimilation
CO3	Understand the physiological effects of phytohormones and mechanism of plant movement
CO4	Understand the concept of phytochrome ,vernalization and biological clock
CO5	Understand the physiology of seed and bud dormancy and its significance
CO6	Understand the effect of stressful conditions on plant growth

Unit I

Plant - Water relations, Diffusion and Osmosis, Water potential, Absorption of water, transpiration pull and ascent of sap. Transpiration and its significance. Factors affecting transpiration. Mechanism of stomatal movement (13hrs)

Unit II

Essential, non- essential, macro and micro elements, brief account only; Assimilation of Mineral Nutrients -Transport of ions across cell membranes, passive absorption and active absorption; Translocation in the phloem: Structure-function relationship for the translocation of photo- assimilates from source to sink cells. (10 hrs)

Unit III

Patterns of plant growth, growth kinetics and measurement of growth. Plant growth regulators – physiological functions of Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid - Plant movements: Nastic movements, Tropisms-Phototropism, Gravitropism (16 hrs)

Unit IV

Photo morphogenesis- Structure, function and mechanisms of action of phytochrome, crypto chromes and phototropism; photoperiodism and vernalization; Biological clocks. (15 hrs)

Unit V

Dormancy - Seed longevity and germination, seed dormancy, methods of breaking seed dormancy, bud dormancy. (5 hrs)

Unit VI

Stress physiology-Introduction to stress, types of stress, stress resistance, effects of stress, drought stress, salt stress, temperature stress. (13 hrs)

Books for study:

1. Dr. Jain V.K.-Fundamentals of Plant Physiology, Revised edition-S. Chand &

Company Pvt. Ltd.

2. Verma S.K., Mohit Verma-A textbook of Plant Physiology, Biochemistry and Biotechnology-S. Chand & Company Ltd.

3. G.Ray Noggle& George J.Fritz-Introductory plant physiology

Books for reference

1. Salisbury, F.B., Ross C.Plant Physiology-Wordsworth Pub, California.

2. Teiz and Zeiger-Plant Physiology, Sinaeur Associates Inc. Pub, Sundeland

3. William.G.Hopkins & Norman.P.A.Huner-Introduction to plant physiology, IVth edition

Marks including choice:

Unit	Marks
1	10
II	10
III	10
IV	10
V	10
VI	10

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE IX: GENETIC ENGINEERING

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B09BTC	5	3	3

COURSE OUTCOME

CO1	Understand the methodology of isolation and purification of genomic DNA from Bacteria, Plant and Animal cells and plasmid DNA
CO2	Understand the mechanism of different enzymes used in genetic engineering, identification of transformants and recombinants, types of vectors and construction of genomic and cDNA libraries.
CO3	Understand the principle and types of PCR and DNA sequencing method.
CO4	Understand the application of recombinant DNA in medicine and forensic science.
CO5	Understand the application of genetic engineering in plants and animal.

Unit I

Isolation and purification of genomic DNA from Bacteria, Plant and Animal cells.Isolation of plasmid DNA.Extraction of RNA and mRNA purification.Electrophoresis of DNA. Southern blotting and hybridization. (16 hrs)

Unit II

Enzymes involved in genetic engineering: Nucleases, Restriction endonucleases, Ligases and polymerases. Cloning vectors: Plasmid vectors, Phage vectors and Cosmids. Expression vectors. Introduction of DNA into living cells: Transformation – identification of transformants and recombinants. Genomic and cDNA libraries, Identification of the desired clone. (20 hrs)

Unit III

Polymerase Chain Reaction (PCR) – Principle of PCR and types- Applications of PCR. DNA sequencing methods- Chain termination and chemical degradation method. Automated DNA sequencing. (18 hrs)

Unit IV

Recombinant DNA in medicine: production of recombinant insulin, human growth hormones, factor VIII, monoclonal antibodies and recombinant vaccines. DNA fingerprinting in forensic science. (16 hrs)

Unit V

Genetic engineering in plants: Agrobacterium mediated gene transfer and direct gene transfer methods. Plant selectable markers and reporter genes. Applications of plant genetic engineering in crop improvement. Genetic engineering in animals: Gene transfer methods in animals, gene cloning vectors. Transgenic animal models. (20 hrs)

Books for study

1 Gene cloning and DNA analysis. T.A Brown. Balckwell publishing
2 Molecular Biotechnology. Bernard R.Glick, ASM press

3. Gene Biotechnology, S N Jogdand, Himalaya Publications.

Books for References:

1. Recombinant DNA. James D. Watson, Scientific American Books
2. Molecular cloning Vol 1-3. Sambrook and Russell, CSHL press
3. Principles of gene manipulatins and Genomics. S.B Primrose and R.M Twyman, Balckwell publishing.

Marks including choice:

Unit	Marks
I	6
II	16
III	12
IV	14
V	12

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)

- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)

- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)

- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE X: PLANT BIOTECHNOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B10BTC	4	3	3

COURSE OUTCOME

CO1	Understand the basic principles of plant tissue culture
CO2	Understand the types and significance of callus culture
CO3	Understand the principles and applications of organogenesis and somatic embryogenesis
CO4	Understand the types of organ culture
CO5	Understand the production and applications of haploid and triploid plants
CO6	Understand protoplast culture and somatic hybridization
CO7	Understand plant genetic transformation and terminator gene technology

Unit I

Introduction to plant Biotechnology: History and development, totipotency, nutritional medium- components of media . (8 hrs)

Unit II

Callus culture: Types of callus, significance, organogenesis, somatic embryogenesis and artificial seed. Somaclonal variation and its application- cell suspension culture . (12 hrs)

Unit III

Organ culture: Types of organ culture-root culture, shoot tip culture, ovary and ovule culture, embryo culture and embryo rescue . (11 hrs)

Unit IV

Production of haploid plants: Anther and pollen culture, significance and production of triploids. Endosperm culture- In-vitro pollination and cryopreservation . (15 hrs)

Unit V

Protoplast culture: protoplast isolation, protoplast fusion, somatic hybridization and its applications – Hybrid and cybrid . (10 hrs)

Unit VI

Plant genetic manipulation: Gene transfer methods- Electroporation, liposome mediated and Biolistics - Agrobacterium mediated genetic transformation. Organization of Ti plasmid ,Ti plasmid derived vector system. Terminator gene technology (16 hrs)

Books for study

1. Plant cell and tissue culture,Kalyan Kumar De
2. Biotechnology ,Sathyanarayana
3. Biotechnology B D Singh,kalyani Publishers

Books for Reference:

1. Introduction to Plant Biotechnology,H S Chawla,Science Publishers
2. Introduction to plant tissue culture ,M.K Razdan.

Marks including choice:

Unit	Marks
I	4
II	10
III	10
IV	11
V	12
VI	13

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

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CORE COURSE XI : BIOTECHNOLOGY PRACTICAL III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B11BTC	5	4	3

COURSE OUTCOME

CO1	Understand plant tissue culture media preparation, sterilization and inoculation
CO2	Understand callus induction from different explants like leaf, node, shoot tip
CO3	Understand direct organogenesis and seed culture & Apply cell suspension culture
CO4	Apply the methodology of DNA isolation from Bacteria
CO5	Apply the principle of plasmid DNA isolation and isolation RNA from liver
CO6	Apply DNA manipulative tools like restriction digestion and DNA ligation
CO7	Understand the technique of Polymerase Chain Reaction (PCR)
CO8	Understand the role of light on seed germination & ploidy level of plants

1. Plant tissue culture media preparation – MS media
2. Explant selection, sterilization and inoculation
3. Callus induction from leaf, node, shoot tip
4. Direct organogenesis
5. Seed culture
6. Cell suspension culture
7. Artificial seed
8. Hardening of regenerated plant
9. DNA isolation from Bacteria
10. RNA isolation from liver
11. Plasmid isolation
12. Restriction digestion
13. DNA ligation
14. Transformation
15. Polymerase Chain Reaction (PCR) – Demonstration
16. Dry weight analysis
17. Role of light on seed germination
18. Clinostat
19. Determination of ploidy level of plants

Books for Study:

1. Plant tissue culture-kalyan kumar de
2. Plant Biotechnology A Laboratory Manual- H. S. Chawla
3. Laboratory Manual for Genetic Engineering. S John Vennison

Books for Reference:

1. Salisbury, F.B., Ross C.Plant Physiology-Wordsworth Pub, California.

Pattern of questions (Model)

Time: 3hrs **Maximum Marks: 40**

1. Inoculate the given explants and explain. Write the principle and procedure (10 marks)
2. Perform agarose gel electrophoresis of the given sample and write the principle and procedure (10 marks)
3. Prepare synthetic seed by encapsulation procedure (6 marks)
4. Identify and comment on the following spotted items A, B, C, & D (4x 2=8 marks)
5. Viva-Voce (3 marks)
6. Record (3 marks)

CORE COURSE XII : ANIMAL CELL BIOTECHNOLGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B12BTC	4	3	3

COURSE OUTCOME

CO1	Understand the basics of animal cell culture
CO2	Understand animal tissue culture media preparation
CO3	Understanding establishment of animal cell culture
CO4	Understand the use of bioreactors for large scale culture of animal cells
CO5	Understand the method of production of recombinant products
CO6	Understand the principles of transgenesis and animal cloning

Unit I

History and development of animal cell culture: Laboratory Set up for Animal cell culture; equipments and materials for animal cell culture technology . (6 hrs)

Unit II

Culture media for animal cell culture: Physico - chemical properties of culture media- Balanced salt solutions – Natural and artificial media. . (10 hrs)

Unit III

Primary culture: Disaggregation – mechanical and enzymatic – Cell lines definite and continuous/transformed cell lines, their origin and characteristics. Growth kinetics of cells in culture . (15 hrs)

Unit IV

Cell synchronization- Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, NGF and Interleukins etc.). Bioreactors for large scale culture of cell. (8 hrs)

Unit V

Applications of animal cell culture- Expression of cloned proteins in animal cells (Insulin, growth hormones, interferon and t-plasminogen activator). Cell culture based production of vaccines and monoclonal antibodies . (16 hrs)

Unit VI

Animal cloning: Gene transfer methods- Transgenic animals and production of useful products from transgenic animals. Transgenic animals as models for human diseases. Xeno-transplantation; Somatic cell nuclear transfer; Ethics of animal cloning. (17 hrs)

Books for study

1. Animal Biotechnology-Recent Concepts to Development; P.Ramadas, MJP Publishers
2. Biotechnology,B D Singh,2012,Kalyani Publishers, Ludhiyana

Books for Reference:

1 Culture of Animal Cells-A Manual of basic Technique; R.Ian Freshny; John Wiley and Sons, Inc., Publication.

2 Animal Cell Biotechnology-Methods and Protocols; Edited by Nigel Jenkins, Humana Press, Totowa, New Jersey

Marks including choice:

Unit	Marks
I	4
II	4
III	10
IV	10
V	12
VI	20

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)

- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)

- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)

- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE XIII : INDUSTRIAL BIOTECHNOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B13BTC	4	3	3

COURSE OUTCOME

CO1	Understand basic principles and types of fermentation and bioreactors
CO2	Understand processing stages involved in industrial fermentation
CO3	Understand technique of immobilization of cells and enzymes.
CO4	Understand large scale production of acids, vitamins, antibiotics and SCP
CO5	Understand the production of fermented food products
CO6	Understand food preservation principles and food manufacturing practices

Unit I

Introduction to bioprocess engineering: Basic principles of fermentation- Types of fermentation processes, analysis of batch, fed batch and continuous fermentations. Bioreactors - Design and types of bioreactors. Measurement and control of bioprocess parameters (aeration, pH, temperature and dissolved oxygen) . (18 hrs)

Unit II

Isolation, preservation and maintenance of industrial microorganisms. Strain improvement. Media for industrial fermentation - Media sterilization. Downstream processing. (18 hrs)

Unit III

Enzyme and whole cell immobilization and their industrial applications - Microbial production of enzymes (bacterial and fungal amylase) – Biosensors. (8 hrs)

Unit IV

Industrial production of acids (citric and acetic acid), antibiotics (Penicillin G), vitamins(B12)and SCP. Probiotics and Prebiotics. (8 hrs)

Unit V

Food and Beverage Biotechnology: Fermented food: fermented milk products - cheese, butter, and yoghurt, fermented vegetables – sauerkraut. Wines and different types of wines - factors affecting wine production. Brewing- steps involved in Beer production. Distilled liquors (brandy, rum, whisky, vodka). (15 hrs)

Unit VI

Food hygiene- Food sanitation, food manufacturing practice and Hazard Analysis Critical Control Points (HACCP). FSSAI. (5 hrs)

Books for study:

1. Industrial microbiology. A H Patel. MacMillian.
2. Industrial microbiology. Prescott and Dunn. A V I Publishing Co USA.
3. Industrial Microbiology. L E Casida. AGE International Publications.
4. Industrial Biotechnology-Problems and Remedies.Indu Shekhar Thakur

Books for References:

1. Microbial Biotechnology. Fundamentals of applied microbiology. Alexander N Glazer, Hiroshi Nikalido. Cambridge Univ. Press.
2. Principles of fermentation technology. Stanbury PF, A Whitaker and S J Hall. Pergmon Press

Marks including choice:

Unit	Marks
I	12
II	12
III	11
IV	9
V	11
VI	5

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE XIV : ENVIRONMENTAL BIOTECHNOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B14BTC	4	3	3

COURSE OUTCOME

CO1	Understand various environmental resources available.
CO2	Understand different types of pollution, its effects in various systems
CO3	Understand biological management of environment
CO4	Understand nitrogen fixation and how they can be regulated
CO5	Understand the production of natural fibers

Unit I

Renewable and non-renewable resources - Conventional fuels and their environmental impacts; Firewood, Plant and animal waste, Coal, Gas, Animal oil Modern fuels and their environmental impacts; Biogas, Biohydrogen, Biodiesel, Ethanol, Plant based petroleum industry (16 hrs)

Unit II

Environmental pollution-air and water pollution-source, type and effects of pollution on human beings and plants-Global environmental problems (green house effect, acid rain, ozone depletion) (13 hrs)

UNIT III

Environmental management - air, water and soil quality management Social forestry, Bioremediation, Bioleaching, Biomonitoring, biopesticides - Thuringiensis toxin as a natural pesticide. . (13 hrs)

Unit IV

Nitrogen fixation: Symbiotic and asymbiotic Nitrogen fixing systems Leghaemoglobin and Nitrogen fixation in nature. Nitrogenase structure and chemical properties - Nif gene – organization - regulation of nif expression - nif LA operon. Plasmid mediated engineering for nitrogen fixation. Biofertilizers. (16 hrs)

Unit V

Biotechnological inputs in producing good quality natural fibers - wool, cotton and silk; Disaster Management: Natural Disasters, Hazardous Material Spill/Release.. (14 hrs)

Books for study:

1. Agarwal S.K-Environmental Biotechnology-S B Nangia for APH Publishing Corporation.

2. Sharma P.D-Ecology and Environment-Rastogi Publications.

Books for References:

1. Santra S.C-Environmental Science-NewCentralBook Agency (P) Ltd.

2, Dr Raghavan Namibia .K-Textbook of Environmental Studies-SCITECH publications.

3. Odum-Fundementals of Ecology.

Marks including choice:

Unit	Marks
I	16
II	12
III	10
IV	12
V	10

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE XV: DEVELOPMENTAL BIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B15BTC	4	3	3

COURSE OUTCOME

CO1	Understand the reproduction and reproductive parts of plants
CO2	Understand the sexual reproduction in animals
CO3	Understand the cellular changes in the zygote and post fertilization events
CO4	Understand the gene expression and differentiation in zygote
CO5	Understand the molecular level changes occurring in zygote

Unit I

Plant development: Microsporangium – microsporogenesis and male gametophyte, pollen structure, palynology. Megasporangium - megasporogenesis and female gametophyte, structure of female embryo sac. Pollination. Fertilization – pollen pistil interaction, double fertilization, triple fusion. Embryo structure – dicot and monocot, endosperm. Polyembryony, apomixes, parthenocarpy, parthenogenesis. (18 hrs)

Unit II

Animal development: Gametogenesis; oogenesis and spermatogenesis, structure of ovum and sperm. Fertilization – mechanism of fertilization; recognition of egg and sperm, acrosome reaction, cortical reaction, activation of egg metabolism, fusion of genetic material, rearrangement of egg cytoplasm. Cleavage – types of cleavage based on planes (meridional, vertical, Equatorial and Latitudinal), based on amount of yolk (Holoblastic & Meroblastic), based on devt. (Determinate & Indeterminate) and based on Pattern (Radial & Spiral). Blastulation- types of blastula. . (13 hrs)

Unit III

Gastrulation – major events of gastrulation, formative or morphogenetic movements, initiation of chemo differentiation, chemical changes during gastrulation, nuclear activation during gastrulation. Neurulation, neurogenesis, notogenesis and mesogenesis. Flexion of embryo, morphogenesis, histogenesis and organogenesis. Growth – protoplasmic or sub cellular growth, types of growth. Differentiation – cyto-differentiation. . (13 hrs)

Unit IV

Concepts in development – nucleocytoplasmic interactions in development, cell-cell communication in development – induction, competence, instructive and permissive interactions, epithelial mesenchymal interactions, paracrine factors, cell surface receptors and their signal transduction (brief account).. (14 hrs)

Unit V

Cell differentiation and differential gene expression, levels of differentiation, stem cells, role of microenvironment in differentiation, gradient and polarity, origin of anterior-posterior polarity, dorso-ventral polarity (eg. Drosophila). . (14 hrs)

Books for study:

1. Chordate Embryology – Developmental Biology, P.S.Verma and V.K.Agarwal, S.chand

Publishers
2. The Embryology of Angiosperms, S.S.Bhojwani and S.P.Bhatnagar
3. Introduction to Embryology of Angiosperms, Maheswari, P.

Books for References:

1. Developmental Biology, Scott F. Gilbert, Sinauer Associates, Inc. Publishers
2. Embryology, Mitchell, Elsevier

Marks including choice:

Unit	Marks
I	15
II	10
III	9
IV	13
V	13

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

CORE COURSE XVI : BIOTECHNOLOGY PRACTICAL IV

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B16BTC	5	4	3

COURSE OUTCOME

CO1	Apply the principle of fermentation for the production of Wine, Yoghurt, Cheese and Sauerkraut
CO2	Determine the quality of water
CO2	Understand the method of isolation of Rizhobium from root nodules
CO3	Apply Industrial biotechnology for the production of biopesticides and biofertlizers
CO4	Understand embryo dissection and mounting
CO5	Understand Hemocytometry
CO6	Understand WBC count
CO7	Understand RBC count
CO8	Understand the estimation of hemoglobin by hemoglobinometer and osmotic hemolysis

1. Production and characterization of wine
2. Production of cheese
3. Production of sauerkraut
4. Production of yoghurt
5. Determination of BOD of water sample by Winklers method
6. Microbial analysis of waste water
7. Isolation of Rizhobium from legume root
8. Production of biopesticides
9. Production of biofertlizers
10. Embryo dissection and mounting – tridax
11. Identification of CS of mature anther, dicot and monocot embryos
12. Pollen grains of Hibiscus, Balsum and Datura
13. Observation of permanent slides of blastula and gastrula
14. Hemocytometry
15. Differential WBC count
16. Enumeration of total WBC
17. Enumeration of total RBC
18. Estimation of hemoglobin by hemoglobinometer
19. Demonstration of osmotic hemolysis

Books for study

1. Alcamos Laboratory Fundamentals of Microbiology, Jeffrey C Pommerville
2. Microbiology: A Laboratory Manual, Cappucino
3. Rastogi S.C.-Essentials of Animal Physiology-New Age International Publication

Books for reference

1. Developmental Biology, Scott F. Gilbert, Sinauer Associates, Inc. Publishers

Agarwal S K- Environmental Biotechnology- S B Nangia for APH Publishing Corporation.

Pattern of questions (Model)

Time: 3hrs **Maximum Marks: 40**

1. Estimate the amount of dissolved oxygen in the given water sample by Winklers method (15 marks)
2. Estimate the acid content in the given wine sample (10 marks)
3. Separate embryo from the given flower (3 marks)
4. Identify and comment on the following spotted items A, B & C (3x 2=6 marks)
5. Viva-Voce (3 marks)
6. Record (3 marks)

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CORE COURSE XVII: PROJECT WORK

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B17BTC	4	2	

Carry out a small research project on any topic related to Biotechnology and submit a brief dissertation at the end of 6th semester.

Evaluation of the Project

(Maximum marks 50)

Continuous Evaluation of the Project (20% of Total) (Maximum marks 10)

COMPONENT	WEIGHTAGE
ORGANIZATION OF WORK	30%
USE OF DATA	20%
PUNCTUALITY	20%
VIVA VOCE	30%

End Semester Evaluation of the Project (80% of Total) (Maximum marks 40)

COMPONENT	WEIGHTAGE
RELEVANCE OF TOPIC/ METHODOLOGY	20%
PRESENTATION/ ANALYSIS/FINDINGS	30%
VIVA VOCE	50%

PART B:

BIOTECHNOLOGY COMPLEMENTARY ELECTIVE COURSES

[FOR ---------- PROGRAMME(S)]

WORK AND CREDIT DISTRIBUTION

(2019 ADMISSION ONWARDS)

COURSE CODE	COURSE TITLE	SEMESTER	HOURS PER WEEK	CREDIT	EXAM HOURS
1C01BTC	ENVIRONMENTAL BIOTECHNOLOGY	I	4	2	3
2C02BTC	FOOD BIOTECHNOLOGY	II	4	2	3
3C03BTC	PLANT BIOTECHNOLOGY I	III	3	2	3
4C05BTC	BIOTECHNOLOGY PRACTICAL (PART 1)	III	2	-	**
4C04BTC	PLANT BIOTECHNOLOGY II	IV	3	2	3
4C05BTC	BIOTECHNOLOGY PRACTICAL (PART 2)	IV	2	4	3

** Practical examination (part 1 and part 2 together) shall be conducted at the end of 4th semester. The total credit for practical is 4.

EVALUATION

ASSESSMENT	WEIGHTAGE
EXTERNAL	4
INTERNAL	1

CONTINUOUS INTERNAL ASSESSMENT (FOR THEORY)

COMPONENT	WEIGHTAGE	REMARKS
PERIODIC CLASS TESTS	60%	MINIMUM TWO CLASS TESTS AND AVERAGE OF THE BEST TWO
ASSIGNEMENT /SEMINAR	40%	ASSIGNEMENT OR SEMINAR (SAME CRITERIA SHOULD BE APPLIED UNIFORMLY TO ALL STUDENTS IN THE CLASS)

(FOR PRACTICAL)

COMPONENT	WEIGHTAGE	REMARKS
LAB INVOLVEMENT	50%	
PERIODIC EXAMINATIONS	30%	
OBSERVATION NOTE	20%	

COMPLEMENTARY ELECTIVE COURSE I:
ENVIRONMENTAL BIOTECHNOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	1C01BTC	4	2	3

COURSE OUTCOME

CO1	Understand different types of pollution and its effect on various systems
CO2	Understand the waste management systems . Understand the treatment of solid and liquid waste.
CO3	Understand various biodegradation and bioremediation processes.
CO4	Understand biological extraction methods of oil and metals.
CO5	Understand nitrogen fixation and how they can be regulated.
CO6	Understand natural disasters and their causes and effects.

Unit I

Pollution - Different types of pollution- air, water, and land. Environmental impacts of pollution - green house effects, acid rain, ozone depletion and UV radiation. (12 hrs)

Unit II

Sewage treatment process - small scale and large scale process- Primary, secondary and tertiary treatment.Solid waste disposal methods - sanitary landfills, composting, vermicomposting and biogas production. (15 hrs)

Unit III

Biodegradation of xenobiotics, Bioremediation- insitu and exsitu bioremediation, biostimulation, bioaugmentation and phytoremediation.(12 hrs)

Unit IV

Bioresources - biodiesel, bioethanol, bioplastics. Oil recovery process, Bioleaching method. (10 hrs)

Unit V

Biofertilizers – types. Nitrogen fixation - symbiotics and non symbiotics using mycorrhiza. Biopesticides - Bacillus thuringensis and Baculovirus . (15 hrs)

Unit VI

Natural disasters-Tsunami, Floods, Earthquakes, Landslides- Cause and Effects. (8 hrs)

Books for Study:

1. Environmental Science and Biotechnology: Theory and techniques; A.G.Murugesan, C.Rajakumari; MJP Publishers.
2. Biotechnology, U Satyanarayanan,2015,Books and Allied(P) Ltd.
3. S N Jogdand, Environmental Biotechnology,2012,Himalaya Publishing House (P)Ltd.

Books for Reference:

1. Environmental Biotechnology; Alan Scragg; OxfordUniversity Press.
2. Environmental Biotechnology; M.H.Fulekar; Oxford & IBH Publishing Co. Pvt. Ltd.
3. Fundamentals Of Ecology, Eugene P Odum, NatrajPublishers,Dehradun.

Marks including choice:

Unit	Marks
I	9
II	10
III	8
IV	10
V	15
VI	8

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

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COMPLEMENTARY ELECTIVE COURSE II:
FOOD BIOTECHNOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	2C02BTC	4	2	3

COURSE OUTCOME

CO1	Understand the concept of fermentation and its type.
CO2	Understand the production of fermented beverages
CO3	Understand the production of fermented food and SCP.
CO4	Understand the principle of food preservation and food preservation techniques.
CO5	Understand food spoilage and food borne illness and HACCP.

Unit I

History and scope of food fermentation, Primary and secondary fermentation. Fermented beverages-Wines and different types of wines - factors affecting wine production. Brewing-steps involved in Beer production. Distilled liquors (whisky, brandy, rum, vodka). (18 hrs)

Unit II

Fermented food: fermented milk products - cheese, butter, and yoghurt, fermented vegetables - sauerkraut. Bread and other indigenous fermented foods (Idly). Yeast as food and fodder. Single cell protein - spirullina. (18 hrs)

Unit III

Principles of food preservation: Maintenance of anaerobic condition - high temperature and low temperature storage, drying, food additives, chemicals, irradiation and Pascalization. Preservation of milk, meat, fish, fruits and vegetables. (18 hrs)

Unit IV

Food spoilage: Risk factors associated with food borne illness. Spoilage of milk, canned food, fruits and vegetables. Food manufacturing practice and Hazard Analysis Critical Control Points (HACCP). (18 hrs)

Books for study

1. Industrial microbiology. A H Patel. MacMillian.
2. Bioprocess technology. P T Kalaichelvan, I ArunPandi. MJP publishers.
3. Food Biotechnology-S.N Tripathy - Dominant pub

Books For References:

1. Microbial Biotechnology. Fundamentals of applied microbiology. Alexander N Glazer, Hiroshi Nikalido. Cambridge University Press.
2. Principles of fermentation technology. Stanbury PF, A Whitaker and S J Hall. Pergmon Press
3. Fermentation microbiology and biotechnology. E M T. E I- Mansi, C F A Bryee, A L Demain and A R Allman.
4. Industrial microbiology. Prescott and Dunn. A V I Publishing Co USA.
5. Biotechnology. A textbook of Industrial Microbiology. WulfCrueger and AnneliesCrueger. Panima Publishing Co.
6. Industrial Microbiology. L E Casida. AGE International Publications.
7. Industrial Microbiology: An Introduction. Michael J Waites, Neil L Morgan, John S Rockey, Gary Higton. Blackwell science.

Marks including choice:

Unit	Marks
I	17
II	13
III	15
IV	15

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)

- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)

- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)

- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

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COMPLEMENTARY ELECTIVE COURSE III:
PLANT BIOTECHNOLOGY I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3C03BTC	3	2	3

COURSE OUTCOME

CO1	Understand the role of different growth regulators and media constituents in plant growth and development.
CO2	Understand the basic techniques organogenesis, single cell culture and protoplast culture.
CO3	Understand the production of haploids, triploids and protoplast culture.
CO4	Understand morphological, physiological and somaclonal variations. Understand the conservation of endangered plant species through germplasm conservation and cryopreservation
CO5	Understand the application of tissue culture in developing transgenic plants.

Unit I

Introduction to plant biotechnology: History and development of plant biotechnology, Totipotency, Nutritional medium- media components, growth hormones, types of media. Tissue culture lab set up and sterilization methods. (12 hrs)

Unit II

Callus culture-types, cell division, differentiation, morphogenesis, organogenesis and embryogenesis. Single cell culture- methods. Cell suspension culture -Growth kinetics of cells in suspension culture. Organ culture –root culture, shoot tip culture, embryo culture, ovary and ovule culture. (16 hrs)

Unit III

Production of haploids: Anther and pollen culture, application of haploids. Production of triploids- endosperm culture. Protoplast culture- isolation, fusion and regeneration. Hybrids and cybrids. (12 hrs)

Unit IV

Somatic hybridization and application. Somatic embryogenesis and artificial seeds. Somaclonal variations. Germ plasm conservation and cryopreservation. Tissue culture application: transgenic plants (14 hrs)

Books for study

1 Plant cell and Tissue culture. Kalyan Kumar De,
2 Introduction to Plant Tissue Culture. MK Razdan, Oxford, IBH Publishing co Ltd.
3 Introduction to Plant Biotechnology. H S Chawla, Science publishers.
4 Biotechnology. BD Singh, Kalyani Publishers.

Books for References:

1. Gene cloning and DNA analysis. TA Brown, Blackwell publishing.

2. Molecular Biotechnology, Bernard R Glick, ASM press.
3. Recombinant DNA. James D Watson, Scientific American books.

Marks including choice:

Unit	Marks
I	11
II	15
III	16
IV	18

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)
- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)
- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)
- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)
- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

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COMPLEMENTARY ELECTIVE COURSE IV:
PLANT BIOTECHNOLOGY II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4C04BTC	3	2	3

COURSE OUTCOME

CO1	Understand the method of isolation and purification of DNA . Understand the role of restriction enzymes and other enzymes used in construction of rDNA.
CO2	Understand the types of vectors and its application. Understand the basic tools used for the identification of genes.
CO3	Understand the principle of techniques like PCR and Sequencing.
CO4	Understand various gene transfer methods in plants and their screening.

Unit I

Plant genetic manipulation: Isolation and purification of genomic DNA. Enzymes involved in genetic engineering: Nucleases and restriction endonucleases. DNA ligase, Polymerase and other DNA modifying enzymes. (14 hrs)

Unit II

Gene cloning: cloning vectors- plasmids, phage vectors and cosmids. Gene libraries: genomic and cDNA libraries. Identification of the desired genes : Electrophoresis (AGE,PAGE) ,Blotting -Southern,Northern and Western blotting. (14 hrs)

Unit III

Polymerase chain reaction (PCR): Principle and applications of PCR. Different types of PCR. DNA sequencing: Chain termination method,chemical degradation method and Automated DNA sequencing. (14 hrs)

Unit IV

Gene transfer methods in plants: physical methods - Electroporation ,gene gun ,Liposomes and Microinjection. Chemical methods. *Agrobacterium* mediated gene transformation. Screening of Transformants. (12 hrs)

Books for Study:

1. Introduction to Plant Biotechnology. H S Chawla, Science publishers.
2. Biotechnology. BD Singh, Kalyani Publishers.
3. rDNA Technology, DrArunDev Sharma, Himalaya Publishing House.

Books for Reference:

1. Gene cloning and DNA analysis. TA Brown, Blackwell publishing.
2. Molecular Biotechnology, Bernard R Glick, ASM press.
3. Recombinant DNA. James D Watson, Scientific American books.

Marks including choice:

Unit	Marks
I	11
II	15
III	19
IV	15

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (8 questions x 2 marks each = 16 marks)

- Answer any 6 questions (6 questions x 2 marks each = 12 marks)

Part C - Short Essay (6 questions x 3 marks each = 18 marks)

- Answer any 4 questions (4 questions x 3 marks each = 12 marks)

Part D - Essay (4 questions x 5 marks each = 20 marks)

- Answer any 2 questions (2 questions x 5 marks each = 10 marks)

- Total marks including choice = 60
- Maximum marks = 40

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COMPLEMENTARY ELECTIVE COURSE V:

BIOTECHNOLOGY PRACTICAL
(Part 1)

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
1II	4C05BTC	2	-	*

* External examination for Part 1 and Part 2 together shall be conducted at the end of 4th semester. The total credit for the practical is 4.

COURSE OUTCOME

CO1	Understand the method of analyzing water quality.
CO2	Understand the preparation and application of bio fertilizers.
CO3	Understand the methods of production of fermented food products.
CO4	Understand the methods of production of beverages.

1. Determination of BOD of the water sample by winklers method
2. Determination of DO of the water sample
3. Microbial analysis of waste water
4. Isolation of *Rizhobium* from legume root
5. Production of biofertlizers
6. Study of biopesticides using *Trichoderma*
7. Production and characterization of wine
8. Production of cheese
9. Production of yoghurt
10. Production of pickles
11. Production of beer

Books for Study:

Microbiology: A Laboratory Manual,Cappuccino.

Books for Reference:

Alcamo's Laboratory Fundamentals Of Microbiology, Jeffrey C Pommerville

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COMPLEMENTARY ELECTIVE COURSE V:

BIOTECHNOLOGY PRACTICAL
(Part 2)

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4C05BTC	2	4	3

* External examination for Part 1 and Part 2 together shall be conducted at the end of 4th semester. The total credit for the practical is 4.

COURSE OUTCOME

CO1	Understand the media preparation for tissue culture.
CO2	Understand the sterilization techniques and inoculation.
CO3	Understand callus induction from different explants like leaf, node, shoot tip .
CO4	Understand embryo encapsulation protocol.
CO5	Understand the method of isolation DNA from plant sample and quantitation.
CO6	Understand the separation of DNA using agarose gel electrophoresis.
CO7	Understand the method of RNA isolation from plant cell.

1. Plant tissue culture media preparation – MS media
2. Explant selection, sterilization and inoculation
3. Callus induction from leaf, node, shoot tip etc.
4. Direct organogenesis
5. Artificial seed
6. Isolation of plant genomic DNA
7. Spectrophotometric quantitation of DNA
8. Agarose gel electrophoresis of DNA
9. RNA isolation from plant

Books for Study:

1. Plant Biotechnology: A Practical Approach, H.S Chawla
2. Practical Biotechnology:Methods and Protocols, S Janarthanan.

Books for Reference:

1. Introduction to Plant Tissue Culture, M K Razdan,
2. The Condensed Protocols from Molecular Cloning:A Laboratory Manual, Sambrook and Russell.

Pattern of questions (model)

Estimate the amount of dissolved oxygen in the given water sample by Winkler's Method. (14 marks)

Estimate the acid content in the given wine sample. (10 marks)

Spot the given items A,B,C,D (4 x 2 = 8 marks)

Viva Voce (4 marks)

Record (4 marks)

- Maximum marks = 40

PART C:

BIOTECHNOLOGY GENERIC ELECTIVE COURSES
WORK AND CREDIT DISTRIBUTION
(2019 ADMISSION ONWARDS)

EACH DEPARTMENT SHALL OFFER A POOL OF FIVE GENERIC ELECTIVE COURSES **AT A TIME, TRANSACTION THROUGH GUIDANCE MODE**. STUDENTS OF OTHER DEPARTMENTS CAN CHOOSE **ANY ONE OF THE GENERIC ELECTIVE COURSES FROM THE POOL OF FIVE COURSES.** ALL DEPARTMENTS (WHETHER IT IS A CORE DEPARTMENT OR COMPLEMENTARY DEPARTMENT CAN OFFER THE COURSE IN SEMESTER V)

COURSE CODE	COURSE TITLE	SEMESTER	HOURS PER WEEK	CREDIT	EXAM HOURS
5D 01 BTC	BIOINSTRUMENTATION	V	2	2	2
5D 02 BTC	INTELLECTUAL PROPERTY RIGHTS	V	2	2	2
5D 03 BTC	BIOINFORMATICS	V	2	2	2
5D 04 BTC	ENVIRONMENTAL SCIENCE	V	2	2	2
5D 05 BTC	FERMENTATION TECHNOLOGY	V	2	2	2

EVALUATION

ASSESSMENT	WEIGHTAGE	MARKS
EXTERNAL	4	20
INTERNAL	1	5

INTERNAL ASSESSMENT

COMPONENT	WEIGHTAGE	REMARKS
PERIODIC CLASS TESTS	60%	MINIMUM TWO CLASS TESTS AND AVERAGE OF THE BEST TWO
ASSIGNEMENT /SEMINAR	40%	ASSIGNEMENT OR SEMINAR (SAME CRITERIA SHOULD BE APPLIED UNIFORMLY TO ALL STUDENTS IN THE CLASS)

GENERIC ELECTIVE COURSE I: BIOINSTRUMENTATION

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D01BTC	2	2	2

COURSE OUTCOME

CO1	Understand the basic concepts of sterilization and disinfection and biosafety.
CO2	Understand the principle of pH meter, laminar air flow and dialysis.
CO3	Understand electrophoresis, blotting and hybridization.
CO4	Understand chromatographic principles.

Unit I
Sterilization and disinfection. Handling of pathogenic organisms and hazardous chemicals and biosafety. (6 hrs)

Unit II
Principle and working of pH meter, laminar air flow. Dialysis and reverse dialysis. (8 hrs)

Unit III
Electrophoresis (AGE and SDS-PAGE). Blotting and hybridization (Southern). (12 hrs)

Unit IV
Chromatography – Principle and working (adsorption chromatography), Column and Thin Layer Chromatography. (10 hrs)

Books for Study:

1. Biophysical Chemistry by Upadhyay, Upadhyay&Nath, Himalaya Publishing House, Bangalore.

2. Bioinstrumentation – L. Veerakumari, 2006, MJP publishers.

Books for Reference:

1. Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company.

2. A text book of Biophysics by R.N. Roy, New Central Book Agency Pvt. Ltd, Calcutta.

3. Biophysics by Mohan Arora, Himalaya Publishing House, Bangalore.

4. Separation chemistry by R.P Budhiraja, New age international (P) Ltd, New Delhi.

Marks including choice:

Unit	Marks
I	6
II	8
III	10
IV	6

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (6 questions x 2 marks each = 12 marks)

- Answer any 4 questions (4 questions x 2 marks each = 8 marks)

Part C - Essay (2 questions x 6 marks each = 12 marks)

- Answer any 1 question (1 questions x 6 marks each = 6 marks)

Total marks including choice = 30

Maximum marks = 20

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GENERIC ELECTIVE COURSE II: INTELLECTUAL PROPERTY RIGHTS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D02BTC	2	2	2

COURSE OUTCOME

CO1	Understand Intellectual property rights and different forms of IPR protection.
CO2	Understand the patent system; general requirements and procedure for the grant of patent.
CO3	Understand major international conventions and treaties related to IPR protection.

Unit I

Overview of Intellectual Property Rights : Introduction and the need for intellectual property rights (IPR), Different forms of IPRs - patents, copyright, trademark, trade secret, designs, geographical indications. Infringement. (12 hrs)

Unit II

Patents: Types of invention protected by patent system,General requirements for filing a patent, procedure for the grant of patent, patentability of microorganisms, patentability of genes and vectors. Legal protection for plants and other higher organisms, Plant breeder's rights and farmer's rights. (14 hrs)

Unit III

International Conventions and Treaties : GATT (General agreement on tariffs and trade) and WTO (World trade organization), Trade related aspects of intellectual property rights (TRIPS),Budapest Treaty, PCT (Patent cooperation treaty). (10 hrs)

Books for Study:

1. IPR, Biosafety and Bioethics- DeepaGoel, ShominiParashar, Pearson.

2. Intellectual Property law. A Chandrashekaran, C Sitaraman and Co Pvt. Ltd.

Books for Reference:

1. Intellectual Property laws: Containing Acts, rules & regulations. Univ. Law Pub. Co.

2. Intellectual Property Protection and Sustainable Development, Philippe Cullet.

3. Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications, B. L. Wadehra.

4. Law of Copyright and Industrial Designs,P. Narayanan.

Marks including choice:

Unit	Marks
I	10
II	12
III	8

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (6 questions x 2 marks each = 12 marks)

- Answer any 4 questions (4 questions x 2 marks each = 8 marks)

Part C - Essay (2 questions x 6 marks each = 12 marks)

- Answer any 1 question (1 questions x 6 marks each = 6 marks)

Total marks including choice = 30

Maximum marks = 20

GENERIC ELECTIVE COURSE III: BIOINFORMATICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D03BTC	2	2	2

COURSE OUTCOME

CO1	Understand the basic concepts of Information Technology.
CO2	Understand the basic concepts of Bioinformatics and the tools used.
CO3	Understand brief history, goals and significance of Human Genome Project

Unit I:
Overview of information technology: Features of modern personal computer and peripherals - Hardware and software, major application software. Computer network & internet, wireless technology. Overview of operating system. (12 hrs)

Unit II:
Introduction to bioinformatics: Historical overview and definition, scope and applications, databases, major databases in bioinformatics - GenBank, EMBL, DDBJ, PDB, SWISS PROT, PIR, PROSITE, PFAM, CATH, SCOP. Information retrieval from databases, Bioinformatics tools - BLAST and FASTA. (16 hrs)

Unit III:
Human genome project: History, introduction and significance of human genome project (HGP), goals of the HGP, contribution of various countries, National Human Genome Research Institute (NHGRI),rough and final draft of human genome project. (8 hrs)

Books for Study:

1. Informatics Bioinformatics - K. Vijayakumaran Nair. 2015, Academia.

2. Basic Bioinformatics, S. Ignacimuthu.2005, Alpha Science International.

Books for Reference:

1. Introduction to Bioinformatics, T.K. Altwood, D.J. Parry-Smith and S. Phukan. Informatics: Technology in action. Alan Evans. Pearson.

2. Bioinformatics - A beginner's guide, Jean Michel Claverie, John Wiley & Sons.

Marks including choice:

Unit	Marks
I	10
II	12
III	8

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (6 questions x 2 marks each = 12 marks)

- Answer any 4 questions (4 questions x 2 marks each = 8 marks)

Part C - Essay (2 questions x 6 marks each = 12 marks)

- Answer any 1 question (1 questions x 6 marks each = 6 marks)

Total marks including choice = 30

Maximum marks = 20

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GENERIC ELECTIVE COURSE IV: ENVIRONMENTAL SCIENCE

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D04BTC	2	2	2

COURSE OUTCOME

CO1	Understand the causes, control measures and diseases associated with environmental pollution
CO2	Understand the renewable and non-renewable fuels
CO3	Understand Waste management and the treatment of solid and liquid waste

Unit I

Environmental pollution and control – Different types of pollution (Air, water and soil). Disease associated with pollution and control measures. Green house effect, Acid rain and Biomagnification. (14 hrs)

Unit II

Bio-fuels: Renewable and non renewable fuels – Biogas, Hydrogen as a fuel, Biodiesel, Bio-ethanol, solar energy converters. (10 hrs)

Unit III

Waste management, e-waste management, waste water treatment: Primary, secondary and tertiary treatment, solid waste management, vermicomposting, landfills and incineration. (12 hrs)

Books for Study:

1. U. Satyanarayana- Biotechnology
2. Singh B.D. - Biotechnology

Books for Reference:

1. Sharma P.D. – Ecology and Environment. Rastogi publications

Marks including choice:

Unit	Marks
I	12
II	9
III	9

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (6 questions x 2 marks each = 12 marks)

- Answer any 4 questions (4 questions x 2 marks each = 8 marks)

Part C - Essay (2 questions x 6 marks each = 12 marks)

- Answer any 1 question (1 questions x 6 marks each = 6 marks)

Total marks including choice = 30

Maximum marks = 20

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GENERIC ELECTIVE COURSE V: FERMENTATION TECHNOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D05BTC	2	2	2

COURSE OUTCOME

CO1	Understand types of fermentation and bioreactors.
CO2	Understand the production of fermented food & beverages
CO3	Understand industrial production of enzymes and principles of immobilization.

Unit I

Fermentation – Definition and scope. Bioreactor – Basic components and function. Submerged and surface fermentation – Batch and continuous fermentation. Solid and liquid fermentation. (14 hrs)

Unit II

Fermented food and beverages: Bread, Cheese, Yoghurt, Sauerkraut, Wine, Beer, Vinegar. Probiotic food. (10 hrs)

Unit III

Production of microbial enzymes and its importance: Protease and amylase. Brief account of enzyme technology. Immobilization of enzymes. Biosensors. (12 hrs).

Books for Study:

1. U. Satyanarayana-Biotechnology.

Books for Reference:

1. Frazier- Food Microbiology
2. A.H. Patel Industrial Microbiology

Marks including choice:

Unit	Marks
I	12
II	8
III	10

About the Pattern of Questions:

Part A - Short notes (6 questions x 1 mark each = 6 marks)

- Answer all questions (6 questions x 1 mark each = 6 marks)

Part B - Notes (6 questions x 2 marks each = 12 marks)

- Answer any 4 questions (4 questions x 2 marks each = 8 marks)

Part C - Essay (2 questions x 6 marks each = 12 marks)

- Answer any 1 question (1 questions x 6 marks each = 6 marks)

Total marks including choice = 30

Maximum marks = 20

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KANNUR UNIVERSITY

B.Sc. DEGREE EXAMINATION

MODEL QUESTION PAPERS

FOR

BIOTECHNOLOGY

CORE COURSES

I SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

1B01BTC: CELL BIOLOGY

Time: 3 hours **Maximum marks: 40**

Part A

Answer each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. What are secondary lysosomes?
2. What is acrocentric chromosome?
3. What is synapsis?
4. What is lamp brush chromosomes?
5. What is PPLO?
6. What is leucoplasts?

Part B

Answer any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Write a note on salivary gland chromosome.
8. Write a note on nucleolus.
9. Write a note on origin of life.
10. Compare the structure of plant and animal cell.
11. Write a note on different types of ribosomes.
12. Give a brief account of nucleosome structure.
13. Write a note on Cell theory.
14. Write characteristics of smooth and rough endoplasmic reticulum.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. What are the stages in meiosis I?
16. Describe passive transport across a biological membrane.
17 What are the three types of protein filaments that make up the cytoskeleton?
18. What is cytoplasmic matrix?
19. Describe flagellar locomotion.
20. Describe chromosome structure and organization.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Detail the structure and functions of mitochondria.
22. Describe the ultra structure of plasma membrane.
23. Give an account on the structure and functions of Golgi bodies.
24. Discuss the stages of mitosis.

II SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

2B02BTC: GENETICS

Time: 3 hours **Maximum marks: 40**

Part A

Answer each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. What is pleiotropism?
2. What is linkage map?
3. What is test cross?
4. What is aneuploidy?
5. Write on Rh incompatibility.
6. What is polygenetic effect?

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Holandric genes and its inheritance
8. Co-dominance
9. Intra-genetic interaction
10. Mode of action of recessive epistasis in alleles for coat color in mice
11. Lethal genes
12. Multiple allelism
13. H antigen
14. Genetic drift

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Cytoplasmic inheritance
16. Complete and incomplete linkage
17. Different kinds of epistasis
18. Non disjunction in autosomes
19. Genotypic frequencies
20. What are all the possible F2 genotypes in the following cross aaBB X Aabb

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Compare and contrast sex-linked, sex-influenced and sex-limited genes with suitable examples.
22. Write in detail about mechanism of crossing over and its types.
23. Various structural aberrations in chromosome.
24. Hardy Weinberg equilibrium.

III SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERAL AWARENESS COURSE)

3A01BTC: BIOPHYSICS

Time: 3 hours **Maximum marks: 40**

Part A

Answer each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. What is osmosis?
2. Define torsion angle.
3. Give the structure of Adenine.
4. Define molecularity.
5. What is aquaporins?
6. What is facilitated diffusion?

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Dialysis.
8. Activation energy.
9. Base stacking.
10. Omega loops.
11. Zinc finger motif.
12. Reverse osmosis.
13. Enthalpy vs Entropy.
14. Forms of DNA.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Fluid mosaic model.
16. Sodium potassium pump.
17. Tertiary structure of t-RNA.
18. DNA-protein interactions.
19. Types of base pairing.
20. Ramachandran plot.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. What are colloids? Write applications of colloids?
22. Briefly describe laws of thermodynamics.
23. Explain mechanism of bio-electric properties of membrane?
24. Give an account on topological forms of DNA

III SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERAL AWARENESS COURSE)

3A02BTC: BASIC CONCEPTS OF ECOLOGY

Time: 3 hours **Maximum marks: 40**

Part A

Write short notes (2 or 3 sentences) on each of the following. Each question carries 1 mark.

(6 x 1 = 6 marks)

1) Biomes.
2) Edaphic factors.
3) IUCN.
4) Edge effect.
5) Sundarbans.
6) Climax concept.

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7) Ecological indicators.
8) Population dynamics.
9) R and K selection.
10) Habitat and Niche.
11) Tiger reserves in India.
12) Ecospecies.
13) Interspecific interaction.
14) Threats to biodiversity.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15) Explain in detail about sulphur cycle
16) Briefly explain Ecological pyramids
17) Explain the concept of metapopulation
18) Explain the principles of conservation
19) Discuss about aquatic and terrestrial ecosystem
20) Biosphere reserves

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21) Discuss Carbon cycle and Nitrogen cycle.
22) What is ecological succession? Explain the types and process of succession.
23) Explain the fundamentals of population ecology.
24) Discuss the scope and significance of ecology.

III SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

3B03BTC: IMMUNOLOGY

Time: 3 hours **Maximum marks: 40**

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Auto antibodies
2. MHC
3. Hapten
4. TCR
5. Mast cells
6. C3b

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Differentiate passive and active immunity
8. Comment on Opsonization
9. Explain primary and secondary immune response
10. Write a note on Grave's diseases
11. Explain Graft rejection
12. Differentiate agglutination and precipitation
13. What are the factors affecting immunity
14. Define humoral immunity

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Describe the classes of immunoglobulin
16. Give an account on types of Vaccines
17. Explain the components of innate immunity
18. Write a note on tumor antigens
19. Explain the structure and functions of primary lymphoid organs
20. Describe autoimmunity

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Describe the cells of immune system
22. Define complement. Explain different complement activation pathways
23. Explain in detail the production and application of monoclonal antibody
24. Explain type I hypersensitivity reactions.

IV SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERAL AWARENESS COURSE)

4A03BTC: BIOSTATISTICS

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Mutually exclusive events
2. Standard error
3. Geometric mean
4. Correlation Co-efficient
5. Pictogram
6. Variance

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Describe χ^2 - test
8. Find the coefficient of variation from the following:
   18, 12, 24, 20, 25, 30, 32, 34
9. Briefly explain scatter diagram.
10. Write notes on frequency polygon.
11. Describe dependent and independent events.
12. Briefly explain ogives.
13. Describe kurtosis.
14. Differentiate between population and sample. Describe the methods of sampling.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Explain the classification and tabulation of statistical data.
16. Describe Measures of dispersion
17. Explain Laws of Probability.
18. Calculate the mode of the following data:

Marks	0-10	10-20	20-30	30-40	40-50
No. of Students	2	8	16	9	5

19. From a pack of 52 cards two cards are drawn at random. What is the probability of getting either a King or a Queen?
20. Describe cumulative frequency distribution.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Describe the different graphical representation of data.
22. Explain Measures of central tendency.
23. What is correlation. Explain with an example.
24. Write briefly on Tests of Significance.

IV SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERAL AWARENESS COURSE)

4A04BTC: BIOINFORMATICS

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. PROSITE.
2. Proteome.
3. NCBI
4. KEGG.
5. ClustalW.
6. Databases.

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Differentiate between global and local alignment.
8. Describe FASTA.
9. Explain about DDBJ.
10. What is INSDC?
11. Describe structural databases.
12. Explain phylogenetic analysis.
13. Different approaches in proteomics.
14. Explain the concept of similarity and homology.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Explain the homology search tool BLAST.
16. Describe the significance of NHGRI.
17. Describe nucleic acid sequencing.
18. Explain multiple sequence alignment.
19. Explain PAGE.
20. Explain structural genomics.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Explain the process of protein sequencing.
22. Write an essay on biological databases.
23. Explain in detail about the Human Genome Project.
24. Describe brief history, importance and goals of Bioinformatics.

IV SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

4B05BTC: MOLECULAR BIOLOGY

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Satellite DNA
2. snRNP
3. Explain the significance of AGGAGGU sequence
4. Comment on catabolic repression
5. What are the functions of rRNA?
6. What is wobble hypothesis?

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Forms of DNA
8. Genetic code
9. What are the steps in 5' capping?
10. Components of prokaryotic ribosome
11. Explain the structure of eukaryotic promoter.
12. Difference between prokaryotic and eukaryotic DNA replication
13. Enzymatic properties of DNA polymerase
14. Reverse mutation

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Describe transcriptionally active chromatin
16. What are the enzymes involved in DNA replication
17. Describe lac operon in prokaryotes.
18. Briefly explain spliceosome-mediated splicing.
19. DNA as the genetic material
20. Significance of Transcriptional Activator Proteins.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Discuss the various stages of transcription in prokaryotes
22. Define operon. How trp operon is regulated by attenuation?
23. Explain the different repair mechanisms
24. Discuss the various stages of translation

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

5B07BTC: ANIMAL PHYSIOLOGY

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Paracrine hormones
2. Dendrites
3. Myofibril
4. Vasopressin
5. Insulin
6. Cori cycle

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Oxygen Hemoglobin dissociation curve
8. Glomerular Filtration
9. Neuron
10. CO_2 transport
11. Neurotransmitters
12. ECG
13. Respiratory pigments
14. Microcirculation.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Cardiac cycle
16. Hormones of pituitary
17. Smooth muscle
18. Discuss the structure of synapse
19. Mechanism of generating visual signals
20. Cardiac muscle

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Explain the molecular mechanism of muscle contraction
22. Describe the mechanism of hearing
23. Describe the sex hormones. Discuss the hypo and hyper secretions of sex hormones.
24. Homeostasis processes

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

5B08BTC: PLANT PHYSIOLOGY

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Clinostat.
2. Foolish seedling disease.
3. Quiescence.
4. Heat shock proteins.
5. Triple response.
6. Etiolated seedling.

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Patterns of plant growth.
8. Application of Gibberellin biosynthesis inhibitors.
9. Water potential.
10. Nastic movement.
11. Ascent of sap.
12. Give an account on macro- and micro-elements.
13. Cryptochrome.
14. Vernalization.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15 Assimilation of mineral nutrients by plants.
16. Photoperiodism.
17. Biological clock.
18. Mechanism of stomata movement.
19. Physiological functions of Auxin with special mention about its commercial applications.
20. Phototropism.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Give an account on plant movements? Briefly describe the mechanism of gravitropism.
22. Briefly describe response of plants to temperature stress.
23. What is seed dormancy? What are the methods of breaking dormancy?
24. Give an account on translocation in phloem.

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

5B09BTC: GENETIC ENGINEERING

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Alkaline lysis method
2. Automated DNA sequencing
3. Reporter genes
4. Binary vectors
5. Factor VIII
6. Recombinant Monoclonal antibodies

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Comment on electrophoresis of DNA
8. Write short notes on plasmid vectors
9. Comment on transformation
10. Comment on Phage vectors
11. Write short notes on Restriction endonucleases
12. Give an account on Recombinant Vaccines
13. Comment on Recombinant insulin
14. Give an account on plant molecular markers

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Briefly explain CTAB extraction method
16. Briefly explain the construction of cDNA
17. Discuss the applications of recombinant DNA in forensic science
18. Discuss the different methods of DNA sequencing
19. Briefly discuss the production of transgenic animals
20. Write short notes on different types of PCR

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Explain the mode of action of different types of enzymes involved in Genetic engineering
22. Discuss the methodology and applications of PCR
23. Briefly explain the construction and screening of genomic DNA library
24. Give a detailed account of the applications of recombinant DNA in medicine

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

5B10BTC: PLANT BIOTECHNOLOGY

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Embryo rescue
2. Cybrid
3. Cryoprotectants
4. Totipotency
5. Diploidization
6. Liposomes

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Write notes on callus culture
8. Explain in-vitro pollination
9. What are the factors affecting organogenesis?
10. Comment on protoplast culture
11. Write a note on Cell suspension culture
12. What is shoot tip culture?
13. Write a note on termination gene technology
14. What are the applications of triploid plants?

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Describe direct gene transfer methods in plants
16. What are the applications of haploid plants?
17. Explain somaclonal variation and its applications
18. Give an account on the nutritional media in plant cell culture
19. Explain cryopreservation
20. Explain Ti plasmid derived vector systems

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Define organ culture. Describe types of organ culture
22. Give a detailed account of *Agrobacterium* mediated genetic transformation in plants
23. Explain somatic hybridization and its applications
24. Describe somatic embryogenesis. Add a note on artificial seed

VI SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

6B12BTC: ANIMAL CELL BIOTECHNOLOGY

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. CO_2 Incubator.
2. Cell line.
3. Trypsinization.
4. DNA vaccine.
5. Balanced Salt solution.
6. Synchronized Culture.

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Primary Culture
8. Recombinant vaccines.
9. Advantages of serum free media
10. Xenotransplantation
11. Differentiate natural and artificial culture media.
12. Write about mechanical method of tissue disaggregation.
13. Recombinant tPA
14. Transgenesis

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Explain growth kinetics of cultured cells.
16. Compare and contrast normal and transformed cell lines.
17. Discuss the physical and chemical properties of animal tissue culture media.
18. Write the role of serum in animal culture media.
19. Write a note on recombinant subunit vaccines.
20. What are the applications of transgenic animals?

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Discuss the various gene transfer methods used in transgenic technology.
22. What are Monoclonal antibodies? Explain their production.
23. Detail the use of mammalian cells in production of any 2 pharmaceutical products.
24. Explain the procedure of somatic cell nuclear transfer.

VI SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

6B13BTC: INDUSTRIAL BIOTECHNOLOGY

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Hop flower
2. HACCP
3. Probiotics
4. Sauerkraut
5. Stirred Tank Reactor
6. Lyophilization

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Biosensors
8. Solid state fermentation
9. Wine production
10. Immobilization
11. Types of sparger
12. Crowded plate technique
13. Photo bioreactor
14. Brewing

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Explain the different modes of operation of a culture.
16. Write the methods of preservation of industrially important microorganisms.
17. Single Cell Protein
18. Write a note on fermented food products.
19. Write industrial production of penicillin.
20. Discuss measurement and control of any two bioprocess parameters.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Explain the stages of downstream processing.
22. Discuss various primary and secondary screening methods.
23. Write the industrial production of citric acid.
24. Detail the design and parts of a basic bioreactor.

VI SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

6B14BTC: ENVIRONMENTAL BIOTECHNOLOGY

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Green house effect
2. EPA
3. Social forestry
4. Leghemoglobin
5. Eutrophication
6. BOD

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Acid rain
8. Biofuels
9. Bt cotton
10. Indicator organisms
11. Biodiesel
12. Anaerobic Digestor
13. Impact of modern fuels on environment
14. Production of Biohydrogen

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Biofertlizers
16. Write a note on renewable and nonrenewable resources
17. Discuss hazardous waste spill and its management
18. Nif genes.
19. Sources and effects of air pollution.
20. Bioleaching.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Biological nitrogen fixation.
22. Write an essay on Bioremediation
23. Discuss the environmental impacts of petroleum industry.
24. Detail different waste water treatment.

VI SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (CORE COURSE)

6B15BTC: DEVELOPMENTAL BIOLOGY

Time: 3 hours Maximum Marks: 40

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Pollination
2. Triple fusion
3. Parthenocarpy
4. Notogenesis
5. Polarity
6. Stem cells

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Polyembryony
8. Double fertilization
9. Blastulation
10. Paracrine factors
11. Cell surface receptors.
12. Structure of ovum.
13. Dorsal polarity
14. Ventral polarity

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Discuss various types of cleavage.
16. Discuss pollen pistil interaction.
17. Discuss growth and types of growth.
18. Describe nucleocytoplasmic interactions in development.
19. Describe spermatogenesis.
20. Role of microenvironment in differentiation.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Explain cell differentiation and levels of differentiation
22. Explain megasporogenesis and the structure of megasporangium.
23. Write an essay on major changes during gastrulation.
24. Discuss different methods of cell-cell communication in development.

KANNUR UNIVERSITY

B.Sc. DEGREE EXAMINATION

MODEL QUESTION PAPERS

FOR

BIOTECHNOLOGY

COMPLEMENTARY ELECTIVE COURSES

I SEMESTER B.Sc DEGREE EXAMINATION
BIOTECHNOLOGY (COMPLEMENTARY ELECTIVE COURSE)

1C01BTC: ENVIRONMENTAL BIOTECHNOLOGY

Time: 3 hours **Maximum marks: 40**

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Pollution
2. Bioplastic
3. Xenobiotic
4. Biodiesel
5. Bioethanol
6. Natural disaster

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Composting
8. Bioaugmentation
9. Phytoremediation
10. Explain bioleaching method
11. Various bio resources
12. Short note on flood
13. Explain Earthquakes
14. Baculovirus

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Air pollution.
16. Biogas production.
17. Bioremediation.
18. Cause and effect of landslide.
19. Oil recovery process.
20. Bacillus thuringensis.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Discuss environmental impacts of pollution with reference to acid rain.
22. Explain large scale sewage treatment process.
23. Write an essay on Biofertilizers.
24. Give a detailed account on nitrogen fixation.

II SEMESTER B.Sc DEGREE EXAMINATION
BIOTECHNOLOGY (COMPLEMENTARY ELECTIVE COURSE)

2C02BTC: FOOD BIOTECHNOLOGY

Time: 3 hours **Maximum marks: 40**

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Must
2. Wort
3. Hop flower
4. Probiotic
5. Pasteurization
6. Food borne illness

Part B

Write notes on any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Explain processes involved in production of butter
8. Short note on sauerkraut
9. Define pascalization
10. What are food additives?
11. Explain various methods of preservation of fruits
12. Explain spoilage of milk
13. Spoilage of canned food
14. Various food manufacturing practices

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. Explain step by step process of brewing.
16. Details on different types of distilled liquors.
17. Short note on different types of wines.
18. Detailed account on SCP production and its types.
19. Explain various methods of preservation of milk.
20. Describe HACCP.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Give detail account on wine production.
22. Give detail account on production of cheese.
23. Explain principles of food preservation.
24. Explain various risk factors associated with food borne illness.

III SEMESTER B.Sc DEGREE EXAMINATION
BIOTECHNOLOGY (COMPLEMENTARY ELECTIVE COURSE)
3C03BTC: PLANT BIOTECHNOLOGY I

Time: 3 hours **Maximum marks: 40**

Part A

Answer each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Define electrofusion.
2. What is totipotency?
3. What are flavr savr tomatoes?
4. Define differentiation.
5. What is embryo rescue?
6. What is somatic hybridization?

Part B

Answer any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. Write short essay on autoclave.
8. What are transgenic plants?
9. Mention the applications of shoot tip culture.
10. Describe cryopreservation.
11. What are the significances of endosperm culture?
12. Briefly describe somatic embryogenesis.
13. Write down the applications of artificial seeds.
14. Write a note on protoplast regeneration.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. What are growth hormones? Explain auxin.
16. Write an essay on protoplast isolation.
17. Explain the growth kinetics of plant cells in suspension culture.
18. Explain the importance of germplasm conservation.
19. Differentiate between hybrids and cybrids.
20. Explain the process of organogenesis.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Write an essay on the components of a tissue culture media.
22. Explain the process of production of haploid plants.
23. What is somaclonal variation? Explain.
24. Write an essay on single cell culture methods.

IV SEMESTER B.Sc DEGREE EXAMINATION
BIOTECHNOLOGY (COMPLEMENTARY ELECTIVE COURSE)
4C04BTC: PLANT BIOTECHNOLOGY II

Time: 3 hours **Maximum marks: 40**

Part A

Answer each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. What is transformation?
2. What are palindromes?
3. What is $P^{BR\ 322}$?
4. Mention the role of alkaline phosphatase
5. What is Taq DNA polymerase?
6. What are cosmids?

Part B

Answer any six of the following. Each question carries 2 marks.

(6 x 2 = 12 marks)

7. What are liposomes?
8. What is insertional inactivation?
9. Differentiate between isoschizomers and neoschizomers
10. What are dideoxy nucleotides?
11. What are the characteristics of an ideal vector?
12. What are linkers?
13. Explain inverse PCR.
14. What is ligase? Mention its types.

Part C

Write short essay on any four of the following. Each question carries 3 marks.

(4 x 3 = 12 marks)

15. What is automated DNA sequencing?
16. Write a note on the types of restriction enzymes.
17. Explain PAGE.
18. Explain a thermal cycler.
19. Briefly explain northern blotting.
20. Explain the method of colony hybridization used in screening of transformants.

Part D

Write essay on any two of the following. Each question carries 5 marks.

(2 x 5 =10 marks)

21. Write an essay on the construction of cDNA libraries.
22. Explain Maxam and Gilbert method of DNA sequencing.
23. Explain *Agrobacterium* mediated gene transfer.
24. What are the applications of PCR?

KANNUR UNIVERSITY

B.Sc. DEGREE EXAMINATION

MODEL QUESTION PAPERS

FOR

BIOTECHNOLOGY

GENERIC ELECTIVE COURSES

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERIC ELECTIVE COURSE)

5D01BTC: BIOINSTRUMENTATION

Time: 2 hours Maximum Marks: 20

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Autoclave
2. Electrophoresis
3. Disinfection.
4. LAF
5. Hybridization
6. Biosafety

Part B

Write notes on any four of the following. Each question carries 2 marks.

(4 x 2 = 8 marks)

7. Describe the handling of pathogenic microorganisms.
8. Explain adsorption chromatography.
9. Briefly explain the principle of pH meter.
10. Write notes on SDS-PAGE.
11. Describe dialysis
12. Write notes on hot air sterilization.

Part C

Write essay on any one of the following. Each question carries 6 marks.

(1 x 6 = 6 marks)

13. Southern blotting.
14. Sterilization.

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERIC ELECTIVE COURSE)

5D02BTC: INTELLECTUAL PROPERTY RIGHTS

Time: 2 hours Maximum Marks: 20

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Trade secret
2. PCT
3. Sui generis system
4. Copyright
5. Budapest treaty
6. Infringement.

Part B

Write notes on any four of the following. Each question carries 2 marks.

(4 x 2 = 8 marks)

7. Describe the legal protection for plants varieties.
8. Explain Geographical indication.
9. Briefly explain the patentability of microorganisms.
10. Describe the general requirements for filing a patent.
11. Describe Plant Breeder's Rights.
12. Write notes on TRIPS.

Part C

Write essay on any one of the following. Each question carries 6 marks.

(1 x 6 = 6 marks)

13. Explain the procedure for the grant of patent.
14. Write an essay on GATT.

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERIC ELECTIVE COURSE)

5D03BTC: BIOINFORMATICS

Time: 2 Hours Maximum Marks: 20

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. FASTA
2. Gen Bank
3. SWISS-PROT
4. Hardware
5. Wi-Fi
6. NHGRI

Part B

Write notes on any four of the following. Each question carries 2 marks.

(4 x 2 = 8 marks)

7. Briefly explain BLAST.
8. Explain Operating systems.
9. Briefly explain the nucleic acid sequence databases.
10. Write notes on PDB.
11. Describe the major application softwares.
12. Write notes on wireless technology.

Part C

Write essay on any one of the following. Each question carries 6 marks.

(1 x 6 = 6 marks)

13. Explain the structural components of a modern personal computer.
14. Write an essay on Human Genome Project.

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERIC ELECTIVE COURSE)

5D04BTC: ENVIRONMENTAL SCIENCE

Time: 2 Hours Maximum Marks: 20

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Biomagnification
2. e-waste
3. Landfills
4. Biodiesel
5. Methanogenesis
6. Acid rain

Part B

Write notes on any four of the following. Each question carries 2 marks.

(4 x 2 = 8 marks)

7. Briefly explain vermicomposting.
8. Explain solar energy converters.
9. Briefly explain the sources of water pollution.
10. Write notes on biogas.
11. Describe Greenhouse effect.
12. Write notes on trickling filter.

Part C

Write essay on any one of the following. Each question carries 6 marks.

(1 x 6 = 6 marks)

13. Explain the causes and effects of air pollution.
14. Write an essay on sewage treatment.

V SEMESTER B.Sc. DEGREE EXAMINATION
BIOTECHNOLOGY (GENERIC ELECTIVE COURSE)

5D05BTC: FERMENTATION TECHNOLOGY

Time: 2 Hours Maximum Marks: 20

Part A

Write short notes on each of the following in 2 or 3 sentences. Each question carries 1 mark.

(6 x 1 = 6 marks)

1. Leavening
2. Sauerkraut
3. Probiotics
4. Still wines
5. Saccharification
6. Baker's yeast

Part B

Write notes on any four of the following. Each question carries 2 marks.

(4 x 2 = 8 marks)

7. Briefly explain immobilization of enzymes. Highlight the industrial applications of immobilized enzymes.
8. Write notes on biosensors.
9. What are fermented foods? Explain the various fermented milk products.
10. Describe the microbial production of amylase.
11. What are the factors affecting wine production?
12. Write short notes on brewing.

Part C

Write essay on any one of the following. Each question carries 6 marks.

(1 x 6 = 6 marks)

13. Give an account on the various types of fermentation processes.
14. Explain the design of bioreactors.