



UNIVERSITY OF CALICUT

Abstract

General and Academic - Faculty of Science - Syllabus of BSc Biotechnology Programme under CBCSS UG Regulations 2019 with effect from 2019 Admission onwards - Implemented- Orders Issued

G & A - IV - J

U.O.No. 9181/2019/Admn

Dated, Calicut University.P.O, 11.07.2019

*Read:-*1. U.O.No. 4368/2019/Admn dated 23.03.2019

2. The minutes of the meeting of the Board of Studies in Biotechnology on 07.06.2019
3. Item No. I.26 in the minutes of the meeting of Faculty of Science held on 27.06.2019

ORDER

The Regulations for Choice Based Credit and Semester System for Under Graduate (UG) Curriculum- 2019 (CBCSS UG Regulations 2019) for all UG Programmes under CBCSS-Regular and SDE/PrivateRegistration w.e.f. 2019 admission has been implemented vide paper read first above

The meeting of Board of Studies in Biotechnology held on 07/06/2019 has approved the Syllabus of B Sc Biotechnology Programme in tune with the new CBCSS UG Regulations with effect from 2019 Admission onwards, vide paper read second above.

The Faculty of Science at its meeting held on 27/06/2019 has approved the minutes of the meeting of the Board of Studies in Biotechnology held on 07/06/2019, vide paper read third above.

Under these circumstances , considering the urgency, the Vice Chancellor has accorded sanction to implement the Scheme and Syllabus of B Sc Biotechnology Programme in accordance with the new CBCSS UG Regulations 2019, in the University with effect from 2019 Admission onwards, subject to ratification by the Academic Council.

The Scheme and Syllabus of B Sc Biotechnology Programme in accordance with CBCSS UG Regulations 2019, is therefore implemented in the University with effect from 2019Admission onwards.

Orders are issued accordingly. (Syllabus appended)

Biju George K

Assistant Registrar

To

The Principals of all Affiliated Colleges

Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE IV/DoA/EX and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT

**RESTRICTED COURSE CURRICULUM
(Syllabus)**

For

B.Sc. BIOTECHNOLOGY
Academic year
2019 onwards

B.Sc. Biotechnology (for colleges affiliated to Univ. of Calicut)
COURSE STRUCTURE

	Course Title	Instru c. Hrs/W eek	Credit	Exam Hrs	Marks		Total Credit	
					Int.	Ext.		
I semester								
	Common Course		4	4	2/2.5hrs	20%	80%	(19+4) credits
	Common Course		5	3				
	Common Course		5	4				
BTY1B 01	Core Course I	Cell biology	3	3				
	1 st Complementary course –1	Chemistry	2	3				
	1 st Complementary course Practicals -1	Chemistry Practical	2					
BTY1C 01	2 nd Complementary course-1	Environmental Biotechnology	2	2				
	2 nd Complementary course Practicals – 1	Environmental Biotechnology	2	-- -----				
	Audit course 1	Environment Studies	25	19 4				
II semester								
	Common course		4	4	2/2.5 hrs	20%	80%	(19+4) credits
	Common Course		5	3				
	Common Course		5	4				
BTY2B 02	Core course II	General Microbiology	3	3				
	1 st Complementary Course II	Chemistry	2	3				
	1 st Complementary Practical II	Chemistry practical	2	*				
BTY2CO2	2 nd Complementary Course II	Environmental Biotechnology	2	2				
	2 nd Complementary Course Practicals II	Environmental Biotechnology	2 ----- 25	* 19 4				
	Audit course 2	Disaster Management						
III semester								
	General Course	#	5	4	2/2.5 hrs	20%	80%	(19+4) credits
	General Course	##	5	4				
BTY3BO3	Core Course	Biochemistry	3	3				
BTY3BO4(P)	Core Course Practical I	Biochemistry	2	3				
	1 st Complementary course III	Chemistry	3	3				
	1 st Complementary PracticalIII	Chemistry	2	*				
BTY3C03	2 nd Complementary Course III	Environmental Biotechnology	3	2				
	2 nd Complementary Course Practical III	Environmental Biotechnology	2	*				
	Audit course 3	HumanRights/Consumer protection	25	19 4				

Please note that the General courses for III semester are # Biodiversity –Scope and Relevance and ## Research Methodology

IV semester

	General Course	#	5	4	2/2.5 hrs	20%	80%	(24+4) credits
	General Course	##	5	4				
BTY4BO5	Core Course IV	Genetics	3	4				
	1 st Complimentary Course IV	Chemistry	3	3				
	1 st Complimentary Practical IV	Chemistry practical	2	*				
BTY4 C04	2 nd Complimentary Course IV	Environmental Biotechnology	3	2				
BTY4 C05 (P)	2 nd Complimentary Course Practical IV	Environmental Biotechnology practical	2	4*				
BTY4 B06 (P)	Core Course Practical II	Practicals in Genetics	2	3**				
	Audit Course 4	Gender studies/Gerontology	----- 25	----- 24 4				

General Course for Semester IV - # Natural Resource Management and ## Intellectual Property Rights

*The practical exams for the 2nd complimentary course Environmental biotechnology will be conducted in the fourth semester with 4 credits.

V semester

BTY5B 07	Core Course V	Molecular Biology	4	3	2/2.5 hrs	20%	80%	22 credits
BTY5BO8	Core Course VI	Immunology and Immuno-technology	4	3				
BTY5B09	Core Course VII	Bioprocess Technology	4	3				
BTY5B 10(P)	Core Course Practical III	Practicals in Molecular Biology	4	4**				
BTY5 B 11(P)	Core Course Practical IV	Immunology and Immuno-technology practical	4	4**				
	Open Course-1 (From other department)		3	3				
BTY5B12(P)	Core Course Practical V	Practical's in Bioprocess technology	4	2				
			----- 25	----- 22				
BTY6B18	□ Project work							

VI semester

BTY6B13	Core course VIII	Plant Biotechnology	4	3	2/2.5 Hrs	20%	80%	17 credits
BTY6B14	Core Course IX	Animal Biotechnology	3	3				
BTY6B15	Core Course X	Recombinant DNA Technology and bioinformatics	3	3				
BTY6B16(P)	Core Course Practical VI	Plant Biotechnology Practical	4	3**				
BTY6 B17	Elective Course – (from same subject/ department)	Medical Biotechnology	3	3				
BTY6 B18	□ Project	Combined Project of 5 students in each group	4	2				
			-----	-----				

Credits - (19+19+19+24+22+17=120)

- | Combined project of 2 group with 5 students starts in the V Semester

*Credits for the complimentary course practicals will be awarded at the end of the IV semester.

* Credits for the main course practicals will be awarded at the end of the sixth semester.

Credits for common course and genral courses 22+16	38
Credits for core course including project and elective.....	55
Credits for complimentary courses.....	24
Credits for open course.....	03

Credits for Audit course..... 16

N.B.

- | Common courses for Semester I and II have been retained as in previous syllabus while that for Semester III have been changed to 'Biodiversity – Scope and Relevance' and 'Research Methodology' and that for Semester IV are 'Natural Resource Management' and 'Intellectual Property Rights' as per the decision of Combined meeting of BoS Chairmen discussion on subjects following LPR pattern.
- | The project work starts in the V semester and ends on VI Semester.
- | A group of 5 students shall be given the combined project to minimize the work load on teachers.
- | The VI Semester practical examination for the main course subjects shall be clustered in the form of 3 practicals.
- | The practical exams shall be organised for two days (6hrs/day) for each cluster as it is difficult to complete practical examination within 3 hrs for the B.Sc. Biotechnology course.
- | Credit awarded for the compliment course is inclusive of practicals.
- | Each complementary course including practicals is allotted with 50 marks each.
- | Core courses (56 credits) carry 1750 marks.

* Open Course offered for other department students is - **BTY5D01-INTRODUCTION TO BIOTECHNOLOGY**

BTY1B 01 CELL BIOLOGY

I. Introduction to cell biology: Milestones in cell biology, Cell theory, Properties of cell, Classification of cell, Structural organization of prokaryotic and eukaryotic cell. Comparison of microbial, plant and animal cells. Origin and evolution of cells. Theory of microscopy and types of microscopes. (6 hrs)

II. Structure and function of plasma membrane. Transport across membranes: active, passive, diffusion and osmosis. Interaction between cell and its environment- cell adhesions, cell junction, extracellular matrix and cell wall. (12 hrs)

III. Cell compartments endoplasmic reticulum, Golgi complex, lysosomes, vesicular trafficking- endocytosis and exocytosis, peroxisomes, glyoxysomes and vacuoles. Ribosome and protein synthesis. Mitochondrion-aerobic and anaerobic respiration, chloroplast and photosynthesis. (12 hrs)

IV. Structure and function of nucleus, nucleolus, chromosomes and types of chromatin. Cytoskeleton- microfilaments, intermediate filaments, microtubule. Cilia and flagella. (10 hrs)

V. Cell division in prokaryotes and eukaryotes. Cell cycle, phases of cell cycle, mitosis and meiosis. Apoptosis and cell death. A brief overview of cell signaling, stem cells and cancer. (10 hrs)

References:

1. Molecular biology of cell – Alberts B et al
2. Molecular cell biology – Lodish et al
3. Cell and Molecular Biology: Concepts and Experiments - Gerald Karp and Nancy L Pruitt
4. Reproduction in eukaryotic cells – D M Prescott
5. Developmental biology – S F Gilbert, Sinauer Associates
6. Cell in development and inheritance – E B Wilson
7. The coiled spring – Ethan Bier
8. Fertilisation – F T Longo, Champan and Hall
9. Molecular biology of steroid and nuclear hormone receptors – L P Freedman

**BTY1C01. ENVIRONMENTAL BIOTECHNOLOGY
(COMPLEMENTARY COURSE)**

- I. Fundamentals of Ecology: Biotic and abiotic environmental factors, energy flow through ecosystems, renewable and non-renewable resources, physiological and behavioural ecology. Major kinds of ecosystems. (6 hrs)
- II. Kinds of organism interactions, types of communities, characteristics population, succession, water Cycle, Biogeochemical cycles: carbon, nitrogen cycle, phosphorus and sulphur cycle. (8 hrs)
- III. Human Influences on the ecosystem- Pollution, Carbon dioxide and global warming, ozone depletion, acid precipitation, destruction of the tropical forests, loss of biodiversity. Eutrophication. Soil formation, Nutrient availability. (8 hrs)
- IV. Pollution control strategies. Pollution management: In process treatment, End of pipe treatment, Remediation of polluted sites. Preserving nonreplaceable resources. Advantages of biological pollution control methods, (8 hrs)

**2ND COMPLEMENTARY COURSE :PRACTICALS – I
- ENVIRONMENTAL BIOTECHNOLOGY**

1. A septic techniques
2. Preparation of media and sterilization.
3. Isolation of microorganisms from airs, water, soil.
4. Isolation of Nitrogen Fixing Bacteria from root nodule of Leguminous plants.
5. Standard plate count of microorganism in sewage water sample.
6. Estimation of biological oxygen demand of polluted water sample.
7. Estimation of chemical oxygen demand of polluted water sample.

References:

1. Sylvia S. Mader. 2010. BIOLOGY, TENTH EDITION, McGraw-Hill Companies, Inc.
2. T. Srinivas. 2008, New Age International (P) Ltd., Publishers
3. Jogdand, G.N. 1995. EBT, Himalaya Publishing House.
4. EBT : Basic Concepts and Application: Indushekar Thakur (2006). I.K. International Publication.
5. Pelczar, M.J. 1998. Microbiology: Concept & Applications, McGraw.

BTY2B02. GENERAL MICROBIOLOGY

- I. History of Microbiology: Leeuwenhoek and his microscope, Germ theory of disease – Koch's postulates, development in disease prevention, antiseptics, immunisation, chemotherapy, classes of microorganisms, bacteria, virus, fungi.

Morphological characters of bacteria & fungi.

Difference between eukaryotic & prokaryotic cells. (8 hrs)

- II. Preparation of media, eg. nutrient agar, potato dextrose agar, Mac Coukey Agar, Industrial media, Requirements for carbon, N₂.

Concept of sterilization, Methods of sterilization of media and equipments / glassware.

Isolation of pure cultures: Spread plate, streak plate and pour plate. (8 hrs)

- III. Growth and reproduction in bacteria, fungi, virus & bacteriophages – lytic cycle, lysogenic.

Factors affecting growth – pH, temperature, O₂ requirement.

Uptake of nutrients: active, passive, facilitated, group translocation. Measurement of growth: dry weight, CFV, turbidometry. (10 hrs)

- IV. Microbial metabolism: Aerobic and anaerobic respiration, e⁻ transport chain, pentose phosphate pathway. (7 hrs)

- V. Brief account of microbial diseases: eg: Typhoid, AIDS, Dermatomycoses.

(3 hrs)

References:

1. Pelczar, M.J., Chan, E.C.S. and Kreig, Microbiology: Concepts and Applications (Fifth edition).
2. Ronald Atlas. Principles of Microbiology (second edition).
3. Michael T. Medigan, John M. Martinho, Brock, Biology of Microorganisms (Tenth edition).
4. Precott, Harley, Microbiology (Sixth edition).
5. Stainer, R.K., Ingraham, J.L., Wheelis, General Microbiology, Macmillan Publ.
6. Benson, H.J. 1990. Microbiological applications: A laboratory manual in General Microbiology, 5th ed., W.M.C. Brown, Publishing.
7. Cappuccino, J.G. & Sherman, N. 1996. Microbiology Laboratory Manual.

**BTY2CO2. ENVIRONMENTAL BIOTECHNOLOGY
(COMPLEMENTARY COURSE)**

- I. Water pollution: Physical, Chemical and Biological characteristics wastewater, bacteriological examination of water- *Escherichia coli* as indicator, Presumptive, confirmed and completed test. (6 hrs)
- II. Treatment of wastewater - Primary, secondary, tertiary and alternative treatment. Advantages of biological wastewater treatment over other methods. Principles and application of Aerobic and Anaerobic waste water treatment methods. (8 hrs)
- III. Biological wastewater treatment processes: Activated sludge, biological filters, rotating biological contactor, Fed Batch Reactor, trickling filters, contact digesters, packed column reactors, Upflow anaerobic sludge blanket, stabilization ponds. Sludge treatment, nitrogen and phosphate removal. Waste treatment using aquatic plants. (8 hrs)
- IV. Principles and application of water purification methods: sedimentation, filtration, distillation, ultraviolet light and chlorination. Methods used for the removal of nitrogen and phosphorus from waste water. (8 hrs)

2ND COMPLEMENTARY COURSE PRACTICALS II- ENVIRONMENTAL BIOTECHNOLOGY

1. Aerobic treatment of municipal sewage including sedimentation, filtration (sand filter), chlorination.
2. Enumeration of microorganisms total Vs. viable counts.
3. Presumptive and confirmed tests for water quality.
4. Staining methods.
5. IMViC test: using river and tap water samples.
6. Clarification of municipal sewage using flocculants and performing standard plate count before and after clarification.

References

1. Sylvia S. Mader. 2010. BIOLOGY, TENTH EDITION, McGraw-Hill Companies, Inc.
2. T. Srinivas. 2008, New Age International (P) Ltd., Publishers
3. Jogdand, G.N. 1995. EBT, Himalaya Publishing House.
4. EBT : Basic Concepts and Application: Indushekar Thakur (2006). I.K. International Publication.
5. Pelczar, M.J. 1998. Microbiology: Concept & Applications, McGraw.

BTY3BO3. BIOCHEMISTRY

I Introduction to biomolecules; chemical bonds (weak interactions), Energy transactions in Biological systems, measurement of pH (Henderson Hasselbalch equation), buffers & buffer actions (strong & weak acids), Biological buffer systems. (2 hrs)

II Carbohydrates: Classification, occurrence, chemical reactions, structure and functions of monosaccharides, disaccharides & polysaccharides, UDP glucose; glycolysis, Krebs cycle, ETC (Mitochondria) – arrangement of electron carriers in the electron transport chain, Oxidative phosphorylation (Chemiosmotic theory), Fate of pyruvate in alcoholic fermentation, gluconeogenesis and pentose phosphate pathway (only outline without structures of intermediates). (8 hrs)

III Amino acids: Classification based on structure and polarity, amphoteric property, titration curve of alanine, general chemical reactions of amino acids, urea cycle, metabolism of glycine & phenylalanine, peptide bond formation. Rare amino acids (4 hrs)

IV Proteins: Classification, structure and biological function. (3 hrs)

V Lipids: Classification, fatty acids, triacylglyceride, phosphoglycerides (eg., lecithins), sphingolipids (e.g., Cerebrosides), Steroids (Cholesterol), Outline study of β -oxidation; fatty acid biosynthesis (without structure). (4 hrs)

VI Nucleic acids: Structure of purines, pyrimidines, different conformational forms of DNA, Types of DNA. (4 hrs)

VII Enzyme: Classification, Nomenclature, Mechanism of enzyme action, derivation of Michaelis-Menten equation, Enzyme inhibition, Factors affecting enzyme activity, Allosteric enzymes, Isoenzymes. (4 hrs)

VIII Vitamins & Hormones: Classification, physiological functions & deficiency disorders of vitamins and hormones (thyroxine, insulin, growth hormones), an overview to the functions of phytohormones. (4 hrs)

IX Separation technique: Chromatography: (adsorption, ion exchange, affinity, gel filtration). Electrophoresis: PAGE, AGE, SDS-PAGE. (3 hrs)

BTY3BO4(P)-CORE COURSE PRACTICALS I - BIOCHEMISTRY

Biochemical techniques

- Preparation of buffers:- Phosphate buffer, Tris Acetate buffer.
- Quantitative estimation of sugars by Anthrone method, DNS method, Biuret method.
- Quantitative estimation of protein by Lowry et al. method.
- Quantitative estimation of RNA by orcinol method, DNA by DPA method.
- Separation of amino acids by paper chromatography and thin layer chromatography.
- Amylase activity – determination (salivary amylase).

References

1. Lehninger, Cox and Nelson: Biochemistry
2. Voet Voet : Biochemistry.
3. Stryer K. Biochemistry 1995. W.H. Freeman & Company, New York.
4. Mathews, H.R. Freedland R. Miesfeld, R.L. 1997. Biochemistry a short course. Wiley-Liss Inc.
5. Neal, A.C., Chemistry & Biochemistry: A Comprehensive Introduction. McGraw Hill Book Company.
6. Donald Voet, Judith G. Voet, Biochemistry, Second edition.
7. David L. Nelson, Michael M. Cox, Lehninger. Principles of Biochemistry, third edition.
8. Plummer, D.T. 1988. An Introduction to Practical Biochemistry, Tata McGraw Hill Co., New Delhi.

BTY3C03. ENVIRONMENTAL BIOTECHNOLOGY (COMPLEMENTARY COURSE)

- I. Solid pollution: Domestic and industrial wastes, ex situ and in situ Processes, heap technique. Composting – principals and applications, landfill, vermitechnology, phytore mediation, methanogenesis, biogas, medical solid waste management. (8 hrs)
- II. Bioremediation: Advantages of bioremediation, types of bioremediation. Monitoring the efficacy of bioremediation. Bioventing for controlling oil spills. Bioaugmentation and Biosparging. (6 hrs)
- III. Degradation of xenobiotic by microorganisms, Degradation of Aromatic and chlorinated Hydrocarbons. Degradation mechanisms of naphthalene, benzene, phenol, PCB's, propanil, urea. Biodegradation of petrochemical effluents. (8 hrs)
- IV. Air Pollution: Sources, Health effects of air pollution. Greenhouse effect, acid rain, Control of gaseous emissions, control of pollutants from vehicles, Biomonitoring of air pollution. Removal of air pollutants with biosystems. Biofilter, Biotrickling Filter. (8 hrs)

2ND COMPLEMENTARY COURSE PRACTICAL III-ENVIRONMENTAL BIOTECHNOLOGY

1. Delignification of rice straw, rice husk using enzymes (white rot fungi, Pleurotus specis) and alkali.
2. Preparation of vermicompost
3. Growth curve of bacteria.
4. Assessment of microbial growth wet weight, Packed Cell Volume.
5. Isolation of pesticide degrading bacteria from rice field.
6. Microbial screening for phenol degrading organisms.

References:

1. Sylvia S. Mader. 2010. BIOLOGY, TENTH EDITION, McGraw-Hill Companies, Inc.
2. T. Srinivas. 2008, New Age International (P) Ltd., Publishers
3. Jogdand, G.N. 1995. EBT, Himalaya Publishing House.
4. EBT : Basic Concepts and Application: Indushekar Thakur (2006). I.K. International Publication.
5. Pelczar, M.J. 1998. Microbiology: Concept & Applications, McGraw.

BTY4BO5 GENETICS

I. Introduction to Genetics: History of genetics, Mendelian genetics and applications- Monohybrid and dihybrid cross, Principle of segregation, Dominance, Independent Assortment. Gene Interactions, Penetrance, Multiple Alleles. Non-Mendelian Inheritance- Extranuclear Inheritance, Maternal Effect, Epigenetic Inheritance, Linkage, Crossing Over; Gene mapping. Pedigree Analysis.

(10 hrs)

II. Chromosome: Morphology, Structure and Organization of Chromosome, Eu- and heterochromatin, Special chromosomes, Karyotype, Sex Determination, Sex-Linked Characteristics. Variation in Chromosome number and Structure. Human Genome, Human Inherited disorders. Genetic counseling. Eugenics and Euphenics.

(12 hrs)

III. Bacterial genetic system: Viral genome, Bacterial Chromosomes, Plasmids, Transformation, Conjugation, Transduction, Natural Gene Transfer, Isolation of auxotrophs, Replica plating techniques, Analysis of mutations in biochemical pathways.

(12 hrs)

IV. Quantitative Genetics- Quantitative Traits, Polygenic Inheritance, Types of Heritability. Population Genetics- Genotypic and Allelic Frequencies, Hardy-Weinberg Equilibrium, Factors affecting Genetic equilibrium. Genetic Drift. Evolutionary Genetics - Modes of Speciation, Phylogenetic Trees, Molecular Evolution, Molecular Clock.

(14 hrs)

BTY4B 06(P)-Core Course Practical II- Practicals in GENETICS

1. Study of mitotic stages in onion root
2. Study of meiosis
3. Karyotyping
4. Observation of Buccal smear Barr bodies
5. Demonstration of salivary gland chromosomes from Chironomus larvae.
6. Isolation of auxotrophs
7. Induced Transformation in *E. coli*
8. Conjugation

References:

1. Robert J Brooker, 2012, Concepts of Genetics, McGraw-Hill
2. Benjamin A. Pierce, 2012, Genetics, A Conceptual Approach, W. H. Freeman and Company.
3. Principles of genetics: Snustad, Simmons, Jenkins.
4. Robert H.Tamarin, Principles of Genetics, Seventh Edition, The McGraw-Hill Companies

BTY4C04. ENVIRONMENTAL BIOTECHNOLOGY (COMPLEMENTARY COURSE)

- I. Use of biotechnology for environmental protection. Biofertilizers and Biopesticides. Biotechnological application of thuringensis toxin as a natural pesticide. Principle and application of Bioremediation, Bioventing and Biosorption. (8 hrs)
- II. Bioenergy from waste: methane production, biogas, fuel-alcohol from biomass and lignocellulose residues. Production of biodiesel. Advantages and environmental effects of biofuels. Biopower- methods for electricity generation from biomass. (8 hrs)
- III. Single cell protein- production and advantages. Biomass production from waste, Bioplastics- Biopols (PHB), Biolac (polylactic acid), Bio-derived polyethylene and Genetically modified bioplastics. Environmental impacts of bioplastics. (8 hrs)
- IV. Principle and methods for the Bio leaching of gold, Copper and Uranium. Environmental Significance of genetically modified organisms- Effect on biodiversity. (6 hrs)

BTY4C05 (P)-2ND COMPLEMENTARY COURSE PRACTICALS-IV ENVIRONMENTAL BIOTECHNOLOGY

1. Removal of copper from waste water using *Trichoderma viridae*.
2. Production of cellulose and ethanol from lignocellulosic waste (biogas).
3. Use of yeast as biosorbant to remove colour from coir retting waste water / industrial effluent.
4. Production of biogas and methane from municipal sewage & food waste.

References:

1. Sylvia S. Mader. 2010. BIOLOGY, TENTH EDITION, McGraw-Hill Companies, Inc.
2. T. Srinivas. 2008, New Age International (P) Ltd., Publishers
3. Jogdand, G.N. 1995. EBT, Himalaya Publishing House.
4. EBT : Basic Concepts and Application: Indushekar Thakur (2006). I.K. International Publication.
5. Pelczar, M.J. 1998. Microbiology: Concept & Applications, McGraw.

BTY5BO7. MOLECULAR BIOLOGY

I. Genetic material: Discovery of DNA as genetic material, structure and functions of DNA and RNA. DNA topology, nucleosome and regulation of chromatin structure. Histones and Non Histones. Morphology, types and structural organization of chromosomes.

(8 hrs)

II. Genome: Structure, composition and complexity of prokaryotic and eukaryotic genome, Intergenic sequences, pseudogenes, Repeated DNA Sequences, Central dogma. Teminism

(8 hrs)

III. DNA Replication: Chemistry, enzymes involved and salient features of prokaryotic and eukaryotic DNA replication. History of DNA Replication. Types of mutation, DNA Repair-excision repair, mismatch repair and double-strand breakage repair. DNA recombination-homologous and site-specific. Mechanism and type of transposition in prokaryotes and eukaryotes.

(12 hrs)

IV. Gene Expression: Details of initiation, elongation and termination of transcription and translation in prokaryotes and eukaryotes, Post transcriptional modification of mRNA, rRNA and tRNA, chemistry and pathway of splicing, alternative splicing, properties of the genetic code, Post translational modification of protein. Inteins and Exteins

(12 hrs)

V. Regulation of gene expression: Gene structure in prokaryotes and eukaryotes, lac, trp and ara operon, Transcriptional, processing and translational level control of eukaryotic gene expression. Enhancers and Silencers. Chaperones and proteasomes.

(12 hrs)

BTY5B 10(P) -CORE COURSE PRACTICAL-III-PRACTICALS IN MOLECULAR BIOLOGY

1. Isolation of total genomic DNA from plant and bacteria
2. Spectrophotometric determination of nucleic acid purity and concentration
3. Measurement of Chromosome length
4. Induction of Lac Opeon
5. Complementation experiment

References:

1. Karp G 2010, Cell and Molecular Biology Concepts and Experiments, John Wiley & Sons, Inc.
2. Watson JD 2007, Molecular Biology of the Gene, Pearson Benjamin Cummings
3. Alberts B 2008, Molecular Biology of the Cell, Garland Science
4. Cooper GM 2009, The Cell A Molecular Approach, ASM Press
5. Weaver RF 2012, Molecular Biology, McGraw-Hill
6. Bolsover SR 2004, Cell biology: a short course, John Wiley & Sons, Inc.

BTY5B08. IMMUNOLOGY AND IMMUNOTECHNOLOGY

1. Introduction to immune system : Historical perspectives, early vaccination, natural and artificial immunity, innate immunity and acquired immunity, active and passive immunity, humoral and cell mediated immunity.(3hrs)
2. Cells of Immune System: Hematopoiesis, Lymphoid cells B & T lymphocytes. N. K. cells, phagocyte, mast cells, dendritic cells.(4hrs)
3. Organs of the Immune system: Primary lymphoid organs: Thymus, Bone marrow, secondary lymphoid organs: lymph nodes, spleen, mucosa associated lymphoid tissue.(5hrs)
4. Antigens: Nature and Properties of antigens: foreigners, molecular size - epitopes :Immune response to Ag, adjuvants, Immune dosage, route of administration superantigens.(4hrs)
5. Antibodies: Structure of antibodies; classes of Immuno globular, hypervariable regions. Complementary determining regions. Frame work regions. Isotype, allotype and idiotypic determinants, immunoglobulin superfamily.(10hrs)
6. Antigen - Antibody interactions: Affinity avidity, measure of Ag-Ab binding, crossreactivity: application of Ag-Ab interactions: agglutination reaction: blood grouping(5hrs)
7. Major Histocompatibility Complex – types, HLA, Complement system, Cytokines (2hr.)
8. Hypersensitivity: Classes hypersensitive reactions. (type-1) IgE-mediated hypersensitivity - intracellular events in mast cell degranulation, pharmacological agents in type I reactions, type II, hypersensitivity - erythroblastosis foetalis type – III hypersensitivity - Immunocomplex mediated hypersensitivity -type IV- delayed -type hypersensitivity.(10hrs)
9. Immunological disorders: Autoimmunity: Maintenance of tolerance, auto immune diseases: organ specific -Hashimoto's thyroiditis, Grave's disease. Systemic autoimmune disease – multiple sclerosis, Rheumatoid arthritis. Immunodeficiency- SCID, AIDS(6hrs)
10. Tumor immunology: Malignant transformation of cells, oncogenes and induction, tumor of immune system - tumor antigens chemically and virally induced tumor antigen, cancer immunotherapy - cytokine therapy - interferons. Tumor necrosis factor, monoclonal antibodies and immunotoxins.(8hrs)
11. Monoclonal antibodies and vaccines: Active and passive immunisation, vaccine designs recombinant vector vaccines.(7hrs)
12. Immunotechniques: RID, Ouchterlony, RIA and ELISA, Western blotting, Immunoelectrophoresis, Immunofluorescence, Flow cytometry. Fluorescence and immunoelectron microscopy. (5Hrs)

BTY5B11 (P)-Core Course Practical-IV-Immunology and Immuno-technology Practical

1. Blood grouping
2. Blood film preparation and identification of cells
3. Preparation of antigens

Protected of immunisation in rabbits rats/mice, methods of immunisation, bleeding (demonstration only). Necessary approved from CPCSEA may be obtained for animal experiment.

4. Separation of lymphocytes from peripheral blood
5. Radial immuno diffusion
6. Double diffusion
7. Immuno electrophoresis
8. Demonstration of ELISA

References

1. Kuby Immunology by Thomas Kindt and Richard A. Goldsby and Barbara A. Osborne; Ed. 6th; W.H. Freeman and Company, New York; 2007.
2. Cellular and molecular immunology by Abul K. Abbas and Andrew H. Lichtman and Shiv Pillai; Ed. 6th; Saunders, 2007.
3. Immuno biology: the immune system in health and disease by Charles A. Janeway and Paul Travers and Mark Walport and Mark J. Shlomchik; 7th Ed; Garland Science; 2008.
4. Essentials of immunology & serology by Jacqueline H. Stanley; DELMAR; Australia; 2002.

BTY5B09. BIOPROCESS TECHNOLOGY

- I. Introduction to microbial fermentations. Range of microbial fermentation processes. Recombinant DNA technology assisted products. Flow chart of typical industrial fermentation process. Concept of value addition shelf life improvement. Low volume - high value and High volume - low value products.
- II. Isolation of industrially useful microbes from soil air and water. Microbial screening procedure. Preservation of Microorganisms: Stock culture maintenance. Storage at low temperatures on agar slants and liquid nitrogen. Storage in dehydrated form-dried culture.
- III. Industrial strain improvement: Different DNA mutating agents like UV, NTG, Nitrous acid, intercalating agents. Application of genetic engineering and protoplast fusion techniques in strain improvement.
- IV. Fermentation media: Media composition. Requirement of Carbon-nitrogen minerals, growth factors, water and oxygen. Media sterilization: Batch and continuous sterilization, filter sterilization of fermentation media (for animal cell culture) and air.
- V. Microbial growth kinetics - Batch, fed-batch and continuous cultures: Fermentation equipment and use-parts of fermentor. Types of bioreactors - CSTR, air-lift. Packed bed and immobilized reactors. Fermentation process control-control of temperature, pH, dissolved oxygen and RPM.
- VI. Fermentation process operation: Inoculum preparation, scale-up of fermentations. Downstream processing: Separation of cells by froath floatation, sedimentation, flocculation, Filtration and centrifugation. Cell disruption for intracellular products.

- Membrane filtrations, including reverse osmosis. Chromatography techniques - Adsorption, ion-exchange, affinity and gel exclusion chromatography. Precipitation, crystallization and drying of biologicals
- VII. Typical fermentation processes: Antibiotics (Penicillins), organic acids (acetic acid), Microbial enzymes (Amylases and proteases) ethanol. Single cell proteins (SCP), Vatminas (Vti B 12).
- VIII. Enzyme technology: Basic concept of enzymes, sources and extraction of enzymes. Control of microbial enzyme production. Immobilization of enzyme of adsorption, entrapment, crosslinking and encapsulation methods. Application of immobilized enzymes.

BTY5B12 (P)-Core Course Practical-V- Practicals in bioprocess technology

1. Isolation of antibiotic producing microbes from soil by crowded plates technique and demonstration of antibiotic sensitivity by giant colony inhibition spectrum.
2. Fermentation of grape juice and estimation of alcohol by distillation.
3. Enzyme immobilization using sodium alginate.
4. Production microbial enzyme (amylase) and conversion of starch to glucose.
5. Detection of formed glucose by anthrone method,
6. Separation of cells by flocculation. Use of alum as an flocculating agent to separate yeast from fermentation broth.
7. Anaerobic fermentations: Production of methane from Glucose.
8. Comparative study of surface culture (Mat culture of aspergillus niger/Pencillin), solid state fermentation (Mushrooms) and submerged cultures.
9. Effect of pH and aeration on biomass production (Bakers yeast)-wet weight as an yard stick.

References:

1. Stanbury, P.F.A. Whitaker and S.J. Hall (1995). Principles of fermentation technology. Pregamon Press.
2. Cassida, I.E., Jr. Industrial microbiology (1994). Wiley eastern.
3. Cruger and Annillesse cruger (1990). A text book of industrial microbiology, sinaser associates. Inc.
4. Demain, A.L. and Solomon, N.A. Manual of industrial microbiology and biotechnology (1986). American society for microbiology.
5. Gasesca, P. and Able, J.J. (1987). Enzyme technology. Open University Press.
6. Purohit, S.S. (1988). Lab Manual of Plant Biotechnology, India.
7. Alman. A. (1988). Agricultural Biotechnology. Marcel and Decker Inc. Medium avenue (NY).
8. Burler, W. (1995). Bioerector design and product yield. Heineman Lincare House, Oxford.
9. Fermentation a practical approach: Ed. B.M.C Neil and L.M. Harvey (1990) University Press.

BTY5D01. INTRODUCTION TO BIOTECHNOLOGY

(Open Course –Elective from other department students)

- I. Introduction to Biotechnology. History of biotechnology. Tools in biotechnology. Use of cell and cell process in biotechnology. (8 hrs)
- II. Application of Biotechnology in food industry: Basic principle of Fermentation, Production of fermented food products- Bread, wines, vinegar and pickles. Fermented milk products and traditional Indian foods. High value food products- single cell proteins and mushroom. (8 hrs)
- III. Application of Biotechnology in agriculture: genetically modified foods. Bt cotton and Bt brinjal. Biopesticides and biofertilizers. (8 hrs)
- IV. Application of Biotechnology in medicine: application in treatment and diagnosis of diseases. DNA figure printing and paternity test. (8 hrs)

References

1. Reinhard Renneberg, Arnold L. Demain. Biotechnology for Beginners. Academic Press
2. William J. Thieman, Michael A. Palladino. Introduction to Biotechnology. Benjamin Cummings
3. Sang Yup Lee. An Introduction to Molecular Biotechnology: Fundamentals, Methods, and Applications, John Wiley & Sons, Inc.
4. Chawla. Introduction To Plant Biotechnology, Oxford and IBH Publishing

BTY6B13. PLANT BIOTECHNOLOGY

- I. Basic techniques of plant tissue culture (Introduction, Definition, Medium preparation and sterilization, inoculation, explant selection, growth regulators, subculture, conditions of culture room, etc.) (7)
- II. In vitro morphogenesis (Organogenesis – Meristem culture, Production of virus free plants, embryogenesis and synthetic seeds, significance studies on regeneration – single / multiple shoot, root formation, somaclonal variation and its significance, transfer and establishment of whole plants into soil). (15)
- III. Different types of culture (Callus culture, studies on different types of callus formation, cell culture / suspension culture). (5)
- IV. Organ culture: (ovary, ovule, endosperm triploid production, embryoculture, induction of polyembryony, anther culture, in vitro production of haploids and its significance in crop improvement). (8)

- V. Tissue culture and Biotechnological applications in agriculture, horticulture, pharmacology, industry.
(8)
- VI. Protoplast isolation and fusion, importance of hybrids and cybrids culture, importance and applications in crop improvement.
(9)
- VII. Cryopreservation, germplasm storage, and establishment of gene banks, viability & potentiality test, gene sanctuaries.
(5)
- VIII Genetic manipulations: Recombinant DNA technology – production of transgenic plants, hairy root culture – basic concepts, practical applications of genetic transformations. GMO crops and issues related to it. Biosafety, Bioethics and IPR in Plant biotechnology (15)

BTY6B16 (P)-CORE COURSE PRACTICAL-VI- PLANT BIOTECHNOLOGY PRACTICAL

1. Medium Preparations
 - a. Stock preparations
 - i) Macro and micro nutrients
 - ii) Hormones
 - iii) Vitamins
 - b. PM adjustments
 - c. Sterilization
 - i) Cotton plugging
 - ii) Autoclaving
 - iii) Explant collections
 - iv) Surface sterilization
 - v) Practices in Lamine flow chamber
 - vi) Personal Hygenic
 - d. Inoculations
 - i) Monitoring for callus induction and Regenerations

References

1. Herlaw, F. & David, L.D. (Eds.). 1998. Antibodies: A Laboratory Manual, Coldspring Harbor Laboratory.
2. Coligan, J.E. Kruisbeck, A.M. Margulies, D.H. Shevach, E.M. and W. Strober 1996. Current Practicals in Immunology, John Wiley & Sons Inc.
3. Dixon, R.A. & Genzales, R.A. (Eds.) 1994. Plant Cell Culture – A Practical Approach, IRL Press, Oxford.

4. Smith, R.H. 1992. Plant Tissue Culture Techniques and Experiments, Academic Press.
- 17
5. Edwin F. George (1993). Plant propagation by Tissue Culture, Part I. The Technology II Ed. Exegetics Ltd.
 6. Edwin F. George, 1993/1996. Plant Propagation by Tissue Culture, Part II In Practice II Ed.
 7. Pierik, R.L.M. 1989. In vitro culture of higher plants. Martinus Nijhoff Publishers, Dordrecht, Netherlands.
 8. M.Z. Abdin et al. (eds.). 2017. Plant Biotechnology: Principles and Applications, Springer Nature Singapore Pte Ltd.
 9. Kamle, S., & Ali, S. (2013). Genetically modified crops: Detection strategies and biosafety issues. *Gene*, 522(2), 123–132.
 10. Bhajmani & Razdan. Plant Tissue Culture, Theory and Practice.
 11. Reinert & Bajaj. 1977. Plant Cell, Tissue and Organ Culture, Springer Verlag, Berlin.
 12. S. Narayanaswamy, 1994. Plant Cell and Tissue Culture, Tata McGraw Hill Publishing Company Ltd., New Delhi.

BTY6B14. ANIMAL BIOTECHNOLOGY

1. Introduction to animal cell culture: Lab Design and equipments. Sterile area, Laminar flow hood. CO₂ incubator. Cryostorage (liquid Nitrogen flask), refrigerated centrifuges freezers (-80⁰C) inverted microscope, Hemocytometer, pH meter, magnetic stirrer, micropipettes and pipetteaid. (10)
2. Media preparation and sterilization: Sterilization of glass wares: Reagents: Balanced salt solutions, preparation stock of solutions such as amino acids, vitamins, salts, glucose, Hormones and growth factors, antibiotics, role of serum in media, physicochemical properties, - CO₂ and bicarbonate, oxygen, osmolality, Temperature, viscosity, filter sterilizationofmedia. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. (12)
3. Primary culture: Mouse embryo cell culture, protocol for Isolation of mouse embryo, Primary explants, Enzymatic disaggregation, warm and cold trypsin treatment, collagenase treatment, mechanical disaggregation and sieving separation of viable andnon-viablecells. Secondary cell culture. (12)
4. Cell lines & Cryopreservation: Immortalization of cell lines with viral genes - SV. 40, papillomavirus, Epstein-Barr virus, fibroblast immortalisation, cell line designations maintenance of cell lines, cell morphology, criteria for subculture. States of Cryopreservation, freezing a cells, Thawing of frozen cells. Scaling –up of animal cell culture, Cell synchronization. Cell cloning, micromanipulation and types of cloning. Cell transformation. Application of animal cell culture(15)
5. Cytotoxicity: Estimation of viability by Dye exclusion, cell proliferation assays, MTT-based cytotoxicity assay. (5)

References

1. Culture of Animal cells, 3rd Edition, R. Ian Freshney. A John Wiley & Sons, Inc., publications.
2. Animal Cell Culture-Practical Approach, R.W. Masters, Oxford. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
3. Animal Cell Biotechnology, Methods and protocols, Nigel Jenkins, Humana Press. 4.Biotechnology of Animal Tissue. P.R.Yadav& Rajiv Tyagi. 2006. Discovery Publishing House. New Delhi.
4. From Genes to Clones Introduction to Gene Technology -Winnacker, E.L.1987., Panima Educational Book Agency, New Delhi.
5. Gene VII -Benjamin Lewin, 2000. Oxford University Press, UK.
6. Biotechnology,Satyanarayana. U, (2008), Books and Allied (p) Ltd.

BTY6B15. RECOMBINANT DNA TECHNOLOGY AND BIOINFORMATICS

1. Introduction to gene cloning, enzymes and basic tools involved in gene cloning.
(5 hrs)
2. DNA sequencing methods, hybridization techniques (Northern, southern, western blotting), In Situ hybridization, PCR (variation RtPCR), DNA finger printing- RFLP, RAPD, AFLP and STR analysis. Isolation and purification of total cell DNA
(10 hrs)
3. Cloning vectors in prokaryotes and eukaryotes (pBr 322, puc 18, M13, cosmids, Phagemids, phasmids, yeast vectors, Animal viral vectors - SV40, Plant viral vectors - CaMV, Agrobacterium – Ti plasmid.
(10 hrs)
4. Introduction of recombinant DNA into living cells an overview. Selection and screening of recombinant clones.
(10 hrs)
5. Application of r-DNA technology - production of recombinant proteins, vaccines, Transgenic plants. (Insect resistance, disease resistance), Transgenic animals - molecular pharming.
(10 hrs)
6. Introduction to bioinformatics, pattern recognition and prediction, biological databases, primary and secondary sequence databases, composite protein sequence databases, pair wise alignment technique; database searching NCBI, EMB, FASTA, BLAST BITS etc. algorithms and programmes, comparison of two sequences, global and local alignment – multiple sequence alignment
(9 hrs)

References

1. Watson, J.D Gitman, M, Witkowski, J. and Foller, M. 1992, Recombinant DNA, II edition, Scientific American books, W.H. Freeman and Co, New York.
2. Old. R.W and Primerose, S.B. 1994. Principles of gene manipulation 0 An introduction to Genetic engineering.
3. T.A. Brown. Gene cloning and DNA Analysis an Introduction
4. - James D. Watson, Michael Gilman. Recombinant DNA
5. T.K. Altwood, D.J. Parry-Smith and S. Phukan. Introduction to Bioinformatics.
6. David. W. Mount. Bioinformatics: Sequence and Genome Analysis

BTY6B17. MEDICAL BIOTECHNOLOGY

(Elective for same department / Subject/ student)

- I. Morphology and Physiology of Bacteria; Sterilisation and Disinfection; Culture Media and Culture Methods; General identification procedurs for various pathogenic bacteria & fungi. (10 hrs)
- II. Infection & immunity, Antigen & antibody, Antigen & antibody reactions, Complement system. Structure & functions of immune system. (10 hrs)
- III. General properties of the following bacteria
- Staphylococcus
 - Streptococcus
 - Pneumococcus
 - Clostridium
 - Enterobacteriaceae
 - I : Coliforms
 - II : Sheigella
 - III : Salmonella
 - Vibrio
 - Pseudomonas
 - Mycobacterium I : tuberculosis
 - Spirochetes & Mycoplasma
 - Rickettesia & Chlamydea (15 hrs)
- IV. General properties of viruses:
- Virus host interaction
 - Pox viruses
 - Herpes virus
 - Adenonirus
 - Rhabdoviruses
 - Hepatitis
 - Oncogenic viruses
 - H1N1 disease control and prevention (15 hrs)
- V. Human Immunodeficiency Virus : AIDS
- Normal Microflora of Human body

Acute diarrhoeal diseases

Antimicrobial therapy

Immunoprophylaxis & Immunotherapy

Nasocomial infections

(10 hrs)

References

1. Ananthanarayanan : Textbook of Microbiology, 1994, Oriental Publishers.
2. Peleczar : Microbiology.
3. Prescott : Microbiology.

A11. GENERAL COURSE I BIODIVERSITY – SCOPE AND RELEVANCE (THEORY)

(CREDITS: 4)

SEMESTER – III

TOTAL HOURS: 72

Unit 1 Defining Biodiversity (Hours: 12)

The concept of biodiversity. Biodiversity crisis. Importance of biodiversity in daily life. Biodiversity and climate change. India as mega biodiversity nation. Hot spots of biodiversity in India.

Unit 2 Components of Biodiversity. (Hours: 12)

Genetic diversity, species diversity and ecosystem diversity. Brief outlines of the magnitude of bacterial, fungal, protist, animal and plant diversity.

Unit 3 Loss of Biodiversity (Hours: 12)

Factors causing loss of genetic-, species- and ecosystem diversity. Processes responsible for species extinction. Threatened species and IUCN Red List categories. Loss of agrobiodiversity. Significance of wild relatives of cultivated plants and domesticated animals.

Unit 4 Values and uses of biodiversity (Hours: 12)

Ethical and aesthetic values of biodiversity. Direct and indirect economic benefits of biodiversity. Bio-prospecting – micro-organisms and plants as a source of novel enzymes, antibiotics, antiviral agents, Immunosuppressive agents and other therapeutic agents.

Unit 5 Inventorying and Monitoring of Biodiversity (Hours: 12)

The need for inventorying and monitoring of biodiversity. Methods of inventorying and monitoring of biodiversity and their limitations.

Unit 6 Conservation of biodiversity (Hours: 12)

Conservation of genetic-, species- and ecosystem diversity. In situ and ex situ conservations: biosphere reserves, national parks, wild-life sanctuaries, gene banks, seed banks, botanical gardens, microbial culture collections.

SUGGESTED READING

1. Patent, D. H., Munnoz W. 1996. Biodiversity. Clarion Books.
2. Maiti, P. K., Maiti, P. 2011. Biodiversity: Perception, Peril and Preservation. Prentice Hall India.
3. Maclaurin, J. 2008. What is biodiversity? University of Chicago Press.
4. Krishnamurthy, K. V. 2003. Textbook of Biodiversity. SciencePublishers Inc.
5. Wilson E. O. 2010. The Diversity of Life. Harvard University Press.

6. Hosetti B.B., Ramkrishna, S. 2016. Biodiversity: Concepts and Conservation. Aavishkar Publishers.
7. Kumar A. 2011. Understanding Biodiversity. Discovery Publishing House.
8. Hendon, J. 2017. Textbook of Biodiversity. Syrawood Publishing House.
9. Adom, D. Umachandran, K., Ziarati, P., Sawicka, B., Sekyere, P. 2019. The Concept of Biodiversity and its Relevance to Mankind: A Short Review. Journal of Agriculture and Sustainability 12(2): 219-231.
10. Ehrlich, P.R., Ehrlich, A.H. 1992. The Value of Biodiversity. Stanford University Press.

A12. GENERAL COURSE II RESEARCH METHODOLOGY

(THEORY)

(CREDITS: 4)

SEMESTER – III

TOTAL HOURS: 72

Unit I (Hours: 13)

Topic selection - Planning research – defining objectives - Preparation of work plans.

Identification of suitable methodology - Preparation of project proposal –Summer Schools – Training in research institutes

Unit II (Hours: 14)

Collection of literature- News articles – Newsletters – Magazines – Books - Journals. Digital library and search of articles - Keywords and search - Internet – Google Scholar – PubMed – Infilbnet – Medline – Agricola – Science direct -Open access Journals - virtual sources – other sources. Short communications –review articles

Unit III (Hours: 15)

Collection of protocols and selection of suitable methods according to work plan.

Observational and experimental research. Data analysis – Construction of tables – headings - footer - Tabulation – Presentation of results - Use of statistical software to analyze the results- SPSS.

Unit IV (Hours: 15)

Thesis structure –Components - Writing Introduction – review of literature – Materials & Methods – Presentation of results – Discussion of Results based on literature – Arriving at conclusions – Preparation of Summary/abstract – Arrangement of Bibliography and how to quote reference in thesis - Appendix.

Unit V (Hours: 15)

Publishing of Articles in newspapers /newsletters - Selection of journals – ISSN Number – Peer-reviewed Journals – Science citation index – impact factor and importance. Manuscripts preparation for Journals – components – Plagiarism - Submission and Publication – reprints and pdf formats. Paper presentation in Conferences.

SUGGESTED READING

1. Anderson, Durston & Polle 1970: Thesis and assignment, writing. Wiley Eastern Limited.
2. Booth W. C. et al. 2016. The Craft of Research. University of Chicago Press.
3. Rajendrakumar C. 2008. Research Methodology. APH publishing Corporation.
4. Kothari C. R. 2004. Research Methodology. New Age International Publishers.
5. Gurumani, N. 2006. Research Methodology for Biological Sciences. MJP. Publishers.
6. Marczyk, G., DeMatteo, D., Festinger, D. 2005. Essentials of research design and methodology. John Wiley.

7. Katz, M. J. 2009. From Research to Manuscript: A Guide to Scientific Writing. Springer.
8. Michael Alley. The Craft of Scientific Writing (3rd Edition) Publisher: Springer.
9. Cargill, M., O'Connor, P. 2013. Writing Scientific Research Articles: Strategy and Steps. Wiley-Blackwell.
10. Blake, G. and Bly, R. W. 2000. The Elements of Technical Writing. Pearson.
11. Reep, D. C. 2014. Technical Writing: Principles, Strategies, and Readings. Longman.

A13. NATURAL RESOURCE MANAGEMENT

(THEORY)

(CREDITS: 4)

SEMESTER – IV

TOTAL HOURS: 72

Unit 1: Introduction to natural resources (Hours: 8)

Definition of natural resources. Types of natural resources. Need for protecting natural resources

Unit 2: Sustainable utilization (Hours: 8)

Concept of sustainable utilization. Economic, ecological and socio-cultural approaches.

Unit 3: Land (Hours: 8)

Agricultural, pastoral, horticultural and silvicultural land utilization. Soil degradation and soil management.

Unit 4: Water (Hours: 8)

Fresh water (rivers, lakes, groundwater); Marine; Estuarine; Wetlands; Threats and management strategies.

Unit 5: Biological Resources (Hours: 8)

Biodiversity-definition and types; Significance; Threats; Management strategies.

Bioprospecting. National Biodiversity Action Plan.

Unit 6: Forests (Hours: 8)

Definition. Types of forests. Forest cover and its significance (with special reference to India); Major and minor forest products; Forest depletion. Forest Management.

Unit 7: Energy (Hours: 8)

Renewable and non-renewable sources of energy.

Unit 8: Contemporary practices in natural resource management (Hours: 8)

Environmental Impact Assessment, Remote Sensing, Geographic Information System, Participatory Resource Appraisal. Ecological footprint with emphasis on carbon footprint. Resource Accounting. Waste management.

Unit 9: National and international efforts in natural resource management and conservation (Hours: 8)

SUGGESTED READING

1. Singh K. K. 2008. Natural Resources Conservation & Management. M D Publications Pvt. Ltd.
2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to Sustainable Development. Prentice Hall of India.
4. Pandey, B. W. 2005. Natural Resource Management. Mittal Publications.

Press.

6. Nuberg, I., George, B., Reid, R. 2009. Agroforestry For Natural Resource Management. CSIRO Publishing.

7. Camp, W. G., Heath-Camp, B. 2016. Managing Our Natural Resources. Cengage Learning Pte. Ltd

8. Chiras, D. D., Reganold, J. P. 2009. Natural Resource Conservation: Management for a Sustainable Future. Pearson.

9. Campbell, B. M., Sayer, J. A. 2003. Integrated Natural Resource Management: Linking Productivity, the Environment and Development. CABI Publishing.

10. Deal, K. H. 2011. Wildlife and Natural Resource Management. Delmar Cengage Learning.

A14. INTELLECTUAL PROPERTY RIGHTS

(THEORY)

(CREDITS: 4)

SEMESTER – IV

TOTAL HOURS: 72

Module 1: Overview of intellectual property (Hours: 4)

Introduction and the need for intellectual property right (IPR). IPR in India – Genesis and Development. Some important examples of IPR.

Module 2: Patents (Hours: 10)

Macro-economic impact of the patent system. Patent and kind of inventions protected by a patent. Patent document. How to protect your inventions? Granting of patent. Rights of a patent. How extensive is patent protection? Why protect inventions by patents? Searching a patent. Drafting of a patent. Filing of a patent

Module 3: Copyright (Hours: 10)

What is copyright? What is covered by copyright? How long does copyright last? Why protect copyright?

Related rights: What are related rights? Distinction between related rights and copyright.

Rights covered by copyright.

Module 4: Trademarks (Hours: 14)

Definition of trademark. Rights of trademark. Kinds of signs that can be used as trademarks.

Types of trademark. Function that a trademark performs. How is a trademark protected? How is a trademark registered? How long is a registered trademark protected for? How extensive is trademark protection? What are well-known marks and how are they protected? Domain name and how does it relate to trademarks?

Module 5: Geographical Indications (Hours: 4)

What is a geographical indication? How is a geographical indication protected? Why protect geographical indications?

Module 6: Industrial Designs (Hours: 10)

What is an industrial design? How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

Module 7: Biotechnology and IPR (Hours: 20)

Rationale for Intellectual Property Protection in biotechnology. Concept of Novelty in Biotechnological Inventions. Concept of Inventive Step in Biotechnological Inventions. Microorganisms as Biotechnological Inventions. Patenting biological inventions. Patenting microorganisms. Patenting other biological processes and products. Protection of new varieties of plants. Justification for Protection. Biotechnology and International Treaties such as Convention on Biological Diversity and TRIPs.

SUGGESTED READING

1. T. M Murray, M.J. Mehlman. 2000. Encyclopaedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons.

2. P.N. Cheremisinoff, R.P. Ouellette and R.M. Bartholomew.1985. Biotechnology

- Applications and Research, Technomic Publishing Co., Inc.
3. D. Balasubramaniam, C.F.A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman, 2002. Concepts in Biotechnology, University Press (Orient Longman Ltd.).
 4. Bourgagaize, Jewell and Buiser. 2000. Biotechnology: Demystifying the Concepts, Wesley Longman.
 5. Ajit Parulekar, Sarita D' Souza. 2006. Indian Patents Law – Legal & Business Implications; Macmillan India,
 6. B.L. Wadehra. 2000. Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd.
 7. P. Narayanan. 2010. Law of Copyright and Industrial Designs; Eastern law House.
 8. N.S. Gopalakrishnan, T.G. Agitha. 2009. Principles of Intellectual Property. Eastern Book Company.
 9. T. Ramakrishan (Ed.). 2003. Biotechnology and Intellectual Property Rights. CIPRA, NLSIU, Bangalore.
 - 10 N.K. Acharya. 2012. Text Book on Intellectual Property Rights, 6th ed. Asia Law House.
 - 11 M. M. S. Karki. 2009. Intellectual Property Rights: Basic Concepts. Atlantic Publishers.
 - 12 N. S. Sreenivasalu. 2007. Intellectual Property Rights. Neha Publishers & Distributors.
 - 13 Pal P. 2008. Intellectual Property Rights in India: General Issues and Implications. Regal Publications

MODEL QUESTION PAPERS FOR GENERAL PAPERS

Research methodology

Time: 2 hrs and 30 min.

Marks 80

Section A

Answer any 12 questions. Each question carries 2 marks (Ceiling 25 marks)

1. What is the role of keywords in a research paper?
2. What is meant by a protocol?
3. What is meant by trial and error method?
4. What is Google Scholar?
5. Define plagiarism
6. What is meant by impact factor of journals?
7. What is meant by Science Citation Index
8. What are the basics of data collection?
9. What is SPSS? Explain its uses in research.
10. What is ISSN Number?
11. Define the term thesis?
12. What are open-access journals?
13. Explain the role of bibliography in a thesis
14. What is meant by data analysis?
15. What is meant by peer-reviewed journals?

Section B

Answer any 7 questions. Each question carries 5 marks (Ceiling 35marks)

16. Which are the different components of a thesis?
17. Differentiate between a research article and a monograph.
18. What is the significance of review of literature in research?
19. Briefly explain the significance of INFLIBNET.
20. Discuss summer school and training research institutes in India
21. Explain the basics of manuscript writing for a journal.
22. Differentiate between observational and experimental research.
23. What is a predatory journal?

Section C

Answer any 2 questions. Each question carries 10 marks (Ceiling 20 marks)

24. Explain the different steps in the preparation of a manuscript for publishing in a journal.
 25. Explain the significance of planning in research.
 26. What is a research project proposal? What are the different components of a project proposal?
 27. What are the main steps of research and analysis of results?
-

Model Question Paper for Core /Complementary papers

Cell Biology (Subject code: **BTY1BO1**) Total Marks: 80

Time: 2.5 Hours

Section A

(Ceiling-25)

Short Answers carries 2 marks each

1. What is endoplasmic reticulum?
2. What are peroxisomes?
3. Differentiate endocytosis and exocytosis?
4. What is plasmodesmata?
5. Cyclins?
6. Cdk inhibitors?
7. Watson-Crick model of DNA?
8. Ribosomes?
9. Karyotyping?
10. Euploidy and Aneuploidy
11. Diakinesis?
12. What is apoptosis?
13. What are oncogenes?
14. Distinguish heterochromatin and euchromatin?
15. Polyribosomes?

Section B

(Ceiling-35)

Paragraph type carries 5 marks each

16. Compare structural organisation of prokaryotic and eukaryotic cell?
17. Define gap junction and tight junction. Give their structure?
18. Explain role of ribosomes in biosynthesis of protein?
19. Explain different types of chromatins?
20. What is MPF? Explain its structure and function?
21. Explain role of chloroplast in photosynthesis?
22. Explain the function of lymphokines, nerve growth factors and platelet derived growth factors?
23. What are telomerases?

Section C

(2X10=20 Marks)

Essay type carries 10 marks

Answer any two

24. Explain cell cycle with neat diagram?
25. Explain protein synthesis with neat diagram?
26. Explain function and types of microscopes with diagram?
27. Explain the molecular organisation and functional role of mitotic apparatus?