

**MAHENDRA ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)**

**NAAC Accredited with 'A' grade | Recognized u/s 2(f) & 12 (B) of the UGC Act 1956
Affiliated to Periyar University
KALIPPATTI, NAMAKKAL (Dt.) – 637 501**



**DEGREE OF BACHELOR OF SCIENCE
CHOICE BASED CREDIT SYSTEM**

SYLLABUS FOR B.Sc. BIOTECHNOLOGY

**FOR THE STUDENTS ADMITTED FROM THE
ACADEMIC YEAR 2016 – 2017 ONWARDS**

REGULATIONS

1. Objectives of the course:

- ▣ To learn the applications of biological agents to provide goods and services for human community by materials processing.
- ▣ To equip the practical skills of molecular and genome based techniques.
- ▣ To gain knowledge on frontier areas of Biotechnology.
- ▣ To understand the impact of Biotechnology on basic human needs such as Agriculture, Industry, Medicine, Environment etc.
- ▣ To enrich the knowledge of students on current scenario in Biotechnology

2. Eligibility for Admission:

Candidates seeking admission to the first year Degree course shall be required to have passed PUC/12th Std. / 10+2/ its equivalent with at least Biology and Chemistry as two optional subjects.

3. Duration of the course:

The duration of the course is THREE academic years divided into six semesters under Choice Based Credit System.

4. Features of CBCS:

Under Choice Based Credit System (CBCS), a set of papers consisting of Core papers, Elective papers, Skill based elective papers and Non-major elective papers are offered. Beside the Core Papers, which are totally related to the major subject, the students have the advantage of studying supportive papers and non-major papers. This provides enough opportunity to the students to learn not only the major subject but also inter disciplinary and application oriented subjects.

5. Credits:

In CBCS, each paper is assigned with a certain number of Credits depending upon the workload of the students. The total Credits to be earned by a student to qualify for the degree is above 140. The credit of the paper is fixed by giving due weightage to the syllabus content and contact hours per week.

6. Evaluation Procedure:

Evaluation is based on Continuous Internal Assessment (CIA) test and University Examination. Distribution of marks as follows

THEORY

University examination (UE)	Internal Assessment (IA)
75 marks	25 marks

PRACTICAL

University examination (UE)	Internal Assessment (IA)
60 marks	40 marks

7. Question Paper Pattern

THEORY

Time: 3 Hours

Max. Marks: 75

SECTION – A

(Answer ALL Questions)

(10 x 2= 20marks)

All Question Carry equal marks-2 questions from each unit

SECTION – B

Answer ALL Questions:

(5x 5 = 25marks)

(Internal Choice)

All Questions carry equal marks-2 questions from each unit.

SECTION – C

Answer any THREE out of five

(3X10=30 marks)

1 question from each unit

All units in the syllabus should be given equal weightage

PRACTICAL

Time: 6 Hours

Maximum Marks: 60

Major Practical

20 Marks

Minor Practical

10 Marks

Spotters	5 x 4 = 20 Marks
Record	5 Marks
Viva-voce	5 Marks

8. Model Question paper:

NOVEMBER /DECEMBER

Fifth Semester

Biotechnology

MOLECULAR BIOLOGY

Time: Three hours

Max: 75 marks

SECTION A – (10 X 2 = 20 marks)

Answer ALL questions

1. SSBP
2. Okazaki fragments
3. Gene silencing
4. Poly adenylation
5. Oncogenes
6. Post translational modification
7. Tumour suppressor genes
8. Recombination
9. Hybridization
10. Genome mapping

SECTION B (5 X 5= 25 marks)

Answer ALL questions

11. (a) Trace the mechanism of DNA replication OR
(b) Explain briefly the DNA repair mechanism.
12. (a) Write short note on RNA splicing OR
(b) Describe the exportation of mRNA from nucleus.
13. (a) How are proteins imported into mitochondria? OR
(b) Explain about the gene silencing.
14. (a) Give an account on cancer. OR
(b) Write short notes on Tumour suppressor genes.
15. (a) Explain about the genetic mapping. OR
(b) Describe about the physical mapping.

SECTION C – (3 X 10= 30 marks)

Answer any THREE questions

16. Discuss the regulation of gene expression with reference to trp operon.
17. Explain in detail the modifications in RNA in the process of transcription.
18. Analyse the events in translation process.
19. Describe the Holliday model of genetic recombination.
20. Write a detailed account on southern in situ hybridization

MAHENDRA ARTS AND SCIENCE COLLEGE
(Autonomous)
DEPARTMENT OF BIOTECHNOLOGY
B.Sc., Biotechnology – Course Structure (CBCS Pattern- 2016-2017 Onwards)

Part	Sem.	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Part -I	I	M16UFTA01	Tamil –I	3	5	25	75
Part –II		M16UFEN01	English -I	3	5	25	75
Part –III Core -I		M16UBT01	Major -Cell Biology	5	6	25	75
Part –III Allied –I		M16UBCA01	Allied Biochemistry – I	4	6	25	75
Part –III Core Practical-I		M16UBTP01	Lab in Cell biology and Plant biology	-	3	-	-
Part –III Allied Practical–I		M16UBCAP01	Lab in Biochemistry	-	3	-	-
Part –IV Value Education		M16UVE01	Manavalakalai – Yoga	2	2	25	75
				17			
Part -I	II	M16UFTA02	Tamil –II	3	5	25	75
Part –II		M16UFEN02	English –II	3	5	25	75
Part –III Core -II		M16UBT02	Major –Plant Biology	5	5	25	75
Part –III Allied –II		M16UBCA02	Allied -Biochemistry –II	4	5	25	75
Part –IV SBEC –I		M16UBTS01	Computer applications in Biology	2	2	25	75
Value Education		M16UES01	Environmental Studies	2	2	25	75
Part –III Core Practical-I		M16UBTP01	Lab in Cell biology and Plant biology	3	3	40	60
Part –III Allied Practical–I	M16UBCAP01	Lab in Biochemistry	3	3	40	60	
				25			
Part –I	III	M16UFTA03	Tamil –III	3	5	25	75
Part –II		M16UFEN03	English –III	3	5	25	75
Part –III Core –III		M16UBT03	Major -Animal Biology	5	5	25	75
Part –III Allied –III		M16UMBA01	Allied – Basic Microbiology	4	5	25	75
Part –IV SBEC-II		M16UBTS02	Biophysics and Bioinstrumentation	2	2	25	75
Part –IV NMEC			NMEC	2	2	25	75
Part –III Core Practical-II		M16UBTP02	Lab in Animal biology, Genetics and Molecular biology	-	3	-	-

Part –III Allied Practical–II		M16UMBAP01	Lab in Microbiology	-	3	-	
				19			
Part –I	IV	M16UFTA04	Tamil –IV	3	5	25	75
Part –II		M16UFEN04	English –IV	3	5	25	75
Part –III Core -IV		M16UBT04	Major –Genetics and Molecular Biology	5	5	25	75
Part –III Allied –IV		M16UMBA02	Allied – Applied Microbiology	4	5	25	75
Part –IV SBEC -III		M16UBTS03	Bioinformatics	2	2	25	75
Part –IV NMEC			NMEC	2	2	25	75
Part –III Core Practical-II		M16UBTP02	Lab in Animal biology, Genetics and Molecular biology	3	3	40	60
Part –III Allied Practical–II		M16UMBAP01	Lab in Microbiology	3	3	40	60
				25			
Part –III Core –V	V	M16UBT05	Immunology	5	5	25	75
Part –III Core -VI		M16UBT06	rDNA Technology	5	5	25	75
Part –III Core -VII		M16UBT07	Bioprocess Technology	5	5	25	75
Elective I			Elective	4	5	25	75
Part –IV SBEC -V		M16UBTS04	Industrial Biotechnology and IPR	2	4	25	75
Part –III Core Practical-III		M16UBTP03	Lab in Immunology & rDNA Technology	3	3	40	60
Part –III Core Practical-IV		M16UBTP04	Lab in Bioprocess Technology	3	3	40	60
				27			
Part –III Core –VIII	VI	M16UBT08	Plant & Animal Biotechnology	5	5	25	75
Part –III Core -IX		M16UBT09	Environmental Biotechnology	5	5	25	75
Elective II			Elective	4	5	25	75
Part –IV SBEC -VI		M16UBTS05	Nano-biotechnology	2	2	25	75
Part –III Core Practical-V		M16UBTP05	Lab in Plant & Animal Biotechnology	3	4	40	60
Part –III Core Practical-VI		M16UBTP06	Lab in Environmental Biotechnology	3	4	40	60

Project		M16UBTPR1	Project	5	5	40	60
Extension activities		M16UEX01	Extension activities	1	0	0	100
				28			
Total Credits				141			

List of Non Major Elective Courses offered by the Department

SEM	Paper Code	Title of the Paper	Credits	Marks		
				Lecture Hrs/Wk	Int. Marks	Ext. Marks
III	M16UBTN01	Health and Hygiene	2	4	25	75
	M16UBTN02	Food and Nutrition	2	4	25	75
IV	M16UBTN03	Applied Biotechnology	2	4	25	75
	M16UBTN04	Agricultural Biotechnology	2	4	25	75

List of Elective Papers offered by the Department

SEM	Paper Code	Title of the Paper	Credits	Marks		
				Lecture Hrs/Wk	Int. Marks	Ext. Marks
V	M16UBTE01	Bioethics & Bio-safety	4	4	25	75
	M16UBTE02	Developmental Biology	4	4	25	75
	M16UBTE03	Nursery and gardening	4	4	25	75
	M16UBTE04	Herbal Technology	4	4	25	75
VI	M16UBTE05	Food Biotechnology	4	4	25	75
	M16UBTE06	Microbial Disease and Control	4	4	25	75
	M16UBTE07	Pharmaceutical Biotechnology	4	4	25	75
	M16UBTE08	Biofertilizer Technology	4	4	25	75

SEMESTER - I

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Part -I	M16UFTA01	Tamil –I	3	5	25	75
Part –II	M16UFEN01	English -I	3	5	25	75
Part –III Core -I	M16UBT01	Major -Cell Biology	5	6	25	75
Part –III Allied –I	M16UBCA01	Allied Biochemistry – I	4	6	25	75
Part –III Core Practical-I	M16UBTP01	Lab in Cell biology and Plant biology	-	3	-	-
Part –III Allied Practical–I	M16UBCAP01	Lab in Biochemistry	-	3	-	-
Part –IV Value Education	M16UVE01	Manavalakalai – Yoga	2	2	25	75
			17			

CELL BIOLOGY - M16UBT01

UNIT I

Cell as a Basic unit; Classification of cell types; Cell theory; Organization of plant and animals cells; Structural comparison of Microbial, Plant and Animal cells.

UNIT II

Ultra structure of cells; Sub cellular Organization; structure and function of Cell wall, cell membrane, Cytosol Endoplasmic reticulum and Chloroplast, vacuoles, Peroxisomes, lyzosome.

UNIT III

Chromosomes and cell division: Morphology, Structural organization, ultra Structure of chromosome, specialized chromosomes. Cell cycle, Mitosis, Meiosis, Cellular senescence and applications.

UNIT IV

Specialized cells: Motile cells (amoeboid, ciliary, flagellar movements), nerve Cells and nerve impulse conduction, muscle cells and muscle contraction.

UNIT V

Cell-Cell adhesion, Cell signaling- types- G Protein receptors, Cell membrane traffic, Histological techniques- Sectioning, Embedding and Mounting

REFERENCES

1. A Text Book of Cell Biology- Aminul Islam. Books and Allied (P) Ltd, Kolkatta. First edition.2011.
2. Cell Biology- Powar.C.B, Himalaya publishing house, New Delhi.1983.
3. Cell Biology - - DeRoberties, Blaze publishers & Distributors Pvt.Ltd., NewDelhi.
4. Fundamentals of Cytology – Sharp, Mc Graw Hill Company.
5. Cytology – Wilson & Marrison, reinform Publications.
6. Cell and Molecular biology concepts and experiments- Gerald Karp; 4 the Edition.

ALLIED - I - BIOCHEMISTRY - I - M16UBCA01

UNIT-I

Carbohydrates - Introduction, classification, monosaccharide-structure, stereoisomers and structural isomers, mutarotation, and chemical reactions. Oligosaccharides-Dissaccharides-structure and importance of sucrose, Lactose, maltose, .Polysaccharides-structure and importance of homopolysaccharides and heteropolysaccharides.

UNIT-II

Amino acids - Classification, Essential & Non essential amino acids, structure and properties. Protein: Definition, classification and functions – structural levels of organization

UNIT-III

Enzymes – Definition, classification with example, active site, lock and key model, induced fit hypothesis. Enzyme units – kinetics- factors affecting enzyme activity,

UNIT -IV

Lipids - Classification, physical & Chemical properties, saturated and unsaturated fatty acids , Structure of cell membrane & transport.

UNIT-V

Vitamins - Classification, occurrence, deficiency symptoms, biochemical functions of fat soluble and water soluble Vitamins.

REFERENCES

1. Lehninger's Principles of Biochemistry (2000) by Nelson, David I. and Cox, M.M. Macmillan/ worth,.NY
2. Fundamentals Of Biochemistry (1999) by Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY
3. Biochemistry 3rd (1994) by Lubert stryer, W H freeman and co, Sanfrancisco.
4. Biochemistry 4th edition (1988) by Zubay G L , W M C Brown Publishers.
5. Principles of Biochemistry (1994) Garrette & Grisham, Saunders college publishing.
6. Outlines of Biochemistry (1987) by Eric E.Conn, P.K. Stumpf, G.Brueins and Ray H.DoI, John Wiley & Sons, NY
7. Text book of biochemistry (1997) 4th edition Thomas M devlin, A John Wiley, Inc publication, New york.

SEMESTER - II

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Part -I	M16UFTA02	Tamil –II	3	5	25	75
Part –II	M16UFEN02	English –II	3	5	25	75
Part –III Core -II	M16UBT02	Major –Plant Biology	5	5	25	75
Part –III Allied –II	M16UBCA02	Allied -Biochemistry –II	4	5	25	75
Part –IV SBEC –I	M16UBTS01	Computer applications in Biology	2	2	25	75
Value Education	M16UES01	Environmental Studies	2	2	25	75
Part –III Core Practical-I	M16UBTP01	Lab in Cell biology and Plant biology	3	3	40	60
Part –III Allied Practical–I	M16UBCAP01	Lab in Biochemistry	3	3	40	60
			25			

PLANT BIOLOGY - M16UBT02

UNIT I

Classifications : Artificial - Natural – Phylogenetic. Biosystematics : Two Kingdom and Five Kingdom System of classification. General outlines of Bentham and Hooker's classification- Study of the range, character and economic importance of following families: Anonaceae, Fabaceae, Apocynaceae, Euphorbiaceae and Musaceae.

UNIT II

Structure and modifications of Root, Stem and Leaf, Phyllotaxy - Structure and types of Inflorescences - Structure and types of flowers, fruits and seeds

UNIT III

Tissue and tissue systems – Meristem: types of meristem- Shoot and root apical meristem - anatomy of monocot and dicot roots – anatomy of monocot and dicot stems - anatomy of monocot and dicot leaves.

UNIT IV

Absorption of Water and movement - Diffusion, Osmosis, Plasmolysis, Mechanism of Stomatal opening and closing. Photosynthesis – significance–electron transport system – cyclic and non-cyclic photophosphorylation – C₃ and C₄ pathways. Respiration – mechanism of glycolysis – Krebs cycle – pentose phosphate pathway.

UNIT V

Modes of Reproduction in Angiosperms - Vegetative propagation - Micropropagation - Sexual Reproduction: Structure of mature anther, Structure of mature Ovule and its types Pollination : types – Double fertilization - Development of male and female gametophytes - Development of Dicot Embryo.

REFERENCES

1. Pandey, S.N. 1991 – Plant Physiology, Tata McGraw Hill Publishers (P) Ltd., New Delhi.
2. Verma, V., 1991-A Text Book of Plant Physiology, Emkay Publications, New Delhi.
3. Sivarajan, V.V (1993) – Introduction to Principles of Plant Taxonomy, Oxford & IBH Publishing Co., New Delhi.
4. Sen, S. (1992) – Economic Botany, New Central Book Agency, Calcutta.
5. Earnes, A.J. 1936. Morphology of Lower Vascular Plants. Tata McGraw Hill Publishing Co., New Delhi
6. Esau, K. 1960. Plant Anatomy, Wiley Eastern Private Limited. New Delhi.

ALLIED - II-BIOCHEMISTRY - II - M16UBCA02

UNIT I

Concept of acids and bases. Buffers -Definition and determination of pH, Henderson Hasselbach Equation. Bioenergetics- Laws of Thermodynamics, Redox potential, Respiratory chain, Oxidative phosphorylation (Theories and Mechanism).

UNIT II

Carbohydrate metabolism -Glycolysis, Pyruvate Oxidation and Citric acid cycle HMP shunt, Gluconeogenesis, Glycogenesis, Glycogenolysis.

UNIT III

Protein metabolism -Transamination, oxidative and non-oxidative deamination, decarboxylation - urea cycle.

UNIT IV

Lipid metabolism- Biosynthesis of fatty acids and Oxidation of fatty acids (alpha,beta and omega oxidation). Cholesterol Biosynthesis.

UNIT V

Hormones – Definition, Classification of Hormones, Pituitary Hormones (TSH, ACTH, FSH, LH, GH) and Hypothalamic Hormones (TRF, CRF, GnRH, GHRH).Biological function and disorders of Hormones - Insulin, thyroxine, adrenaline and nor-adrenaline.

REFERENCES

1. Fundamentals of Biochemistry, J.L. Jain, S.Chand publications, 2004.
2. Harper's Biochemistry Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 24th edition, Prentice Hall International. Inc.
3. Fundamentals of Biochemistry (1999) by Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY.
4. Biochemistry 3rd (1994) by Lubert Stryer, W H Freeman and co, Sanfrancisco.
5. Text book of biochemistry (1997) 4th edition Thomas M devlin, A John Wiley, In.
6. Principles of Biochemistry (1994) Garrette & Grisham, Saunders college.
7. Essentials of Biochemistry Sathyanarayanan.U. Books and allied (p) Ltd, 2002 publishing

SBEC - I- COMPUTER APPLICATIONS IN BIOLOGY - M16UBTS01

UNIT I

Introduction to computer: introduction, types of computer; characteristic to computer, generations of computer, classification of computer, programming languages, machine languages, assembly languages, high level languages, input devices, keyboard, mouse, types containing output devices, dot matrix printer, inkjet printer, laser printer, LCD and LED storage devices, ROM, RAM, hard disk. CD, DVD, Primary memory.

UNIT II

Overview Of C- History of C-importance of C, basic structure of C program, contents, variables and data types, character set, Keyboard and identifiers, constants, variables, declaration of storage class, operators and expressions: evaluation of expressions- types of conversion in expressions, operators, -associative mathematical functions- managing input and output operations: reading and writing a character- formatted input and output.

UNIT-III

Decision making and branching: simple IF-IFELSE, Nesting statements, GO TO statement, Decision making and looping; WHILE statements, DO statements, FOR statement –junks in loops. Array: definition and declarations0 types: one, two, multi and dynamic array.

UNIT VI

Character array and string; introduction, declaring strings, OOPS, user defined function- definition of function, written values and their types, function class, Function declaration, all category of functions, nesting of function. Structure and union, introduction accessing structure members, structure initialization, array of structure, array within structure unions.

UNIT-V

Scope and applications of Bioinformatics, Internet basic, biological data base and analysis, Applications of sequence analysis.

REFERENCES

1. Fundamentals of computer science and communications engineering by Alex Lean and Mathew Lean
2. Programming in ANSCI C by E.Balagurusamy.
3. Introduction to Bioinformatics by S.Ignacimuthu.

ENVIRONMENTAL STUDIES -M16UES01

UNIT I

Environment – definition – scope – structure and function of ecosystems- producers, consumers and decomposers- energy flow in the ecosystem - ecological succession – food chain, food webs and ecological pyramids – concept of sustainable development.

UNIT II

Natural resources: renewable - air, water, soil, land and wildlife resources. Non – renewable – mineral coal ,oil and gas. Environmental problems related to the extraction and use of natural resources.

UNIT III

Biodiversity – definition – values – consumption use, productive social, ethical, aesthetic and option values threats to bio diversity – hotspots of bio diver sity – conservation of bio - diversity: in – situ ex – situ. Bio – wealth - national and global level .

UNIT IV

Environmental Pollution: definition – causes, effects and mitigation measures – air pollution, water pollution, soil pollution noise pollution, thermal pollution – nuclear hazards – solid wastes, acid rain – climate change and global warming environmental laws and regulations in india.

UNIT V

Social Issues and the Environment - urban problems related to energy. water conservation, rain water harvesting, watershed management, wasteland reclamation, Environment Protection Act- Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act, wildlife Protection Act, forest Conservation Act.

REFERENCES

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad - 380013, India, Email: mapin@icenet. net (R).
3. Environmental Studies For Undergraduate Courses Erach Bharucha
4. Down to Earth, Centre for Science and Environment (R).
5. Environmental studies by Anilkumar .D.E. Newvage International.
6. Environmental Biology by Phatia.A.L. Ramesh Publisher.
7. Environmental Problems and solution by Arthana.D.K. Vanathy Publisher. Environment its important and the imperative by Sivam varatharajan. Pratheeba publication.

**PRACTICAL - I - LAB IN CELL BIOLOGY AND PLANT BIOLOGY –
M16UBTP01**

CELL BIOLOGY

1. Microscopes and its parts
2. Micrometry - Stage and Ocular Micrometer.
3. Cell Counting - Haemocytometer
4. Mounting buccal epithelium and observing living cells using vital staining.
5. Mitosis in Onion root tip squash
6. Meiosis in grasshopper testis squash
7. Chironomous - Salivary gland Chromosome squash preparation
8. Staining of macro molecules- Carbohydrates and Lipids..
9. Observation o slides (Cardiac muscle, Sperm cell, Muscle cell).
10. Staining of Mitochondria in Yeast using Janus green.
11. Microtomy (Demo)

PLANT BIOLOGY

1. Description of plant family - Anonaceae, Fabaceae, Apocynaceae, Euphorbiaceae & Musaceae
2. Observation of plant Morphology
3. Primary T.S of Monocot and Dicot stem, root, leaf
4. Osmosis, Plasmolysis and Photosynthesis by O₂ evolution
5. Dissection of embryo.

ALLIED PRACTICAL – I - LAB IN BIOCHEMISTRY - M16UBCAP01

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of amino acids
3. Preparation and estimation of starch from potato
4. Preparation of casein from milk
5. Separation of sugar by paper chromatography
6. Separation of amino acid by paper chromatography
7. Separation of lipid by thin layer chromatography
8. Estimation of amino acid by formal titration method
9. Estimation of ascorbic acid by 2,6 Dichloro phenol Indophenol method
10. Estimation of reducing sugar by DNS method
11. Estimation of protein by Biuret method
12. Estimation of cholesterol by Zak's method

SEMESTER - III

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Part –I	M16UFTA03	Tamil –III	3	5	25	75
Part –II	M16UFEN03	English –III	3	5	25	75
Part –III Core –III	M16UBT03	Major -Animal Biology	5	5	25	75
Part –III Allied –III	M16UMBA01	Allied – Basic Microbiology	4	5	25	75
Part –IV SBEC-II	M16UBTS02	Biophysics and Bioinstrumentation	2	2	25	75
Part –IV NMEC		NMEC	2	2	25	75
Part –III Core Practical-II	M16UBTP02	Lab in Animal biology, Genetics and Molecular biology	-	3	-	-
Part –III Allied Practical–II	M16UMBAP01	Lab in Microbiology	-	3	-	
			19			

ANIMAL BIOLOGY - M16UBT03

UNIT I

Classification: concept of species; binomial nomenclature; Salient features, classification and detailed study of non chordates and chordates up to class level.

UNIT II

Animal tissue - epithelium (covering), connective (support), muscle (movement), nervous (control).

UNIT III

Anatomy and physiology of different systems - digestive, circulatory, respiratory, endocrine and excretory system of human beings.

UNIT IV

Modes of reproduction-Asexual and sexual reproduction; Modes-Binary fission, sporulation, budding, gemmule, fragmentation. Gametogenesis-spermatogenesis & oogenesis; Menstrual cycle; Fertilization, Post-fertilization changes.

UNIT V

Concept of biodiversity; patterns of biodiversity; importance of biodiversity; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, biosphere reserves, national parks and sanctuaries.

REFERENCES

1. Kotpal R.L (2003) Modern text book of Zoology- Rostogi Publications, Meerut.
2. Agarwal V.K (2000) Invertebrate Zoology- S.Chand Company.
3. Ekambaranatha Iyer (1993) Manual of Zoology Vol.II, Viswanathan (printers& publishers) Chennai.
4. Jordon, E.L & Verma, P.S. (2000) Chordate Zoology, S.Chand & Co, New Delhi
5. Hoar, W.S (1987) General and Comparative physiology, prentice – Hall.
6. R.C.Dubey (1998).A Text book of Biotechnology ,S.Chand& co Ltd New Delhi .

ALLIED- BASIC MICROBIOLOGY - M16UMBA01

UNIT - I

Development of microbiology as a discipline. Spontaneous generation *vs.* biogenesis. Development of various microbiological techniques. Concept of fermentation. Establishment of fields of medical microbiology, immunology and environmental microbiology with special reference to the work of following scientists: Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff.

UNIT – II

Classification of Microbes - Systems of classification, Numerical taxonomy, Systematic classification of bacteria - Bergey's Manual of Systematic Bacteriology (up to section level), Classification of bacteria on the basis of Nutritional types, Oxygen requirement. General characteristics of Archaeobacteria, Rickettsias, Mycoplasmas, Cyanobacteria and Actinomycetes.

UNIT - III

History of phycology with emphasis on contributions of Indian scientists. General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot, food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Detailed life cycle of *Chlamydomonas* and *Spirogyra*.

UNIT - IV

Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements. Fungal cell ultra-structure, thallus organization and aggregation. Fungal wall structure and synthesis. Sexual and asexual reproduction. Heterokaryosis, heterothallism and parasexual mechanism. Detailed life cycle of *Aspergillus* and *Rhizopus*.

UNIT - V

Protozoa: General characteristics with special reference to *Amoeba*, *Paramecium* and *Giardia* Viruses, viroids and prions: A general introduction with special reference to the structure of the following: TMV, poliovirus, T4 and λ phage, lytic and lysogenic cycles, one step multiplication curve.

REFERENCES

1. Tortora, G.J., Funke, B.R. and Case, C.L. **2012**. Microbiology - An Introduction. 11th Edition. Pearson Education.
2. Stainer, Ingharam, Wheelis and Painter. 1987. General Microbiology. 5th Edition. Macmillan Education, London.
3. A.J. Salle. 1974. Fundamental Principles of Bacteriology. Tata McGraw – Hill Edition.
4. AH Rose. 1977. Chemical Microbiology – An introduction to microbial physiology. Butterworth, London.
5. S. Meenakumari. 2006. Microbial Physiology. MJP Publishers.
6. MT Madigan, JM Martinko and Jack Parker. Brock Biology of Microorganisms. 10th Edition. Pearson and Education Inc., New Jersey.
7. David Freifelder, David M. Freifelder and John E. Cronan. 1994. Microbial genetics. 2nd Edition. Jones & Bartlett Publishers.
8. R.W. Old and S.B. Primrose. 1985. Principles of gene manipulation. Blackwell Scientific Publications.
9. Benjamin Lewin. 2006. Genes IX. 9th Edition. Jones and Bartlett publishers.
10. R.A. Atlas. 1998. Microbiology, Fundamental and Applications. 2nd Edition. McMillan Publishers.
11. Powar and Daginawala. 2010. General Microbiology. Volume – I. Himalaya Publishing House.
12. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publ.
13. Bernard R. Glick & Jack J. Pasternak. 2002. Molecular Biotechnology. Indian edition. Panima Publishing Corporation.
14. Pelzer, Chan and Kreig. 1986. Microbiology. 5th Edition. McGraw-Hill.

BIOPHYSICS AND BIO-INSTRUMENTATION - M16UBTS02

UNIT –I

Nature of chemical bond, Bonds in biological system. Laws of thermodynamics and concept of free energy, Biophysics of Water, Mole concept, Molarity & Normality

UNIT – II

Microscopes- Principles, applications and types. Spectroscopy – Beer-Lamberts law, Colorimetry, UV-Visible spectrophotometer (Single beam and double beam), IR spectrophotometer, Atomic Absorption spectrophotometer. Flame photometer.

UNIT –III

Centrifugation – Principle, preparation and analytical centrifugation, differential centrifugation, density gradient centrifugation – Rate zonal and Isopycnic. Chromatography – Principle, gas liquid chromatography, HPLC, Ion exchange chromatography, affinity chromatography and gel permeation chromatography.

UNIT – IV

Electrophoresis – Agarose gel electrophoresis, SDS-PAGE, 2D gel electrophoresis, X-ray crystallography, Auto radiography.

UNIT – V

Methods of Imaging – X-ray, CT Scan, ECG, EEG, Concept of Radioactivity, methods for measuring radioactivity – GM counter, Scintillation counter (Liquid and solid)

REFERENCES

1. General Biophysics, vol. I & II – H.V. Volkones.
2. David Freifelder, David M. Freifelder and John E. Cronan. 1994. Microbial genetics. 2nd Edition. Jones & Bartlett Publishers.
3. Bioseparations. B.Sivasankar. First edition. 2010. PHI Learning Pvt Ltd, New Delhi
4. Biophysical chemistry – Upadhyay, Himalaya Publication, edition 3, 2005.
5. Biophysics - S. Mahesh (2003), New Age International (P), Ltd.
6. Techniques and methods in Biology. K.L Ghatak. 2001. First edition. PHI Learning Private Limited, New Delhi.

NMEC- APPLIED STATISTICS - M16USTN01

UNIT I

Bio-statistics - definition - types of data – Diagrammatic and Graphical Representation- Sources of data in life science - Uses of statistics.

UNIT II

Measures of Central Tendency - Mean, Median, Mode, - Merits and Demerits.

UNIT III

Measures of dispersion - Range, Standard deviation, Quartile deviation, Merits and demerits, coefficient of variations

UNIT IV

Correlation - Types and methods of correlation, Rank - Correlation,

UNIT V

Regression, Simple regression equation, fitting, Prediction.

REFERENCES

1. P.S.S. Sundar Rao, J. Richard (2012). An introduction to Biostatistics and
2. Reaserch methodology. Fifth Edition, Prentice Hall of India Learning Private Ltd, New Delhi. Price RS.275/-.
3. 2.Gurumani N (2005). An introduction to Biostatistics. 2nd Revised Edition,
4. MJP Publishers, Chennai. PriceRs.160/-.
5. Daniel WW, (1987). Biostatistics, John Wiley and Sons, New York.

SEMESTER - IV

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Part –I	M16UFTA04	Tamil –IV	3	5	25	75
Part –II	M16UFEN04	English –IV	3	5	25	75
Part –III Core -IV	M16UBT04	Major –Genetics and Molecular Biology	5	5	25	75
Part –III Allied –IV	M16UMBA02	Allied – Applied Microbiology	4	5	25	75
Part –IV SBEC -III	M16UBTS03	Bioinformatics	2	2	25	75
Part –IV NMEC		NMEC	2	2	25	75
Part –III Core Practical-II	M16UBTP02	Lab in Animal biology, Genetics and Molecular biology	3	3	40	60
Part –III Allied Practical–II	M16UMBAP01	Lab in Microbiology	3	3	40	60
			25			

GENETICS AND MOLECULAR BIOLOGY - M16UBT04

UNIT I

Mendelian laws of inheritance, Back cross and Test cross. Non-Mendelian inheritance; Chromosomal theory of inheritance. Cytoplasmic inheritance- Snail coiling, keppa particl in paramecium; Haemophilia, Color blindness.

UNIT II

Chromosome aberrations – Numeral and Structural aberrations. Albinism, Sickle Cell Anemia, Phenyl Ketonuria. Genome organization in Bacteria, Plant and Animal.

UNIT III

Structure, types and forms & functions of DNA and RNA. Central dogma of molecular Biology- DNA replication in prokaryotic and eukaryotic, DNA Repair, DNA recombination. Regulation of gene expression-lac and trp operons.

UNIT IV

Microbial genetics and Mutations: Conjugation, Transduction, Transformation. Mutations – Spontaneous and induced- chemical and Physical mutagens. Analysis of mutations in biochemical pathways, one gene – one enzyme hypothesis. One gene one polypeptide hypothesis.

UNIT V

Molecular biology of N₂ fixation, nif gene rearrangement and N₂ fixation in cyanophytes, nif gene transfer in Chloroplast. Agrobacterium and crown gall tumor formation. Molecular marker techniques - RFLP, RAPD, AFLP.

REFERENCES

1. Plant biochemistry and Molecular biology, Lea, P.J & Leegood; 1993 John Wiley & sons.
2. Molecular genetics of Photosynthesis, Anderson, B Salter, H, 1996., IRL press, Oxford.
3. Cell and Molecular Biology – Robertis *et al.* Waverly publication, edition 8, 1995.
4. Genetics – Strickberger, M.W. Printice hall, edition 4, 1997.
5. Molecular Biology of the Cell – Alberts. Garland publication, edition 4, 2002.
6. Text Book of Cell and Molecular Biology - Ajay Paul. Books and Allied (P) Ltd, 2 edi. 2007.
7. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & Sons Publications.

ALLIED- APPLIED MICROBIOLOGY II - M16UMBA02

UNIT- I

Sterilization- Physical and chemical. Growth of bacteria – multiplication – growth curve – Determination of growth. Culture techniques – Pure culture, anaerobic culture – preservation of cultures. Collection and transport of clinical specimens for microbiological examinations. Antimicrobial chemotherapy – Antibiotics – mode of actions

UNIT -II

Morphology, culture, biochemical, pathogenicity, laboratory diagnosis and prevention of bacterial diseases - *Staphylococcus aureus*, *Streptococcus pyogenes*, *Mycobacterium tuberculosis*, *Corynebacterium diphtheriae*, *Clostridium tetani*, *Bacillus anthracis*, *Salmonella typhi*, *Vibrio cholerae*, *Escherichia coli*, *Pseudomonas aeruginosa*.

UNIT –III

Virology: Pox viruses – Variola, Vaccinia. Herpes viruses — Hepatitis Viruses. Picorna Viruses - Polio. Orthomyxo Virus – Influenza. Retro Virus – HIV. Parasitology:, Malaria parasite - Plasmodium species. Mycology: Morphological features of fungi - isolation, identification and diagnosis of fungi from clinical specimens. Superficial mycosis- Taenia nigra - Cutaneous mycosis Dermatophytosis. Subcutaneous mycosis- Sporotrichosi,. Systemic mycosis –Histoplasmosis. Opportunistic mycosis - Candidiasis, - Aspergillosis. Antifungal agents – Sensitivity tests - Mycotoxins.

UNIT –IV

Microorganisms of environment (soil, water and air). Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation. Microbiology of air. Microbes in air. Methods of purification of air. Air borne diseases.

UNIT –V

Microbiology of water – Potability of water quality – Indicator organisms – water purification – waterborne diseases and their control measures. Microbiology of sewage – chemical and biochemical characteristics of sewage – BOD & COD – Sewage treatment – Physical, chemical and biological (trickling filter, activated sludge and oxidation pond) treatment.

REFERENCES

1. AH Rose. 1976. Chemical Microbiology – An introduction to microbial physiology – Butterworth, London.
2. MT Madigan, JM Martinko & Jack Parker. 2002. Brock Biology of Microorganisms – 10th Edition – Pearson and Education Inc., New Jersey.
3. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publ.
4. Bernard R. Glick & Jack J. Pasternak. 2002. Molecular Biotechnology. Indian edition. Panima Publishing Corporation.
5. Pelzer, Chan and Kreig. 1986. Microbiology. 5th Edition. McGraw-Hill.
6. S. Meenakumari. 2009. Microbial Physiology. MJP Publishers.

BIOINFORMATICS - M16UBTS03

UNIT -I

Important contributions - sequencing development - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - Computers and programs – internet - world wide web – browsers - EMB net – NCBI.

UNIT- II

Importance of databases - nucleic acid sequence databases - protein sequence data bases - structure databases - bibliographic databases and virtual library - specialized analysis packages

UNIT -III

Sequence analysis of biological data- models for sequence analysis and their biological motivation- methods of alignment - methods for optimal alignments; using gap penalties and scoring matrices- multiple sequence alignment – introduction - tools for MSA - application of multiple sequence alignment.

UNIT- IV

Gene predictions strategies - protein prediction strategies - molecular visualization- Homology - phylogeny and evolutionary trees - Homology and similarity - phylogeny and relationships.

UNIT -V

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

REFERENCES

1. T K Attwood, D J parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005.
2. C S V Murthy, Bioinformatics, Himalaya Publishing House, 1st Edition 2003.
3. Stephen A. Krawetz, David D. Womble, Introduction To Bioinformatics A Theoretical and Practical Approach, Humana Press, 2003.
4. Hooman H. Rashidi, Lukas K. Buehler, Bioinformatics Basics-Applications in Biological Science and Medicine, CRC press, 2005.
5. S.C. Rastogi & others, Bioinformatics- Concepts, Skills, and Applications, CBS Publishing, 2003.
6. S. Ignacimuthu, S.J., Basic Bioinformatics, Narosa Publishing House, 1995.

NMEC-II -APPLIED BIOTECHNOLOGY - 16UBTN03

UNIT I

Genetic engineering of Herbicide resistant plants, Insect resistance, Viral resistance – Stress tolerant plants, flower pigmentation,- modification of nutritional content, Delayed fruit ripening, Artificial seeds, Terminator seed technology, Nif gene transfer. Intellectual Property Rights.

UNIT II

Transgenic animals (Cattle, Mice) , super ovulation, Embryo transfer, IVF, Preservation Methods. Production of recombinant products – Growth hormones, Human interferons. Dairy Biotechnology, Seri technology. Stem cell therapy. Ethical issues of animal Biotechnology.

UNIT III

Fermentation – Types, Fermentor- Types, Strain improvement, Media formulation, Upstream & Down stream processing. Production of industrially important enzymes, antibiotics, organic acids, Vitamins & aminoacids.SCP. Role of GMOs in Biodegradation. Bioremediation

UNIT IV

Immunoglobulin genes – functions & phylogenetic analysis. Isolation, characterization, purification and production of lymphocytes. Role of Immuno Suppressors and Modulators. Molecular Immunodiagnostic methods. Specificity of T- cell receptors. Role of Biotechnology in Vaccine production. Monoclonal antibodies.

UNIT V

Nanoparticles- Metals. Biological networks. Bionano Particles- nanostarch, nanoparticulate, nanocomposites,nanobiosensors. Dendrimers as nanoparticulates. Nanotechnology in Molecular diagnosis. Nanotechnology in drug Discovery & Delivery. Applications of nanomaterials in medicine. Ethical considerations of Nanobiotechnology.

REFERENCES

1. J.Hammond, P.McGarvey and V.Yusibov 2000. Plant Biotechnology. Springer verlag.
2. Paul Christou and Harry Klee. (2004). Hand Book of Plant Biotechnology. Vol I& II. John Wiley & Sons. Ltd.

3. H.S.Chawla. 1998. Biotechnology in crop improvement. International Book Distributing Company.
4. Nigel Jenkins. Animal Cell Biotechnology: Methods and protocols. Humana Press.
5. John,R.W.Masters. (2000). Animal Cell Culture- Practical approach. Third edn. Oxford University Press.
6. U.Satyanarayana. 2005. Biotechnology. Books and Allied (p) Ltd.
7. Peter F. Stanbury. Principles of Fermentation Technology. Butterworth-Heinemann, Elsevier Science Ltd.
8. Alexander. N. Glazer & Hiroshi Nikaido.W.H. (1995) Microbial Biotechnology. Freeman and Company.
9. Rajasekara Pandian M and Senthilkumar B (2007) Immunology and Immunotechnology. Panima Publishing Corporation , New Delhi.
10. Kuby J (1997) Immunology 3rd Edn .WH Freeman &Co. New York.

**LAB IN ANIMAL BIOLOGY, GENETICS AND MOLECULAR BIOLOGY -
M16UBTP02**

Animal Biology

1. Cockroach –Digestive system and Reproductive systems.
2. Mounting of chick embryo blastoderm
3. Mounting of Mouth parts of Cockroach.
4. Mounting of Mouth parts of Cockroach.
5. Analysis of excretory product during chick development.
6. Collection and handling of Blood specimen
7. Collection and handling of Urine specimen
8. Qualitative analysis of Urine sample
9. Determine haemoglobin concentration
10. Estimation of sugar in Urine
11. Estimation of sugar in Blood
12. Observation of Amoeba, paramecium, Plasmodium, Tapeworm – Scolex, Earth worm, Starfish,
13. Observation of Chick embryos (24, 33 &48Hours).
14. Observation of Frog post-fertilization stages- 2, 4 &8 cell stages.
15. Observation of Transverse section of Ovum, ovary, testis, kidney Pancreas, pituitary thymus and thyroid gland.

Genetics and Molecular Biology

1. Karyotype analysis: Man – Normal and Abnormal – Down and Turner’s Syndromes.
2. Mendel’s laws of genetics - Mono and Dihybrid crosses.
3. Rearing morphology of drosophila (mutant eye identification)
4. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorradbitis elegans*)
5. Isolation and purification of plasmid DNA.
6. Observation of DNA - Agarose gel electrophoresis.
7. Quantification of nucleic acids – DNA & RNA – Chemical and UV method.
8. Separation of protein by SDS PAGE and Staining
9. Bacterial mutagenesis – physical & chemical.
10. Preparation of *E. coli* competent cells.
11. Transformation of bacteria – CaCl₂ method.
12. Bacterial conjugation.
13. Transduction.

LAB IN MICROBIOLOGY - M16UMBAP01

1. Cleaning and Preparation of glassware
2. Preparation of Microbiological media
3. Sterilization – glassware and media – wet, dry and filtration
4. Isolation of microorganisms from various samples
5. Counting of microbes – Use of haemocytometer, colony counting
6. Identification of microbes – Microscopy & Macroscopy
7. Motility of Bacteria by Hanging drop method
8. Staining of bacteria – Simple & differentia staining - Gram, spore, capsule, flagella
9. Culture Techniques - Pure culture - slant, stab, streak etc.
10. Maintenance and storage of bacterial strains.
11. Staining of fungi
12. Identification of algae, fungi, lichens and yeast
13. Identification of protozoa and nematodes
14. Biochemical characterization of Bacteria – Catalase test, oxidase test, Sugar fermentation, IMVIC, urease test, TSI test, Starch hydrolysis.
15. Cultural characteristics of microorganisms on Basal medium, Selective medium,
16. Differential medium, Enriched medium, Enrichment medium.
17. Growth - Growth curve
18. Antibiotic sensitivity test by Kirby- Bauer disc diffusion method.
19. Determination of potability of water by MPN method.

SEMESTER - V

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Part –III Core –V	M16UBT05	Immunology	5	5	25	75
Part –III Core -VI	M16UBT06	rDNA Technology	5	5	25	75
Part –III Core -VII	M16UBT07	Bioprocess Technology	5	5	25	75
Elective I		Elective	4	5	25	75
Part –IV SBEC -V	M16UBTS04	Industrial Biotechnology and IPR	2	4	25	75
Part –III Core Practical-III	M16UBTP03	Lab in Immunology & rDNA Technology	3	3	40	60
Part –III Core Practical- IV	M16UBTP04	Lab in Bioprocess Technology	3	3	40	60
			27			

IMMUNOLOGY- M16UBT05

UNIT I

Historical perspectives and Scope of Immunology, Innate and Acquired immunity, Cells of the Immune system, Haematopoiesis, Organs of the Immune System: Primary and Secondary Lymphoid Organs.

UNIT II

Antigen – Characteristics of antigens, Classes , Factors that influence immunogenicity. Haptens, Mitogens, Adjuvants. Humoral Immune response – B cell activation and proliferation. Cell mediated Immune response – T cell receptors and its activation.

UNIT III

Immunoglobulins – Structure and functions. Antigen – Antibody reactions – Agglutination, precipitation, RIA, ELISA, FACS. Organization and expression of immunoglobulin genes.

UNIT IV

Cytokines: Types and function, Complement-, Classical, Alternative pathway. Major Histocompatibility Complex, Hybridoma technology. Hypersensitivity and its types.

UNIT V

Transplantation immunology.. Autoimmunity, Cancer immunology, Vaccines. Immunotherapeutics. Immuno tolerance, Immunity to infectious diseases-AIDS.

REFERENCES

1. Kubey, J. 1993. Immunology Freeman and company.
2. Janeway, C.A., Immuno-biology Paul Travers 1994.
3. Seemi Farhat Basir., Text Book of Immunology by. First edition.
4. Madhavee Latha, P., A Text Book of Immunology, First Edition. S.Chand & Company Ltd, New Delhi.
5. Ajoy Paul.. Textbook of Immunology
6. Rajasekara pandian M and Senthil kumar B., 2007. Immunology and Immunotechnology. (2007), Panima publishing corporation , New Delhi.

rDNA TECHNOLOGY - M16UBT06

UNIT I

Introduction to genetic engineering and recombinant DNA technology. Various steps involved in rDNA technology. Enzymes of rDNA technology - Restriction endonucleases, exonuclease, DNA modifying enzymes - Polymerase, Transferase, alkaline phosphatase, polynucleotide kinase, and Ligase. cohesive and blunt end ligation, linkers, adaptors and homopolymeric tailing.

UNIT II

Vectors - Plasmids - pBR322, PUC19, Phage vectors, Cosmids, Phagemids, lambda phage virus vectors, Shuttle vectors and expression vectors and M13 mp vectors. Insertion and replacement vectors, Artificial chromosome vectors (YAC, BAC), animal virus derived vectors - SV40p, vaccinia/baculo and retroviral vectors. Plant based vectors - Ti and Ri as vectors.

UNIT III

Construction of genomic libraries and cDNA Libraries. Recombinant selection and screening, DNA amplification - Principles, application and types of Polymerase chain reaction (PCR), RFLP and RAPD.

UNIT IV

Principles of DNA hybridization. Southern, Northern and Western blotting techniques. DNA Sequencing methods, Site directed mutagenesis, Chromosome jumping, DNA Microarray, Method of gene transfer - agrobacterium mediated / chemical mediated and Biolistics.

UNIT V

Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); Transgenic animals – Pharmaceutical products - insulin. Farm animal production. Recombinant DNA technology in the production of vaccines. Ethical issues and safety regulations in rDNA technology.

REFERENCES

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. 2002. Molecular Biology of the Cell, 4th Edition. Garland Sciences.
2. Stanley Maloy 1994. Microbial genetics. 2nd Edition. Jones and Bartlett publisher.
3. Uldis N. Streips and Ronald E. Yasbin. 2002. Modern Microbial Genetics. 2nd Edition. Wiley-Blackwell.

4. Sandy B. Primrose, Richard M. Twyman, Robert W. Old. 2008. Principles of Gene Manipulation. 6th Edition. Blackwell Science.
5. Brown TA. 2008. Genomes. 3rd Edition. New York: Garland Publishing Co. New York: Garland Science.
6. Old, R.W and S.B. Primrose. 1996. Principles of Gene Manipulation: An Introduction to Genetic Engineering. 2nd Edition. Blackwell Scientific Publications, Oxford.
7. Glover, DM. and BD. Hames. 1995. DNA Cloning: A Practical Approach. 2nd Edition. IRL Press, Oxford.
8. Watson J.D., Gilman M., Witkowski, J. and Zoller M. 1992. Recombinant DNA. 2nd Edition. Scientific American Books, New York.
9. Daniel L. Hartl. 2011. Analysis of Genes and Genomes. 8th edition. Maryellen Ruvolo. Laxmi Publications.
10. Keya Chaudhuri. 2012. Recombinant DNA Technology. The Energy and Resources Institute, TERI.

BIOPROCESS TECHNOLOGY - M16UBT07

UNIT I

Introduction to bioprocess, isolation and screening of industrially important microbes. Primary & Secondary detection & assay of fermentation products. Improvement of the strains for increased yield and other desirable characteristics.

UNIT II

Advantages of bioprocess over chemical process. Fermentations – submerged and solid state. Types of fermentor- CSTR, Tower, jet loop, Air lift, bubble column, packed bed. Immobilization- Immobilized cells. Enzyme co-immobilization. Bioreactor design, parts and their functions.

UNIT III

Media formulation, sterilization- Batch and continuous sterilization systems, Sterilization of air- Fibrous filters. Measurement and control of bioprocess parameters- pH, Temperature, Dissolved oxygen. Antifoam agents. Aeration and agitation.

UNIT IV

Rate of oxygen transfer. Determination of oxygen transfer coefficients. Biological properties of medium. Biological heat transfer. Heat transfer coefficients. Scale up and scale down process.

UNIT V

Downstream processing: Precipitation, filtration, flocculation and centrifugation. Cell disruption methods - physical and chemical. Chromatography and separation, drying and crystallization.

REFERENCES

1. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, Prentice Hall, Engelwood Cliffs, 2002.
2. Kalaichelvan and Arulpandi, Bioprocess Technology. MJP. Publishers 2008.
3. Doran. Bioprocess Engineering Principle. Elsevier. 2007.
4. Stanbury, RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
5. Comprehensive Biotechnology. The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4 (2004). Edited by M. M. Young, Reed Elsevier India Private Ltd, India

ELECTIVE- BIOETHICS & BIO-SAFETY - M16UBTE01

UNIT-I

Introduction to ethics/bioethics – Framework for ethical decision making; biotechnology and ethics – biotechnology in agriculture and environment: benefits and risks – benefits and risks of genetic engineering.

UNIT-II

Ethical issues against the molecular technologie. Basics of bioethics principles, international codes and guidelines in India - Ethics in post-genomic era Ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare.

UNIT III

Introduction to Biosafety, Biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

UNIT IV

Biosafety guidelines and regulations (National and International) – Operation of biosafety Guidelines and regulations of Government of India; Definition of GMOs & LMOs; Benefits of Biotechnology, ELSI of Biotechnology, Recombinant products for human healthcare.

UNIT V

Recombinant foods & religious beliefs, GM foods, Release of genetically engineered organisms. Roles of Institutional Biosafety Committee, RCGM, GEAC etc. Biosafety issues in Biotechnology. Overview of National Regulations and International Agreements.

REFERENCES

1. Sateesh, M.K., 2008. Bioethics and Biosafety, I.K.International Pvt. Ltd, New Delhi, India.
2. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.
3. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers.

INDUSTRIAL BIOTECHNOLOGY AND IPR - M16UBTS04

UNIT I

Microbial production of Beer, wine, vinegar, and its commercial importance. Ketogenic fermentation process and mushroom fermentation. SCP production and its economic importance.

UNIT II

Microbial production of Butanol- Acetone , glycerol fermentation- History, versatility of the process, fermentation procedure and equipments, sterility and contaminations, future prospects for the butanol acetone fermentation.

UNIT III

Microbial processes, production and commercial important of Organic acids- Citric acid, Acetic acid. Microbial production of amino acids- Process control in amino acid fermentation, production of L-Glutamic acids, L-Lysine. commercial uses of amino acids.

UNIT IV

Microbial production of Antibiotics- Production, biosynthesis of Tetracycline, Aromatic amino acids -Chloramphenicol, novobiocin. Industrial production of Biopesticides and Biofertilizers.

UNIT V

Intellectual Property Rights (IPR)- different types of IPRs, studies on patents granted in India and other countries. IPR in genetically modified organisms; Regulating the use of biotechnology – rDNA technology – Food and Agricultural ingredients – patenting Biotechnology invention.

REFERENCES

1. Wulf crueger and Anneliese crueger. 2003. Biotechnology- A text book of industrial microbiology. Panima publishing corporation. New Delhi.
2. Jackson AT. 1991. Bioprocess Engineering in Biotechnology. Prentice Hall, Engelwood Cliffs.
3. Shuler ML and Kargi F. 2002. Bioprocess Engineering: Basic concepts, 2nd Edition. Prentice Hall, Engelwood Cliffs.
4. Pepler-Perlman. 2004. microbial technology(Microbial processes). Academic press, 2nd Edition.

5. Young M.M., Reed. 2004. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine. Vol 1, 2, 3 and 4. Elsevier India Private Ltd, India.
6. Mansi EMTEL, Bryle CFA. 2007. Fermentation Microbiology and Biotechnology. 2nd Edition. Taylor & Francis Ltd, UK.

LAB IN IMMUNOLOGY & rDNA TECHNOLOGY - M16UBTP03

1. Preparation of plasma and serum.
2. Blood cell analysis – Using Haemocytometer
 - a. Total count of WBC,
 - b. Differential count of WBC.
3. Agglutination tests:
 - a. ABO Blood grouping.
 - b. WIDAL test.
 - c. ASO test.
 - d. Pregnancy test.
 - e. RPR test.
4. Precipitations:
 - a. Radial immunodiffusion.
 - b. Double immnodiffusion.
 - c. Counter Current immuno electrophoresis.
5. ELISA
6. Isolation and visualization of plasmid DNA.
7. Restriction Digestion of Lamda DNA.
8. Ligation of DNA Fragments.
9. Isolation of Antibiotic Resistant Mutants.
10. Bacterial Transformation.

LAB IN BIOPROCESS TECHNOLOGY - M16UBTP04

1. Isolation of Amylase producing organisms from soil.
2. Isolation of antibiotic producing microbes from soil.
3. Culture optimization (pH and Temperature).
4. Production of industrial enzyme by submerged fermentation- Amylase and Protease
5. Assay of Industrial important enzymes – Amylase & Protease.
6. Microbial production of citric acid using *Aspergillus niger*.
7. Immobilization of cells & enzyme.
8. Wine production.
9. Alcohol production and estimation by chromic acid method.
10. Purification of Enzymes by Dialysis and Chromatography method-Demo.

SEMESTER - VI

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Part –III Core –VIII	M16UBT08	Plant & Animal Biotechnology	5	5	25	75
Part –III Core -IX	M16UBT09	Environmental Biotechnology	5	5	25	75
Elective II		Elective	4	5	25	75
Part –IV SBEC -VI	M16UBTS05	Nano-biotechnology	2	2	25	75
Part –III Core Practical-V	M16UBTP05	Lab in Plant & Animal Biotechnology	3	4	40	60
Part –III Core Practical- VI	M16UBTP06	Lab in Environmental Biotechnology	3	4	40	60
Project	M16UBTPR1	Project	5	5	40	60
Extension activities	M16UEX01	Extension activities	1	0	0	100
			28			

PLANT AND ANIMAL BIOTECHNOLOGY - M16UBT08

UNIT I

Historical events in plant tissue culture, Plant tissue culture, Callus induction, organogenesis, Meristem culture, anther, pollen, embryo culture and their application.

UNIT II

Protoplast technology - protoplast isolation, protoplast fusion and its application. Applications of plant tissue culture: - Elimination of pathogens, Germplasm conservation, somoclonal variation, embryo rescue, artificial seeds, Production of secondary metabolites, production of somatic hybrids.

UNIT III

Agrobacterium mediated gene transfer, Plant viral vectors. Resistance to herbicide, insecticide, virus and bacteria. Plant tissue culture techniques for crop improvement in dicots and monocots

UNIT – IV

Animal cell and Tissue culture: Culture media Primary culture, sub-culture and establishment of cell lines, types of cell lines, maintenance of cell lines, cloning of cell lines. Collection and Preservation of embryos.

UNIT – V

Molecular techniques in cell culture – In situ Molecular Hybridization, Somatic cell fusion, Production of Monoclonal antibodies. DNA transfer – Co precipitation with CaCl₂, Lipofection, Electroporation, Other methods. Transgenics: Transgenic animals – Production and application, Expression of the bovine growth hormone; transgenic in industry – vaccine production.

REFERENCES

1. Culture of Animal cells, A manual of basic technique, R. Ian Freshney, John Wiley and Sons, 5th edition, 2005.
2. Animal Biotechnology – M.M. Ranga, Agrobios Publications, 2nd edition, 2004.
3. An Introduction to plant tissue culture. M.K. Razdan, Oxford and IBH Publishing Company, New Delhi, 2000.
4. Plant Biotechnology: The Genetic Manipulation of Plants, Slater et al, Oxford University Press, Oxford, 3rd edition, 2003.
5. Plant Biotechnology – Mantell S.H and Smith H, Cambridge University Press, UK, 1st edition, 1983.

ENVIRONMENTAL BIOTECHNOLOGY - M16UBT09

UNIT I

Renewable and Non-Renewable resources of energy. Conventional fuels and their environmental impact – Firewood, plant, Animal, Water, Coal and Gas. Modern fuels and their and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen production, Convert ion of sugar to alcohol Gasohol.

UNIT II

Bioremediation : Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes.

UNIT III

Phytoremediation. Degradation of pesticides and other toxic chemicals by microorganisms. Degradation aromatic and chlorinates hydrocarbons and petroleum products.

UNIT IV

Treatment of municipal waste and Industrial waste and Industrial effluents. Biofertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and Fungal biofertilizers (VAM).

UNIT V

Bioleaching Enrichment of ores by microorganisms (gold, copper and uranium). Environmental significance of genetically modified microbes, plants and animals.

REFERENCES

1. Environmental biotechnology (Industrial pollution management) - S.N.Jogdand, 3rdedition, Himalaya publication, 2004.
2. Environmental biotechnology-S.K.Agarwal, TBH, 2nd Edition, 1999.
3. Waste water engineering treatment and reuse-Metcalf&Eddy, Franklin L.Burton, H.David Stensel, 4th edition, Tata McGraw Hill publication, 2005.
4. Ecology and Biotreatment by Ec Eldowney, S. Hardman D.J. and Waite S. 1993. - Longman Scientific Technical.
5. Bioremediation by Baker K.H. and Herson. D. S, 1994, Mc Graw Hill Inc.,
6. Environmental Microbiology edited by Ralph Mitchell. A John Wiley and Sons. Inc.

ELECTIVE- FOOD BIOTECHNOLOGY - M16UBTE05

UNIT I

Microorganisms associated with food - bacteria, fungi & yeast. Enzymes in food preparation. Food contaminations. Food preservation & Food spoilage- types. Canned foods.

UNIT II

Food borne diseases. Food colors (natural & artificial food colourants) – carotenoids, anthocyanins and melanin. Food flavoring agents.

UNIT III

Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods.

UNIT IV

Food quality: Sensory evaluation of food quality, quality factors for consumer safety, food safety standards. FSSA, HACCP and FDA. Processing plants- Cleaning and sanitation methods.

UNIT V

General principle, plant design – design, construction, functionality of building, design & fabrication of equipment. Plant layout Pest proofing/ fumigation methods. Water supply to food processing unit.

REFERENCES

1. Food Processing & Preservation – B.Siva PHI Learning Pvt Ltd 2011.
2. Fundamentals of Food Engineering – D.G. Rao, PHI Learning Pvt Ltd 2010.
3. Food Microbiology – Fundamentals & Frontiers – Michael P. Doyle.
4. Food Microbiology – Frazier. McGraw Hill Publications. Fourth edition.
5. Food Biotechnology – Yiu Hui & G. Khachatourians.
6. Fundamentals of Food Microbiology - Bibek, Laramie & Bhunia, CRC Press.

NANO BIOTECHNOLOGY - M16UBTS05

UNIT I

Nanobiology-concepts, definitions, prospects. Biological Nano objects –DNA, protein, lipids. Biological networks. Bionanoparticles– nanocomposites, nanoparticles.

UNIT II

Methods of Nanobiotechnology - TEM, SEM, AFM, Scanning Probe Electron Microscopy. Nanofabrication- Lithography. Characterization techniques – NMR, Mass (MALDI-TOF) spectroscopy, x-ray diffraction.

UNIT III

Biosensors – definition and classification – Types: Potential, Electrochemical and Biomembrane based sensors. Imaging techniques-digital & molecular.

UNIT IV

Drug delivery systems –polymer therapeutics - polymer drug conjugates; polymeric micelles, Liposome. Determination of mechanical properties - Mechanical testing, Elasticity, Toughness.

UNIT V

Application of Nanobiotechnology in medicine, Drug designing and Cancer treatment. Medical, Social and Ethical considerations of Nanobiotechnology.

REFERENCES

1. Biomaterials Sciences: An Introduction to Materials in Medicine 2nd Edition, Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons.
2. Lehninger's Principles of Biochemistry, 4th Edition, David L. Nelson and Michael M. Cox, 2006
3. Nanobiotechnology: Concepts, applications and perspectives, Christof M. Niemayer, Chad A. Mirkin, Wiley VCH publishers 2004.
4. Bionanotechnology: Lessons from Nature, David. S. Goodsell. Jhonwiley 2006.
5. Naobiotechnology: Molecular Diagnosis, K.K. Jain, Tailor L. Francis Group.

LAB IN PLANT AND ANIMAL BIOTECHNOLOGY - M16UBTP05

Plant Biotechnology

1. Aseptic culture techniques for establishment and maintenance of cultures.
2. Tissue culture media preparation: Preparation of stock solutions of MS, Whites and Gamborg media.
3. Establishment of meristem culture using MS medium
4. Isolation of protoplasts.
5. Establishment and maintenance of callus culture.
6. Establishment and maintenance of suspension culture.
7. Synthetic seeds (Entrapment method).
8. Isolation of genomic DNA from plant.

Animal Biotechnology

1. Preparation & sterilization of animal cell culture media: balanced salt solution and DMEM.
2. Disaggregation of tissues – Trypsinization.
3. Culture of chick embryo fibroblast (monolayer).
4. Viability test and cell counting.
5. Inoculation of virus and observation.
6. Applications of CO₂ incubator & inverted microscope.

LAB IN ENVIRONMENTAL BIOTECHNOLOGY - M16UBTP06

1. Isolation and enumeration of microorganism from air
2. Isolation of halophiles
3. Isolation of heavy metal resistance microorganisms
4. Determination of soil and water pH
5. Determination of dissolved sulphate in water
6. Determination of residual chlorine
7. Analysis of TDS in effluent
8. Estimation of total solids in the effluent sample
9. Isolation of coli forms from water
10. Dissolved oxygen (DO) Experiment
11. Biochemical Oxygen Demand (BOD) Experiment
12. Chemical Oxygen Demand (COD) Experiment