File Ref.No.97375/GA - IV - J3/2019/Admn

UNIVERSITY OF CALICUT

Abstract

General & Academic - CBCSS UG Regulations 2019 - Scheme and Syllabus of B.Sc Biotechnology programme w.e.f 2020 Admission onwards -Incorporating Outcome Based Education - Implemented - Subject to ratification of Academic Council - Orders Issued.

G & A - IV - J

U.O.No. 5760/2021/Admn Dated, Calicut University.P.O, 30.05.2021

Read:-1) U.O.No. 9181/2019/Admn, Dated11.07.2019.
2) U.O.No. 15610/2019/Admn, Dated 05.11.2019.
3) The email Dated 25.05.2021, from the Chairperson, Board of Studies in Biotechnology.
4) Remarks of the Dean, Faculty of Science, Dated 29.05.2021.
5) Orders of the Vice Chancellor in the file of even no, Dated 29.05.2021.

ORDER

1. The scheme and syllabus of B.Sc Biotechnology Programme under CBCSS UG Regulations 2019 in the affiliated Colleges of the University, w.e.f 2019 admission onwards has been implemented, vide paper read (1) above and same has been modified , vide paper read (2) above.
2. The Chairman, Board of Studies in Biotechnology, vide paper read (3) above, has forwarded the Scheme and Syllabus of B.Sc Biotechnology Programme , incorporating Outcome Based Education(OBE) in the existing syllabus in accordance with CBCSS UG Regulations 2019, w.e.f 2020 admission, after circulating among the members of the Board of Studies, as per Chapter 3(34) of Calicut University First Statute, 1976.
3. The Scheme and Syllabus of B.Sc Biotechnology Programme, incorporating Outcome Based Education(OBE), has been approved by the Dean, Faculty of Science, vide paper read (4) above and by the Vice Chancellor, subject to ratification by the Academic Council, vide paper read (5) above.
4. The Scheme and Syllabus of B.Sc Biotechnology programme (CBCSS) incorporating Outcome Based Education (OBE) in the existing syllabus, in tune with CBCSS UG Regulations 2019, is therefore implemented with effect from 2020 Admission onwards under affiliated colleges of the University, subject to ratification by the Academic Council.
5. Orders are issued accordingly.
6. U.O.No. 15610/2019/Admn Dated, 05.11.2019 is stands modified to this extend. (Modified syllabus appended)

Ajitha P.P

Joint 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

RESTRUCTURED COURSE CURRICULUM
(Syllabus)

For

B.Sc. BIOTECHNOLOGY
To be followed with the OBE from the academic year
2020 admission onwards

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

COURSE STRUCTURE

	Course Title		Instruc. Hrs/ Week	Credit	Exam Hrs	Marks		
						Int.	Ext.	Total Credit
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				
	1st Complementary course –1	Chemistry	2	3				
	1st Complementary course Practicals -1	Chemistry Practical	2					
BTY1C 01	2nd Complementary course-1	Environmental Biotechnology	2	2				
	2nd Complementary course Practicals – 1	Environmental Biotechnology	2 -------	-- ----				
----------	---------- ----------	----------	25	19				
	Audit course 1	Environment Studies		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				
	1st Complementary Course II	Chemistry	2	3				
	1st Complementary Practical II	Chemistry practical	2	*				
BTY2CO2	2nd Complementary Course II	Environmental Biotechnology	2	2				
	2nd 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 I I	Biochemistry	2	3				
	1st Complementary course III	Chemistry	3	3				
	1st Complementary PracticalIII	Chemistry	2	*				
BTY3C03	2nd Complementary Course III	Environmental Biotechnology	3	2				
	2nd 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				
	Gereral Course	##	5	4				
BTY4BO5	Core Course IV	Genetics	3	4				
	1st Complementary Course IV	Chemistry	3	3				
	1st Complimentary Practical IV	Chemistry practical	2	*	2/2.5 hrs	20%	80%	(24+4) credits
BTY4 C04	2nd Complementary Course IV	Environmental Biotechnology	3	2				
BTY4 C05 (P)	2nd Complementary Course Practical IV	Environmental Biotechnology practical	2	4*				
BTY4 B06 (P)	Core Course Practical II	Practicals in Genetics	2 ------ 25	3** ----- 24				
	Audit Course 4	Gender studies/Gerontology		4				

General Course for Semester IV - # Natural Resource Management and # # Intellectual Property Rights
*The practical exams for the 2nd complimentary course Environmental biotechnology willl be conducted in the fourth semester with 4 credits.

V semester

BTY5B 07	Core Course V	Molecular Biology	4	3				
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**	2/2.5 hrs	20%	80%	22 credits
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 ------- 25	2 ------ 22				
BTY6B18	Project work							

VI semester

BTY6B13	Core course VIII	Plant Biotechnology	4	3				
BTY6B14	Core Course IX	Animal Biotechnology	3	3				
BTY6B15	Core Course X	Recombinant DNA Technology and bioinformatics	3	3	2/2.5 Hrs			
BTY6B16(P)	Core Course Practical VI	Plant Biotechnology Practical	4	3**		20%	80%	17 credits
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 ------				

			25	17				

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.

* 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: Leeuvenhoek and his microscope, Germ theory of disease – Koch's postulates, development in disease prevention, antisepsis, 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, N_2.

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, temperture, O_2 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, ē transport chain, pentose phosphate pathway. (7 hrs)

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

(3 hrs)

References:

1. Pelczar, MJ., 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, 5^{th} 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.

used for the removal of

IV. Principles and application of water purification methods: distillation, ultraviolet light and chlorination. Methods (8 hrs)
nitrogen and phosphorus from waste water.

(8 hrs)

sedimentation, filtration,

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 wing 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 bimolecules; chemical bonds (weak interactions),Energy transactions in Biological systems, measurement of pH(Henderson Hasselbalch equation),l 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 o fintermediates). (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., Cerebrorides), Steroids (Cholesterol), Outline study of □-oxidation; fattyacid biosynthesis (without structure). (4 hrs)

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

VII Enzyme: Classification, Nomenclature, Mechanism of enzyme action, derivation of MichaelisMenten 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, gelfiltration). Electrophoresis: PAGE, AGE, SDS-PAGE. (3hrs)

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 aminoacids 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. Deliguification of rice straw, rice husk using enzymes (white rot jungi, 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 anddihybrid 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 Chironopous 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 thuringenesis 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 eukaryoticgenome, 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, mismatchrepair 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, rRNAand tRNA, chemistry and pathway of splicing, alternative splicing, properties of the geneticcode, 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 lymphoidtissue.(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, hypervariableregions. Complementary determining regions. Frame work regions. Isotype, allotypeand idotypic 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 Histocompatability Complex – types, HLA, Complement system, Cytokines (2hr.)

8. Hypersensitivity: Classes hypersensitive reactions. (type-1) IgE-mediatedhypersensitivity - intracellular events in most cell degranulation, pharmacological agents in type I reactions, type II, hypersensitivity - erythroblastosisfoetalis type – IIIhypersensitivity - Immunocomplex mediated hypersensitivity -type IV- delayed -type hypersensitivity.(10hrs)

9. Immunological disorders: Autoimmunity: Maintenance of tolerance, auto immune diseases: organ specific -Hashimoto's thyroidits, Grave's disease. Systematic autoimmune disease – multiplesclerosis, 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 tumorantigen, cancer immunotherapy - cytokine therapy - interferons. Tumor necrosisfactros, monoclonal antibodies and immunotoxins.(8hrs)

11. Monoclonal antibodies and vaccines: Active and passive immunisation, vaccine designsrecombinant 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 fementor. 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. Chromatographi 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.

BTY6B12 (P)-Core Course Practical-V- Practicals in bioprocess technology

1. Isolation of antiobiotic 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 Annilesse 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.

5. Edwin F. George (1993). Plant propagation by Tissue Culture, Part

I. The Technology II Ed. Exegetics Ltd.
6. Edvin 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. CO_2 incubator. Cryostorage (liquid Nitrogen flask), refrigerated centrifuges freezers (-80^0C) 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, - CO_2 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

Culture of Animal cells, 3rd Edition, R. Ian Freshney. A John Wiley & Sons, Inc.,

publications.
Animal Cell Culture-Practical Approach, R.W. Masters, Oxford. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
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.
From Genes to Clones Introduction to Gene Technology -Winnacker, E.L.1987., Panima Educational Book Agency, New Delhi.
Gene VII -Benjamin Lewin, 2000. Oxford University Press, UK.
1. 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 hybridiztion, 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 – Tiplasmid.

(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, Witkowsk, 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

Staphyolococcus

Streptococcus

Pneumococcus

Clostridium

Enterobacteriacea 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 – Inflibnet – 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 SustainableDevelopment. Prentice Hall of India.
4. Pandey, B. W. 2005. Natural Resource Management. Mittal Publications.

5. Lynch D. R. 2011. Sustainable Natural Resource Management. Cambridge University

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 7questions. 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?

Programme Outcome for the BSc. Biotechnology

Students will attain following capabilities after successful completion of B.Sc. Biotechnology programme. To be followed with the OBE from the academic year 2020 admission onwards

PO1	**Acquire basic knowledge about fundamentals of Biotechnology programme**
PO2	**Understand the technological components in Biotechnology after acquiring basics of classical science and engineering**
PO3	**Apply the Biotechnology for the large-scale exploration in healthcare, agriculture, environment and industry.**
PO4	**Analyse the basic problems that can be addressed by biotechnology**
PO5	**Appreciate difference between technologies adopted by Biotechnology over the other technologies**
PO6	**Perceive the option of higher studies in the specific area or in a biotechnology based industrial venture.**

Semester 1- Cell Biology (BTY1B 01) Learning Outcomes

At the end of the semester a student should be able to:

Know the

- Basics of structural organization of prokaryotic and eukaryotic cell.
- Cell organelles and its properties.
- Clear idea of Interaction between cell and its environment.
- Overview of cell division in prokaryotes and eukaryotes
- Acquire knowledge about of cell signalling, stem cells and cancer.

Also they can demonstrate skill in communication of their idea in cell Biology *via* presentation and group discussion.

Semester 1- Environmental Biotechnology (BTY1C 01) Learning Outcomes

At the end of thesemester a student should be able to:

Demonstrate the

- Basic concepts of ecology and ecological relationships between organisms and their environment.
- Overview of diversity of life forms in an ecosystem.
- Identify a number of habitats from the differentecosystem.
- Correlate choice of habitat for organisms to Abiotic Factors.
- Identify the role of the organism in energy transfers.
- Ecology of Communities and Dynamics of Population.
- Ecological Cycles and human influences on ecosystem.
- Strategies of pollution control and waste management.
- Experimental design, understanding and use of information from scientific articles.
- Ecological problems of humanity and nature protection which includes biological variability.

Also they can demonstrate skill in communication of their idea and concept in academic writing and in oral presentations in academic forums.

Semester 2- General Microbiology (BTY2B 02) Learning Outcomes

On Completion of the course the students will be able:

- Know the history of microbiology and classes of microorganisms.
- Know the Difference between eukaryotic & prokaryotic cells.
- Concept of sterilization, Methods of sterilization of media and equipment.
- Isolation of pure cultures.
- Brief account of microbial diseases.

Also they can demonstrate skill in communication of their idea in microbiology*via* presentation and group discussion.

Semester 2- Environmental Biotechnology (BTY2CO2) Learning Outcomes

While completion of the course the student will attain the following learning outcome

- Basics of Water pollution and bacteriological examination of water.
- Various treatments involved in waste water treatment.
- Advantages and application of primary, secondary and tertiary waste water Treatment.
- Detailed exposure to Biological wastewater treatment processes.
- Principles and application of water purification methods.

Also they can demonstrate skill in communication of their idea in Environmental Biotechnology *via* presentation and group discussion.

Semester 3-Biochemistry (BTY3BO3) Learning Outcomes

The course provides a foundation for understanding the fundamental principles to the advanced knowledge in biochemistry.

Learning Outcome

Upon completion of the Biochemistry paper students will be able to:

- Demonstrate the separation techniques in biochemistry and to apply them in basic scientific research.
- Quantify the biological macro and micro molecules in different samples.
- Explain the basic principles behind biochemistry.
- Explain the structure and functions of four major biological macromolecules.
- Outline the major metabolic pathways in human.
- Identify the role of regulatory molecules in human body.

Semester 3-EnvironmentalBiotechnology (BTY3C03) Learning Outcomes

Students who complete this Subject will be able to:

- Identify the sources of solid waste pollution and classify them based on their physical and chemical properties. Adopt simple techniques of solid waste management such as landfill composting and vermicomposting in their residence and vicinity.
- To apply the microbial and floral processes to diminish the solid waste in a specific land area.
- Understand the biochemical mechanism of xenobiotic and recalcitrant degradation using microorganisms.
- Create awareness of emerging concerns related to air pollution and new technologies for addressing these.
- Demonstrate advanced skills in performing literature searches and presenting a critical appraisal.

Semester 3-Course Learning Outcomes- Biodiversity Scope and Relevance

Biodiversity Scope and Relevance paper is included in the third semester of BSc Biotechnology Course. This paper concerns global biodiversity, what we understand by it and why it is in crisis and current efforts to conserve and manage it. By studying the paper, students can

1. Understand different levels of biodiversity.
2. Outline the main reasons for decline and threats to biodiversity.
3. Identify important approaches and practices in biodiversity conservation and management.
4. Develop an understanding of ethical and aesthetic value of biodiversity.

Semester 3-Course Learning Outcomes- Research methodology

Research methodology paper is included in the third semester of BSc Biotechnology Course. The paper imparts understanding on foundational methods and techniques of academic research in biological sciences. By studying the paper, students can

1. Develop understanding on framework of research process.

2. Identify various sources for literature review and data collection
3. Understand ethical issues in research
4. Develop an understanding on project writing, thesis writing and presentation.

Semester 4- Intellectual Property RightsLearning Outcomes

- The students are expected to have the following learning outcomes:
- Acquire skill to understand the concept of intellectual property rights and to develop procedural knowledge to Legal System.
- Demonstrate the importance of patent and also demonstrate process/procedures of drafting/filing a patent grant.
- Demonstrate the usage of copyrights/ trademarks and related rights and their functions.
- Equipped with knowledge in protecting "industrial design", which could be an intellectual property of their experimental design.
- Ability to solve issues relating to intellectual property rights in scientific inventions especially in biotechnological industries.
- Also analyze ethical and professional issues which arise in the intellectual property law context.
- Students will be able to analyze the effects of intellectual property rights on society as a whole.

Semester 4- Genetics (BTY4BO5) Learning Outcomes

The students are expected to have

1. In-depth knowledge about the basis of hereditary and how characters are transferred from one generation to another
2. Understand the mechanistic pathways by which characters are transferred in microorganism
3. Students gain insight into the various genetic disorders and determine the probability of these disorders emerging in a family
4. Understand the statistical method to determine the presence of a character within a population
5. Gain knowledge in analysis and comparing different organism and group to their nearest neighbor on the basis of characters and genomic composition

Semester 4- EnvironmentalBiotechnology (BTY4 C04) Learning Outcomes

Students who complete this Subject will be able to:

- Learn different techniques to reduce a load of chemicals in the environment by applying biofertilizers, biopesticides, and microbial consortiums.

- Learn the theory involved in the production of biofuels from biomass and lignocellulosic waste.
- Differentiate the advantages and disadvantages of “Single Cell Protein” (SCP) for human consumption and bioplastics for the environment.
- Know the biochemical mechanism, optimum condition behind bioleaching, and the microbial consortium used in the same.
- Demonstrate advanced skills in performing literature searches and presenting a critical appraisal.

Semester V- Molecular Biology (BTY5B 07)Learning Outcomes

- Molecular Biology gives an in-depth knowledge of biological process through the investigation of the underlying molecular mechanisms.
- Demonstrate the main structural elements and processes that participate in reproduction, growth, maintenance and regulation of the cell.
- Explain the fundamental structure, properties and processes in which nucleic acids play a part.
- Discuss the molecular mechanisms by which DNA controls development, growth or morphological characteristics of organisms.
- Explain the principles of cloning and genetic manipulation and their application in genetic analysis
- Demonstrate the knowledge of common and advanced laboratory practices in cell and molecular biology.
- Understand and apply the principles and techniques of molecular biology which prepares students for further education and employment in teaching, basic research, or the health professions.
- They can critically and quantitatively analyze scientific data, either their own original data or the published data of others.
- They can define a specific hypothesis and design an experiment to test it, also work collaboratively in team to produce a joint intellectual product.
- With the knowledge of Molecular biology, the student can obtain a position in both public and private sector as a consultant in biochemical, pharmaceutical, biomedical and biotechnological industry.

Semester V- Immunology andImmuno-technology (BTY5BO8)Learning Outcomes

Upon completion of the course the student will have the following learning outcome

- Demonstrate how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology.
- Know the cellular ontogeny and organs involvement in immunity.
- Explain the principles of self-tolerance and autoimmunity.
- Able to provide an overview of the interactionbetween the immune system and pathogens.
- Understand the molecular basis of complex, cellular processes involved in inflammation and immunity, in health and disease.
- Effectively communicate the understanding of basic mechanisms and therapeuticimplications.
- Develop critical thinking and use of primary research publications to understand the scientific processes which lead them to draw hypothesis and scientific discovery.

Also they can engage themselves in discussions about concepts in immunology and research. Communicate their findings using oral presentations and involve in a question & answer session on the content and also publish their research articles on recent advances in immunology.

Semester V- Bioprocess Technology (BTY5B09)Learning Outcomes

- Students will acquire knowledge about the underlying principles of bioprocess unit operations like fermentation, downstream processing including the types and use parts of a fermenter.

- Also have knowledge about genetic engineering for recombinant protein expression and production from various cell systems has advanced knowledge about factorial experimental set up.

- They will understand how industrially useful microorganisms are getting isolated and preserved and the processes of using it for synthesis of industrially important products like Antibiotics, organic acids, enzymes, Single cell proteins, vitamins.

- They will have a strong knowledge about the techniques of development of a new industrially important microorganism.

- Also understand how to select suitable bioreactor for desired application and also to select suitable separation system for downstream processing.

Practical outcome:

- Knowledge about isolating antibiotic producing microbes

- Perform fermentation of grape juice, Microbial enzyme and biomass production

The key concepts of the course will improve the ability of the students to acquire knowledge in industrial bioprocessing and to promote their research in the field of Bioprocess Technology.

Semester V- Open course Introduction toBiotechnology (BTY5D01)Learning Outcomes

Upon completion of the course the student will have the following learning outcome

- Knowledge about the introduction and history of biotechnology.
- Acquire knowledge about the basic principle of Fermentation.
- Application of Biotechnology in food industry, agriculture and medicine.
- DNA finger printing and paternity test

Semester 6- Plant Biotechnology (BTY6B13) Learning outcomes

On Completion of the course the students will be able:

- The goal of this course is to introduce biotechnological methods in plant system.
- Understanding of biotechnological processes and also has applicative value in pharmaceutical and food industry.
- Basis of Plant Tissue culture and its importance
- This course explores the use of biotechnology tools in manipulating the plant system.
- A problem-based learning approach is employed to demonstrate the use of various technologies.

The key concepts of the course will enhance their ability to apply the knowledge acquired in different problem-solving sessions and their own research planning project.

Semester 6- Animal Biotechnology (BTY6B14) Learning outcomes

The students are expected to gain

1. Comprehensive knowledge of the outline of how a cell culture lab should be designed and maintained.
2. Learn how to culture and maintain animal cells
3. Understand the role of different components and their importance for a healthy culture
4. Understand how to subculture and store the cells
5. Gain insight into the methods to determine cytotoxicity which in turn can be used to validate drugs for cancer
6. The students at the end of this course would be experienced in culturing of animal cells and utilizing cells as a source for economically important proteins

Semester 6- Recombinant DNATechnology andbioinformatics (BTY6B15) Learning outcomes

On Completion of the course the students will be able:

- The objective of the course is to familiarize the students with the basic concepts in genetic engineering; to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology; and to appraise them about applications genetic engineering.
- To acquire knowledge in Gene regulation and recombinant protein production.
- Gain the information about Bioinformatics, Biological Databases and Sequence alignment tools.

The key concepts of the course will improve the ability of the students to acquire knowledge in recombinant DNA technology and to promote their individual research in the field of Genetic Engineering and Bioinformatics.

Semester 6- Medical Biotechnology (BTY6 B17) Learning outcomes

- Medical biotechnology is an application of biotechnology that touches the lives of individuals every day. Both wellness and illness have ties to biotechnology.
- This new level of understanding has, in turn, created opportunities for the development of new therapies, drugs, diagnostic tools and research/clinical instrumentation.
- Medical biotechnology is one of the fastest growing opportunities for employment in the medical research field. Scientists are looking at the genetic causes of diseases, genetic links among family members, and individualized cures. As the Human Genome Project continues to map the locations of genes on human chromosomes, more solutions to the cause, prevention and cure of diseases will be discovered.
- This chapter will offer information on the growth structure development and other characteristics of microscopic organism such as bacteria algae or fungi
- Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures

Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also understand structural similarities and differences among various physiological groups of bacteria /archae