MOTHER TERESA WOMEN'S UNIVERSITY,

KODAIKANAL – 624 102,
Tamil Nadu.

SYLLABUS FOR
B.SC MICROBIOLOGY

From 2018 – 2019 Onwards

MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL

Common Course structure for

UG Programmes under CBCS

B.Sc Microbiology

From 2018 – 2019 Onwards

Mother Teresa Women's University

Kodaikanal

B.Sc Microbiology

Course Structure (CBCS)

Papers offered in each semester/Scheme of Examinations.

P. No.	Paper Code	Course Title	Hours	Credits	Internal	End Semester Exam (ESE)	Total
Semester I							
1.	ULTA11	Part I -Tamil	6	3	25	75	100
2.	ULEN11	Part II - English	6	3	25	75	100
3.	UMBT11	Core I - Basic Microbiology	5	4	25	75	100
4.	UMBT12	Core II - Microbial Taxonomy	5	4	25	75	100
5.	UMBA11	Allied Theory I - Chemistry	5	4	25	75	100
6.	UVAE11	Value Education	3	3	25	75	100
		Total Credits	**30**	**21**			**600**
Semester II							
7.	ULTA22	Part I -Tamil	6	3	25	75	100
8.	ULEN22	Part II - English	6	3	25	75	100
9.	UMBT21	Core III - Microbial Physiology & Metabolism	6	4	25	75	100
10.	UMBP21	Core Practical I - Lab in Microbiology	5	4	25	75	100
11.	UMBA21	Allied Practical I - Chemistry	5	4	25	75	100
12.	UEVS21	Environmental Studies	2	2	25	75	100
		Total Credits	**30**	**20**			**600**
Semester III							
13.	ULTA33	Part I -Tamil	6	3	25	75	100
14.	ULEN33	Part II - English	6	3	25	75	100

15.	UMBT31	Core IV- Microbial Genetics & Molecular Biology	5	4	25	75	100
16.	UMBA32	Allied Theory II – Physics for Biology	5	4	25	75	100
17.	UMBE31	Elective I – Choice1: General Biology Choice2: Human Physiology	4	3	25	75	100
18.	UMBN31	Non Major Elective Course I	2	2	25	75	100
19.	UMBS31	Skill Based Studies I – Biofertilizer (Lab)	2	2	25	75	100
		Total Credits	**30**	**21**			**700**
		Semester IV					
20.	ULTA44	Part I – Tamil	6	3	25	75	100
21.	ULEN44	Part II – English	6	3	25	75	100
22.	UMBT41	Core V - Immunology	4	4	25	75	100
23.	UMBP42	Core II - Lab in Microbial Genetics, Molecular Biology & Immunology	4	4	25	75	100
24.	UMBA42	Allied Practical II – Physics for Biology	3	4	25	75	100
25.	UMBE42	Elective II – Choice1:Cell Biology & Biochemistry Choice2:Developmental Biology	3	3	25	75	100
26.	UMBN42	Non Major Elective Course II	2	2	25	75	100
27.	UMBS42	Skill Based Studies II – Microbiological Analysis of Air & Water (Lab)	2	2	25	75	100
		Total Credits	**30**	**25**			25
		Semester V					
28.	UMBT51	Core VI - Agricultural & Environmental Microbiology	5	4	25	75	100
29.	UMBT52	Core VII - Food & Dairy Microbiology	5	4	25	75	100
30.	UMBT53	Core VIII - Industrial Microbiology	5	4	25	75	100
31.	UMBT54	Core IX - General Virology	5	4	25	75	100
32.	UMBT55	Core X - Enzyme & Enzyme Technology	5	4	25	75	100

33.	UMBE53	Elective III – Choice1:Bioinstrumentation Choice2:Nutritional Biochemistry	3	3	25	75	100
34.	UMBS53	Skill Based Studies III – Food Fermentation Techniques (Lab)	2	2	25	75	100
		Total Credits	**30**	**25**			**700**
		Semester VI					
35.	UMBT61	Core XI – Recombinant DNA Technology	5	4	25	75	100
36.	UMBT62	Core XII - Medical Microbiology	5	4	25	75	100
37.	UMBT63	Core XIII - Plant and Animal Biotechnology	5	4	25	75	100
38.	UMBP63	Core Practical III - Lab in Applied Microbiology I	5	4	25	75	100
39.	UMBP64	Core Practical IV - Lab in Applied Microbiology II	5	4	25	75	100
40.	UMBE64	Elective IV – Choice1:Bioinformatics Choice2: Biosafety & IPR	3	3	25	75	100
41.	UMBS64	Skill Based Studies IV – Bioinformatics (Lab)	2	2	25	75	100
42.	UEAS61	Extension Activity -NSS/YRC/RRC	-	3	25	75	100
		Total Credits	**30**	**28**			**800**
		Total Credits		**140**		**Total**	**4200**

Regulations:

1. Qualification for Admission:

i. Candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Examination, Govt. of Tamilnadu or any other Examination accepted by the syndicate as equivalent there to with atleast one of the following subject.

ii. Biology/Botany/Zoology

iii. Candidate should have secured atleast 55% in the above subject and above in the aggregate.

iv. A relaxation of 10% in the total percentage will be given to SC, ST candidates.

v. Candidates sponsored by industries/hospitals/Clinical laboratories may be considered for admission.

2. **Duration of the course:**

The students will undergo the prescribed course of study for a period of not less than three academic years (Six semesters).

3. Medium of Instruction: English

4. Subject of Study: As given in Appendix A

5. Scheme of Examination: As given in Course Structure

6. Eligibility of the degree:

(i) Candidates will be eligible if they complete the course with the required credits and pass in the prescribed examinations.

(ii) The candidate requires 75% of attendance to attend the semester exam.

(iii) The passing minimum is 40 percent (both in internal and external separately) in each paper.

(iv) The internal marks will be divided as 5 for assignment, 5 for attendance and 15 for written tests. One or two assignments can be given and a consolidate can be taken for the evaluation.

(v) To complete the course the students should gain the prescribed credits i.e. 140 credits.

SEMESTER – I

CORE I - BASIC MICROBIOLOGY-UMBT11

Credits : 4 **Hours :5**

Objectives

- To understand the Prokaryotes & Eukaryotes -Structure and function of cell
- To learn the types of Microscope and its applications
- To understand the overview of Food, environment, medical, industry microbiology
- Compare and distinguish the basics prokaryotic and eukaryotic cell structure

Unit I

History of Microbiology: Contributions of Leeuwenhoek, John Needham, Spallanzani, Tyndall, Lister, Jenner, Pasteur, Robert Koch, Fleming and Elie Metchnikoff.

Unit II

Prokaryotes-Structure and function of cell and cellular components – slime layer, capsule, pili, flagella, cell wall, cytoplasmic membrane and other cytoplasmic inclusions.

Unit III

Eukaryotes - Structure and function of cell and cellular components – cell wall, cilia, nucleus, mitochondria, chloroplast, endoplasmic reticulum, golgi apparatus, lysosomes.

Unit IV

Microscope - simple, compound – bright field and dark field, electron and phase contrast microscope - parts and their functions, resolving power, aperture. Confocal and Fluorescence microscope - basics

Unit V

Scope of Microbiology – Food, environment, medical, industry and research. Sterilization - methods of sterilization and Disinfection.

Reference

1. A.J Salle. Fundamentals of Bacteriology

2. Brock T.D Madigan M.T. Biology of Microorganisms, Prentice Hall Inc.
3. Pelczar M.J., Chan E.C.S., Kreig N.R. Microbiology, McGraw Hill.
4. Stanier R.Y., Ingharam J.L., Wheelis M.L., Painter P.R (1999). General Microbiology, Macmillan Education Ltd. London.
5. Prescott L M., Harley.J P., Klein D A., 2000 Microbiology, WMC Publishers, Lowa, USA.

CORE II - MICROBIAL TAXONOMY-UMBT12

Credits :4 **Hours :5**

Objectives

- To understand the Classification of Microorganisms
- To learn Molecular basis of classification of Microorganisms
- To Compare and distinguish General characters of bacteria, archea and actinomycetes.
- To attain knowledge about the classification and taxonomy of bacteria and viruses

Unit I

Classification of Microorganisms – Introduction – Hacekel's three Kingdom concept – Whittaker's five Kingdom concept – three domain concept of Carl Woese.

Unit II

Binomial nomenclature – species concept – Kingdom, division, class, order, family, and genus. Phototrophs, Heterotrophs, Lithotrophs, Chemotrophs, and Organotrophs. Principles of classification – morphological, physiological biochemical basis of classification. Molecular basis of classification – chemotaxonomy & numerical taxonomy.

Unit III

General characters of bacteria, archea and actinomycetes. Classification of bacteria – Bergey's Manual (upto family level). Classification of Archaeobacteria (upto to family level).

Unit IV

Classification of Algae and Fungi. Salient features, structures and reproduction of algae – Nostoc, and Chlamydomonas. Salient features, structures and reproduction of fungi – *Aspergillus, Rhizopus,* Yeast, *Agaricus* and *Pencillium.*

Unit V

Nomenclature and classification of viruses. Salient Features of Bacteriophages - T_4, Plant viruses - TMV and animal viruses - Adenovirus.

Reference

1. A.J Salle. Fundamentals of bacteriology

2. Brock T.D Madigan M.T. Biology of Microorganisms, Prentice Hall Inc.
3. Pelczar M.J., Chan E.C.S., Kreig N.R. Microbiology, McGraw Hill.
4. Bergey's Manual of Systematic Bacteriology – P.H Sneath, N.S Mair, M. Elizabeth.
5. Stanier R.Y., Ingharam J.L., Wheelis M.L., Painter P.R (1999). General Microbiology, Macmillan Education Ltd. London.
6. N.A Logan – Bacterial Systematics. 1991. Blackwell Scientific Publications.
7. Luria – Virology.

ALLIED THEORY I-CHEMISTRY-UMBA11

Credits :4 **Hours :5**

Objectives

- To understand the basic concepts of chemistry.
- To gain knowledge on bonding and the applications of important molecules.
- Acquire knowledge on chemical kinetics and enzyme kinetics.
- To understand the overview of acid base theory.
- To learn the role of chemistry in biomolecules.

Unit I

Bonding:

1) VB theory – Postulates of VB theory – Applications to the formation of simple molecules like H_2 and O_2. Overlap of atomic orbitals S-S, S-P and P-P overlap – principles of hybridization.

2) MO theory – Formation of MO's – bonding and antibonding and non bonding MO's – MO diagram for hydrogen, helium, F_2.

Unit II

Chemical Kinetics:

Chemical kinetics: Rate of reaction – rate law and rate constant – order and molecularity of reactions – derivation of first order rate constant – half life period – examples of second order and third order reaction – enzyme kinetics.

Unit III

Electrochemistry:

A. Arrhenius theory of electrolytes – weak electrolytes – Oswald's dilution of law and its application – ionic product of water and its applications – solubility product and its determination. pH – definition –simple calculation of pH from molarity of acids and

bases – common ion effect and its application in analytical chemistry – buffer solution – definition – theory of buffer action – application.

B. Acid – base indicators – wprking range of indicators – choice of indicators – commercial cells – primary and secondary cells –Weston – cadmium cell lead storage cell.

Unit IV

Corrosion Principle and methods – corrosion and passivity rusting of ion preventive methods from rusting – Electroplating

Unit V

Carbohydrates – definition and classification:

a) Monosaccharide – preparation properties and uses of glucose and fructose. Configuration of glucose and fructose. Haworth's structure.

b) Disaccharides: Sucrose – manufacture, properties and uses of sucrose – structure. Only (No elucidation) Distinction between glucose fructose and sucrose.

c) Polysaccharides: Starch and cellulose (A general study)

VALUE EDUCATION – UVAE11

Credits :3 **Hours :3**

OBJECTIVES

1. To enable the students to understand meaning and concept of values
2. To understand the need for practicing positive values

Unit I

Values – definition – value crisis – need for practicing positive values for good life – values erosion – its impact on individual, societal – cultural level – way out.

Unit II

Family, material, human values – good health – individual and intellectual freedom – human progress – production and distribution – prosperity and peace – Aesthetic values – sense of beauty – moral ethical value – conscience – integrity – fairness.

Unit III

Societal values – cooperative living – healthy behaviors – justice – social responsibility – free from bribery and corruption – good citizen – good society – pursuit of excellence – Psychological values - self-esteem and acceptance – emotional intelligence – spiritual values – devotion and self-fulfillment

Unit IV

Bioethics – definition – goals and objectives – love of life – animal use and ethics – medical ethics – negligence and wrong judgments – issues genomes on organ transplantation – donors – drugs – mortality – social ethics – child labour and bonded labor

Unit V

Women – and development – sex versus gender – women's rights – factors affecting development – violence against women – right to privacy – abortion and reproductive rights – social stigma – women empowerment – social, economic and political – government program and policies.

SEMESTER –I I

CORE III - MICROBIAL PHYSIOLOGY & METABOLISM-UMBT21

Credits :4 **Hours :6**

Objectives

- To understand the Physiology of bacterial growth
- To obtain knowledge on fermentation pathways of bacteria
- Able to understand the Bacterial respiration and Bacterial photosynthesis
- To acquire knowledge on microbial physiology and metabolism and genomes

Unit I

Physiology of bacterial growth conditions – different phases – growth measurements – differentiation of bacterial cell – Sporulation and Germination.

Unit II

Pathways of carbohydrate utilization – Glycolysis, ED and HMP pathway, Krebs's cycle. ETC, Oxidative Phosphorylation and Substrate level phosphorylation – ATP generation and utilization – fermentation pathways of pyruvate.

Unit III

Bacterial respiration – Anaerobic and aerobic respiration – Respiratory pathway in Nitrobacter group and Methanogens. Bacterial photosynthesis – Carbondioxide fixation.

Unit IV

Pathways in aminoacid biosynthesis – Fatty acid synthesis and degradation – Synthesis of cell wall – peptidoglycon and teichoic acid.

Unit V

Structures of protein and nucleic acids. Forms of DNA, Organelle DNA (mitochondria and chloroplast) and types of RNA. Nucleotide biosynthesis – DNA replication, Transcription and Translation.

Reference

1. Caldwell D.H. 1995 Microbial Physiology and Metabolism. Win C Brown publishers.
2. Moat A.G. & Foster J.W. 1999 Microbial Physiology, John Wiley and Sons Inc.
3. Stanier RY, Ingharam JL., Wheelis ML, Painter PL. 1985 General Microbiology.
4. Brock T.D Madigan M.T. Biology of Microorganisms, Prentice Hall Inc.
5. Pelczar M.J., Chan E.C.S., Kreig N.R. Microbiology, McGraw Hill.

CORE PRACTICAL I - LAB IN MICROBIOLOGY-UMBP21

Credits :4 **Hours :5**

Objectives

- To understand the methods of Sterilization techniques, Preparation and storageof Media
- To be trained the isolation and identification of bacterial cell
- To be trained in Pure culture technique
- To develop the ability to handle the microbes and identification of microbes through biochemical method

1) Sterilization techniques
2) Preparation of Media
3) Preparation of Slant. Stab & Plating techniques.
4) Observation of bacterial colony morphology
5) Observation of cell shape & arrangement
6) Staining techniques - Simple Staining, Gram's Staining, Spore Staining
7) Motility of Bacteria
8) Pure culture technique
   a) Spread plate technique
   b) Streak plate Method
   c) Pour plate technique
9) Microbial population count – viable count & haemocytometer count
10) Micrometry
11) Biochemical tests for identification of bacteria
    i) Acid – gas production

ii) Starch & Protein hydrolysis
iii) MRVP test
iv) IMViC test
v) Catalase test
vi) Oxidase test
vii) TSI test
viii) Coagulase test

12) Determination of growth phases of yeast and E.coli
    a) Calculation of generation time
    b) Relationship between OD and colony forming units
    c) Calculation of growth rate.

Reference

1. Cappuccino, G. James and Natalie Sherman, Gram stain, Microbiology A Lab. Manual, 1999.
2. Atlas, M. Ronald, Alfred E. Brown and Lawrence C. Parks, Gram stain, Experimental Microbiology, 1995.
3. Handbook of Microbiological Media – HiMedia.
4. Biochemical Methods – Wilson & Walker.

ALLIED PRACTICAL I- LAB IN CHEMISTRY- UMBA21

Credits :4 **Hours :5**

Objectives

- Understands the basics of acid-base indicator
- To acquire knowledge in the pH adjustments of different buffers and solution
- To gin knowledge in buffer preparation
- To solve problems using molarity and normality calculations.
- To be able to perform various titration

Unit I

Organic analysis

Analysis of the following function group – Acids, Phenols, aldehydes, ketones, esters, amines, amides, anilides, glucose and fructose. No preparation of solid derivatives.

Unit II

Volumetric Analysis

I. Acidimetry and alkalimetry

a) Titration between a strong acid against NaOH

b) Titration between a strong acid against Na_2CO_3.

c) Titration between sodium hydroxide against oxalic acid.

II. Permanganometry

a) Titration between $KMnO_4$ against oxalic acid.

b) Titration between $KMnO_4$ against ferrous sulfate

c) Titration between $KMnO_4$ against Mohr's salt (ferrous ammonium sulfate)

III Iodometry

a) Titration between sodium thiosulfate and potassium dichromate

b) Titration between sodium thiosulfate and copper sulfate

Estimation: Only one question has to be set either from Unit I or Unit II (Random choice)

ENVIRONMENTAL STUDIES-UEVS21

Credits :2 **Hours :2**

Objectives

- To understand the Scope and importance. Need for public awareness
- To be acquainted with about Natural Resources: Renewable and non – renewable resources
- To comprehend the Concept and structure and function of an ecosystem and to conquer knowledge on Biodiversity and its conservation
- Expand knowledge about the environment and its importance for survival of living organisms

Unit – I

The multidisciplinary nature of environmental studies

Definition, Scope and importance.

Need for public awareness

Unit II

Natural Resources: Renewable and non – renewable resources:

Natural resources and associated problems

a) Forest resources: Use and over – exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams – benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non – renewable energy sources, use of alternate energy sources, case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable of resources for sustainable lifestyles.

Unit III

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers.
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem:
    - Forest ecosystem
    - Grassland ecosystem
    - Desert ecosystem
    - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit IV

Biodiversity and its conservation

- Introduction – definition: generic, species and ecosystem diversity.
- Biogeographical classification of India.

- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, National and local levels.
- India as a mega – diversity nation.
- Hot – spots of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wild life, man – wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of biodiversity: In – situ and Ex-situ conservation of biodiversity.

Unit V

Environmental Pollution

- Causes, effects and control measures of:
    - Air pollution
    - Water pollution
    - Soil pollution
    - Marine pollution
    - Noise pollution
    - Thermal pollution
    - Nuclear hazards
- Solid waste Management: causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management: floods, earthquakes, cyclone and landslides.

Unit VI

Social issues and the Environment

- From Unsustainable to Sustainable development

- Urban problems related to energy
- Water conservation. Rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Unit VII

Human population and the Environment

- Population growth, variation among nations.
- Population explosion – family Welfare Programme.
- Environment and human health
- Human Rights
- Value Education
- HIV / AIDS.
- Women and child welfare

- Role of Information Technology in Environment and human health.
- Case studies.

Unit VIII

Field work

- Visit to a local area to document environment assets – river / forest/ grassland/ hill/ mountain.
- Visit to a local polluted site – Urban/ Rural/ Industrial/ Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems – pond, river, hill slopes, etc.

Reference

1. Agarwal, K.C 2001 Environmental Biology, Nidi Publishing Ltd, Bikaner
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt Ltd. (R)
3. Brunner R.C 1989, Hazardous Waste Incineration, McGraw Hill Inc 480p
4. Clark R.S marine Pollution, Claderson Press Oxford (TB)
5. Cunningham, W.P Cooper, T.H Gorhani, E & Hepworth, M.T 2001, Environmental Encyclopedia, Jaico Publ House, Mumbai 1196p.
6. De A.K Environmental Chemistry, Wiley Eastern Ltd.,
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P 1993 Water in crisis, Pacific Institute for Studies in Dev., Environmental & Security. Stockholm Env. Institute. Oxford Univ Press 473p.
9. Hawkins R.E Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
10. Heywood, VH & Watson R.T 1995 Global Biodiversity Assessment. Cambridge Univ Press 1140p.
11. Jadhav, H 7 Bhosale, V.M 1995 Environmental Protection and Laws. Himalaya Pub House, Delhi 248p.
12. McKinney M.L & Schoch R.M 1996 Environmental Science systems & Solutions, Web enhanced edition 639p.
13. Mhaskar A.K Matter Hazardous, Techno Science publications (TB)
14. Miller T.G Jr Environmental Science, Wadsworth Publishing Co (TB).

15. Odum, E.P 1971 Fundamentals of Ecology, W.B Saunders Co USA, 574p.
16. Rao MN & Datta A.K 1987. Waste Water treatment. Oxford & IBH Publ Co Pvt Ltd. 345p.
17. Sharma B.K 2001 Environmental Chemistry Goel Publ House, Meerut.
18. Survey of the Environment, The Hindu (M)
19. Townseed C. Harper J and Michael Begon, Essentials of Ecology, Blackwell Science (TB).
20. Trivedi R.K Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enciro Media (R).
21. Trivedi R.K and P.K Goel, Introduction to air pollution, Techno Science Publications (TB).
22. Wagner K.D 1998. Environmental Management W.B Saunders Co Philadelphia, USA 499p. (M) Magazine, (TB) Textbook, (R) Reference.

SEMESTER III

CORE IV- MICROBIAL GENETICS & MOLECULAR BIOLOGY-UMBT31

Credits :4 **Hours :5**

Objectives

- Describe the principles of gene regulation in prokaryotic and eukaryotic cells
- Describe the consequences of different types of mutations and DNA-repair systems
- Understand current experimentation in the field of molecular biology.
- Learn how to read and understand primary publications in molecular biology.
- Understand basic and advanced molecular biology concepts and techniques.

Unit I

Microbial Genetics Vs Mendelian Genetics – Nucleic acid as genetic material – Experimental evidence – concept of gene and mutation – Fluctuation test and its significance – Cistron, Complementation of gene function.

Unit II

Chemical mutagen – NTG, HNO_2 – Physical mutagen – UV and Biological mutagen –transposons and their mutagenic action – Auxotroph and drug resistant mutants. DNA damage - types and repair mechanism – Excision and SOS.

Unit III

Genetic exchange in bacteria – transformation, transduction and conjugation – genetic maps – linkages – natural transformation – competence – DNA uptake – F factor in conjugation – Chromosome mobilization – HFr strain.

Unit IV

Genetic code – codon – Wobble hypothesis – Gene expression – Organization of operon – positive and negative operon – lac and ara operon.

Unit V

Extrachromosomal inheritance: Plasmids – Types and curing. Transposons – structure, functions and types. Mechanism of antibiotic resistance.

Reference

1. Gene VIII Lewin, Oxford University Press.
2. Molecular Biology – Watson.
3. DNA replication – Arthur Kornberg.
4. Molecular Cell Biology (W.H Freeman) Lodish, Berk, Zippursky.
5. Molecular Biology – Freifelder, Narosa Publishing Co.,

ALLIED THEORY II –PHYSICS FOR BIOLOGY-UMBA32

Credits :4 **Hours :5**

Objectives

- To understand the principles and applications of Spectroscopy
- To be trained Principles of thermodynamics and their applications.
- To attain knowledge on Types of radioisotopes used in biology
- Have the ability to understand the fundamental of physics in Biological applications

Unit I

Spectroscopy - Absorption spectroscopy – principle, instrumentation and applications of atomic absorption, UV visible spectroscopy, Infrared spectroscopy, Nuclear Magnetic Resonance Spectroscopy, NOSY, COSY and ROSY techniques. Electron Spin resonance.

Unit II

Emission spectroscopy – introduction, principle, method and application of Flame photometry. Fluorimetry – principle, instrumentation and application. Mass spectroscopy – principle, instrumentation and application. Light scattering Raman Spectroscopy; principles, method, application with reference to biological macromolecules such as proteins and nucleic acids.

Unit III

Principles of thermodynamics and their applications. Introduction, thermodynamics system, thermodynamic state functions, first and second laws of thermodynamics, concept of free energy, standard free energy, determination of G for a

reaction, relation between equilibrium constant and standard free energy change, biological standard state and standard free energy change in coupled reactions.

Unit IV

Types of radioisotopes used in biology, units of radioactivity measurements, techniques used to measure radioactivity (gas ionization and liquid scintillation counting), nuclear emulsions used in biological studies (pre-mounted liquid and stripping).

Unit V

Isotopes commonly used in biochemical studies – ^{32}P, ^{35}S, ^{14}C and ^{3}H. Autoradiography, Biological hazards of radiation and safety measures in handling radioisotopes – Biological applications.

Reference

1. Physical Biochemistry – VanHolde K.E., Prentice Hall Inc.
2. Biophysical Chemistry – Upathayah
3. Practical Biochemistry – Principles and Techniques – Keith Wilson & John Walker.
4. Practical Biochemistry – D. Friefelder, WH Freeman & Co USA.

ELECTIVE I –CHOICE1: GENERAL BIOLOGY-UMBE31

Credits :3 **Hours :4**

Objectives

- To understand the basis of plant classification
- To acquire knowledge about the different characteristics of plants.
- Learn the basics of human body and its organization
- To know in detail about the structure and function of organs in the human body

Unit I

Basis of Classification – Bentham and Artificial, Natural Classification of plants. Morphology, Structure and reproduction in plants. Algae: General characters – *Sargassum* as an example – Economic importance of Sea weeds. Fungi: General characters – *Yeast* as an example.

Unit II

Bryophytes: General characters – *Funaria* as an example - alternation of generation. Pteridophytes: General characters – *Selaginella* as an example. Gymnosperm: General characters – *Pinus* – Economic uses of gymnosperms. Angiosperms – Monocot flower – *Allium cepa*; Dicot flower – *Tribulus terrestris*.

Unit III

Digestion: Organization, movement and secretions of gastrointestinal tract. Respiration: respiratory organs– morphology and respiratory pigments. Circulation: Blood – composition of blood - General organization of circulatory systems.

Unit IV

Excretion system – excretory organs – general organization in man – muscular system – ultra structure of voluntary muscle.

Unit V

Nervous system – CNS – Autonomic nervous system – Endocrine system in man.

Reference

1. A.C.Dutta, Botany for degree students
2. G.M.Smith, Cryptogamic Botany Volume I & II
3. W.T.Taylor and R.J.Wehe – General Biology
4. Narayanaswamy – Outlines of Botany
5. General Biology – Cambridge Press

ELECTIVE I-CHOICE 2: HUMAN PHYSIOLOGY-UMBE31

Credits :3 **Hours :4**

Objectives

- To learn fundamentals of anatomical structures and physiology of body organs.
- Describe the structure and functions of the blood & blood vessels
- Understand how the nervous system controls the body parts.
- Understand the Structure and Functions Liver and Pancreas, Respiratory organs , Urinary System ,Endocrine System

UNIT I

Composition and Functions of blood; White Blood Cells – Types and function; Red Blood Cells – Structure and functions; Haemoglobin –Structure and functions, Blood coagulation, Blood group – ABO, Rh.Structure of heart and blood vessels; Properties of cardiac muscle; cardiac cycle; origin and conduction of heart beat; measurement of arterial blood pressure. cardiac arrest.

UNIT II

General Anatomy; Digestion in the mouth, stomach and intestines. Movements of the intestine; Role of Liver and Pancreas – Structure and Functions.

UNIT III

Structure of Respiratory organs; Sub – divisions of lung air; Chemistry of Respiration. Physiology of the Urinary System- Structure of kidney and nephron; Formation of urine, Skin – Structure and functions, Regulations of body temperature

UNIT IV

Endocrine System – Structure and functions of thyroid, pituitary, parathyroid, adrenals, islets of langerhans of pancreas b) Reproductive System – anatomy of the male and female reproductive organs; menstrual cycle; mammary glands; Fertilisation; Development of Embryo; Pregnancy and parturition

UNIT V

General classification of nervous system ; Structure of nerve cell and Spinal cord; Basic Knowledge of different parts of the brain – anatomy and functions of cerebrum,

cerebellum and medulla oblongata. Structure and function of eye and ear; taste, smell and cutaneous sensations.

Text Books

1. Chatterjee C.C (2004), Human Physiology Volume I, Medical Allied Agency, Kolkata
2. Chatterjee C.C (2004), Human Physiology Volume II, Medical Allied Agency, Kolkata
3. Sembulingam, K. (2000) Essentials of Medical Physiology, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.

Reference Books

1. Best and Taylor, (1992) The Physiological Basis for Medical Practice, Saunders Company.
2. Chaudhri, K. (1993) Concise Medical Physiology, New Central Book Agency (Parentral) Ltd., Calcutta.

NON MAJOR ELECTIVES COURSE I

BIOFERTILIZER PREPARATION (LAB) –UMBN31

Credits :2 **Hours :2**

1. Biofertilizers – introduction, principles and uses
2. Types of biofertilizers
3. Compost preparation
4. Vermi casting
5. Inoculum preparation - rhizobium
6. Packing and field application

Reference

1. Kannaiyan, S. (2003). Biotechnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. New Delhi.

SKILL BASED STUDIES I – BIOFERTILIZER (LAB)-UMBS31

Credits :2 **Hours :2**

Objectives

- Understanding the principles and concepts of biofertilizer
- How to assess compost materials, How to build a compost pile and to assess finished compost for various uses
- To understand the benefits of composting and the biology of the composting process, emphasizing the key factors required for quality compost production and its use at the garden and farm scale.
- Have the skill how to make compost.

1. Biofertilizers – introduction, principles, types and uses
2. Isolation of symbiotic nitrogen fixers - *Rhizobium*
3. Inoculum preparation - *Rhizobium*
4. VAM - Isolation, Types and Identification
5. Mass inoculum production of VAM
6. Compost preparation
7. Vermi casting
8. Packing and field application

Reference

1. Kannaiyan, S. (2003). Biotechnology of Biofertilizers, CHIPS, Texas.

2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. New Delhi.

SEMESTER IV

CORE V– IMMUNOLOGY-UMBT41

Credits :4 **Hours :4**

Objectives

- To understand the molecular and cellular interactions and principles of the immune system.
- To provide students with knowledge on how the immune system works and principles of auto immunity
- To be skilled in microbial infection (bacterial, protozoan, viral infection) and vaccines – types and development.
- To provide a basic knowledge of the immune response and its involvement in health and disease.

Unit I

Development of immunology – Immunity – types –Organs of immune system – Hematopoiesis – Cells of immune system – blood grouping ABO and Rh systems – Blood transfusion.

Unit II

Antigens: properties and types – Haptens and adjuvants. Antibodies: structure, classes and biological functions.

Unit III

Antigen antibody reaction: Precipitation, Agglutination, Complement fixation, Electrophoresis, ELISA and RIA. Host response – humoral and cell mediated immunity. Complement - pathways of complement activation, MHC.

Unit IV

Hypersensitivity, Immune tolerance, Transplantation immunity, Auto immune diseases - SCID, DiGeorge syndrome, Chediak – Higashi syndrome, Leukocyte adhesion deficiency.

Unit V

Immunodeficiency: Immunology of infectious diseases - microbial infection (bacterial, protozoan, viral infection). Toxoid. Vaccines – types and development.

Reference

1. I.M. Roitt, 1988. Essential immunology; Blackwell Scientific Publications, Oxford.
2. R.M Coleman. 1992. Fundamentals of Immunology. W.C Brown Publ.
3. Janis Kuby. 1992. Immunology. W.H Freeman and Coy, N.Y.
4. Illustrated dictionary of Immunology, Cruse.
5. Cellular and Molecular Immunology, Abbas.

CORE II - LAB IN MICROBIAL GENETICS, MOLECULAR BIOLOGY & IMMUNOLOGY-UMBP42

Credits :4 **Hours :4**

Objectives:

- Understanding the principles and concepts of immunology
- To gain knowledge on microbial genetics through practical approach.
- Learn to perform import molecular biology techniques.
- Acquire practical knowledge on important immunological tests.
- To understand the principles and learn the techniques of important diagnostic tests.

1) Determination of antibiotic resistance of given bacterial culture
2) Determination of lethal death time of UV mutation
3) Auxotrophic mutant and drug resistant mutant
4) Transformation in *E.coli* with plasmid
5) Replica plating method
6) Gradient Plate technique.
7) Conjugation.
8) Blood grouping
9) Precipitation method
    i. Immunodiffusion
    ii. Immuno electrophoresis
10) Widal test

11) Western Blot
12) VDRL test
13) CRP test
14) RA test
15) ASO test
16) ELISA

Reference

1. Hudson and Hay Practical Immunology.

2. Cappuccino, G. James. and Natalie Sherman, Gram stain, Microbiology A Lab. Manual, 1999.

3. Atlas, M. Ronald, Alfred E. Brown. and Lawrence C. Parks, Gram stain, Experimental Microbiology, 1995.

4. Handbook of Microbiological Media – HiMedia

ALLIED PRACTICAL II – PHYSICS FOR BIOLOGY-UMBA42

Credits :4 **Hours :3**

Objective

- To attain knowledge on uniform bending and non -uniform bending using different methods
- To understand the principles and applications of Spectroscopy
- To acquire knowledge in the use of spectrophotometer in different aspects.
- Have the ability to understand the fundamental of physics in Biological applications.

1. Acceleration due to gravity-Compound pendulum method
2. Moment of inertia – Torsional pendulum method
3. Young's modulus - Uniform bending - Optic lever method
4. Young's modulus - Non-uniform bending - Pin and microscope
5. Rigidity modulus – Static torsion method.
6. Frequency of A.C - Sonometer
7. Thermal conductivity - Lee's disc method.
8. Refractive index of a solid prism - Spectrometer
9. Refractive index of a liquid prism – Spectrometer
10. Wavelengths of spectral lines – Grating - Normal incidence - Spectrometer
11. Wavelength of spectral lines – Grating - Minimum deviation - Spectrometer
12. Radius of curvature of lens - Newton's rings method.

13. Viscosity of highly viscous liquid - Stoke's method.

14. Surface tension - Drop weight method

ELECTIVE II –CHOICE1: CELL BIOLOGY & BIOCHEMISTRY-UMBE42

Credits :3 **Hours :3**

Objectives

- Understand the basic concepts of biomolecule structure and functions
- Understand the concepts enzymes and coenzymes
- Describe the most important functions of the cell, its microscopic structure and the structure and function of the different cell organelles, Cell cycle and regulation
- Gain an appreciation and knowledge of cell structure, cell signaling and cellular function of biomolecules

Unit I

Introduction to protein structure: Physical and chemical properties of aminoacids and polypeptides. Theoretical and experimental methods for determination of size of proteins. Physical nature of non-covalent interactions. Conformational properties of proteins, Ramachandran Plot, Secondary, Super Secondary, Tertiary and Quaternary structure of proteins.

Unit II

Enzymes: Unit of activity, coenzymes and metal cofactors, temperature and pH effects, Michaelis-Menton kinetics, inhibitors and activators, active site and mechanism of enzyme action, Isoenzyme, allosteric enzyme.

Unit III

Cell cycle and regulation – Mitosis, Meiosis. Cell signaling, signal transduction, hormones and receptors. Signaling pathways.

Unit IV

Cell structure: prokaryotic and eukaryotic (plant and animal cells – structural features – a brief comparative account). Plasma membrane – structure, models and functions. Protoplasm – chemistry and organization – microtubules and microfilaments.

Unit V

Structure and functions of eukaryotic cell organelles – plastid, mitochondria, lysosomes, ribosomes, nucleus, ER, golgi complex.

Reference:

1. The Cell, Lodish
2. Cell & Molecular Biology, S.C Rastogi
3. Cell & Molecular Biology, E.D.P De Robertis and E.M.F De Robertis.
4. Cytology, P.S Verma & V.K Agarwal.

ELECTIVE II-CHOICE 2: DEVELOPMENTAL BIOLOGY-UMBE42

Credits :3 **Hours :3**

Objectives

- Understand the mechanisms of development from genes to the formation of an organism.
- Understand how evolutionary processes have shaped life in its varied forms.
- Explore selected areas of developmental biology in depth.
- Critically analyze, present, and discuss scientific material.
- Apply concepts in developmental biology to your development as a biologist.

UNIT – I

Gametogenesis: Definition-primordial germ cells-origin-spermatogenesis-physiological ripening of sperm-oogenisis-previtellogenesis-vitellogenesis.

UNIT – II

The egg: Size-shape-egg membranes,tertiary membranes,organization of the egg yolk, pigments, egg cortex, polarity, oriin of polarity, types of eggs. Cleavage-Definition, morula, blastula, types of blastula, molecular changes, planes of cleavages, types of cleavage, factors affecting cleavage, cleavage laws, adhesion of blastomeres during cleavage, nuclei of cleaving cells, cytoplasm of cleaving cells.

UNIT – III

Gastrulation: Definition, exogastrulation, metabolism and molecular changes during gastrulation, gene activities during gastrulation. Morphogenic movements-Definition, types epiboly, emboly mechanism of morphogenic movements.

UNIT – IV

Organogenesis: Definion, tabulation, neurogenesis, spermatogenesis, growth and differentiation derivatives of ectoderm and mesoderm.

UNIT – V

Regeneration: Definition – Types, Human Reproduction puberty, Menstrual cycle. Menopause, Pregnancy and related problems parturition and lactation.

REFERENCE:

1. Verma.S and Agarwal V.K. 2000. Chordate Embryology S.Chand & Co. New Delhi.
2. Berrill.N.J., 1986 Developmental Biology Mc.Graw Hill, New Delhi.
3. Patten, B.M., (1958) Foundations of Embryology Mc.Graw Hill, New Delhi.
4. Saunders.J.W (1982) Developmental Biology – Pattern and Principles, Macmillan New York.
5. Principles of Embryology – Waddington.
6. Embryology by Brath.

SKILL BASED STUDIES I I– MICROBIOLOGICAL ANALYSIS OF AIR & WATER (LAB)-UMBS42

Credits :2 **Hours :2**

Objectives

- Provide students with an understanding of important facts, concepts, and the investigative procedures of a microbiology laboratory.
- To attain knowledge on Aseptic technique; handling and analysis of specimens, reagents, other testing materials and the maintenance of a sterile work area
- Provide students with a hands-on familiarity with basic research procedure and associated critical and investigative thinking skills utilizing identification of unknown microorganism specimens in air and water.
- An understanding of fundamental stains, basic staining techniques, and related bacterial and fungal physiology.

1. Bioaerosols
2. Identification of air borne microorganisms – bacteria, fungus
3. Air sample collections and analysis – air samplers, methods of analysis
4. Water Sample Collections
4. Identification of water borne pathogens
5. To detect potability of water samples – MPN test, Membrane Filter techniques
6. Control Measures: Water treatment and its method

Reference

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cumings Science Publishing, USA.
2. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007). Manual of Environmental Microbiology, 3rd edition, ASM press.

SEMESTER V

CORE VI- AGRICULTURAL & ENVIRONMENTAL MICROBIOLOGY

UMBT51

Credits :4 **Hours :5**

Objectives

- To understand the types, isolation and determination of microorganisms in the environment including; water, air and soil; roles and relation of microorganisms to the environment; roles of microorganisms related to biodegradation of environmental contaminated substances
- Recognize factors influencing growth of microorganisms in the soil and the environment
- Understand roles and relation of microorganisms to Agriculture
- Better understand the basic knowledge and techniques in agriculture and environmental microbiology

Unit I

Microbes in soil – Rhizosphere – Phyllosphere. Microbial Interaction – Symbiosis, Mutualism, Commensalism, Competition, Amensalism, Synergism and Parasitism. Plant microbe interaction.

Unit II

Microbes in biogeochemical cycles – Carbon, Nitrogen, Phosphorus and Sulfur cycle. Biodegradation of xenobiotic – Bioaccumulation, Biomagnification and Biodegradation.

Unit III

Plant diseases caused by bacteria – Xanthomonas, Mycoplasma, Spirodomas. Fungi – Pyricularia, Phytophthera, Fusarium. Viruses – TMV, CMV. Viroids – mechanism of pathogen establishment and symptoms. Plant disease control measures.

Unit IV

Economic importance of agricultural microbes. Biofertilizers – preparation and application. Biological nitrogen fixation – mechanism of nitrogen fixation genes and regulation.

Unit V

Types of waste - characterization of solid and liquid waste – Eutrophification. Waste treatment and useful byproducts: Solid waste gasification – composting, liquid waste – aerobic and anaerobic treatment methods – potability of water.

Reference:

1. Ronald M. Atlas & Richard Bartha. 1991. Microbial Ecology, Fundamentals and application.
2. Thomas D. Brock and M.T Madigan. 1991. Biology of Microorganisms.
3. Alexander 1977. Introduction to soil microorganisms and plant growth.
4. N.S. Subba Rao – Soil Microorganisms and Plant growth.
5. N.S. Subba Rao – Biofertilizers.
6. Dasgupta R.S – Plant Pathology.
7. George N. Agriosis – Plant diseases.

CORE VII - FOOD & DAIRY MICROBIOLOGY-UMBT52

Credits :4 **Hours :5**

Objectives

- To provide in-depth understanding of advances in theoretical and practical aspects of food processing.
- Understand the basic concepts in dairy processing.
- Production and preservation of food and dairy products
- To know the principles, significance and current status of food microbiology for human health .

Unit I

Microorganisms important in food microbiology – molds, yeasts, bacteria. Principles of food preservation – high and low temperatures, drying, chemical preservatives, food additives.

Unit II

Vegetables, meat, milk and milk products: Spoilage, preservation and food borne diseases. Methods of preservation – physical and chemical methods. Canning.

Unit III

Preparation of food products – yoghurt, cheese, pickles, bread, vinegar. Spoilage and general preservation methods

Unit IV

Food borne diseases (causative agents, foods involved, symptoms and preventive measures) - Food intoxications: *Staphylococcus aureus, Clostridium botulinum and mycotoxins;* Food infections*: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli,*

Salmonellosis, *Shigellosis*, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Campylobacter jejuni*

UNIT V

Food sanitation and control - HACCP, Indices of food sanitary quality and sanitizers. Water Potability-Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Reference

1. Adams M.R and Moss M.O. 1995. Food Microbiology. Royal Society of Chemistry Publication, Cambridge.
2. Frazier WG and Westhoff Dc. 1998. Food Microbiology. Tat McGraw Hill Publishing Company.
3. Badwart GJ. 1989. Basic Food Microbiology.
4. Hobbs BC and Robert SD. 1998. Food Poisoning and Food Hygiene.
5. Robinson R.K. 1900. Dairy Microbiology.
6. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology . 7 th edition, CBS Publishers and Distributors, Delhi, India.
7. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods . Vol. 1-2, ASPEN Publication, Gaithersberg, MD
8. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction . 9 th edition . Pearson Education.

. CORE VIII - INDUSTRIAL MICROBIOLOGY- UMBT53

Credits :4 **Hours :5**

Objectives

- To understand the Isolation, screening and strain improvement of industrially important microorganisms
- To better understand the concepts and principles of Fermentation processes- media for industrial fermentation, sterilization, inoculum preparation.
- To attain knowledge in applications of industrial microbes and Microbial products
- Know that microorganisms are important in the production of many useful product,physical and chemical conditions that are involved in the production of useful industrial products of microbial origin, cultural and genetic manipulation of these microorgasms in order to produce more of these useful products

Unit I.

Exploitation of microorganisms and their products, screening, strain development strategies, immobilization methods, fermentation media, raw material used in media production, antifoaming agents, buffers, downstream processing.

Unit II.

Fermentation equipment and its uses, fermentor design, Types of fermentors and fermentations- single, batch, continuous, multiple, surface, submerged and solid state.

Unit III

Industrial products from microorganisms: Antibiotics (production of penicillin and streptomycin), Interferons, vaccines, hormones, vitamins.

Unit IV

Enzymes from microbes: amylase, protease. Organic acids: citric acid, acetic acid, amino acids: glutamic acid, lysine.

Unit V.

Production of alcoholic beverages - beer and wine. Biofuels - ethanol, methane. Biogas.

Reference

1. Whitaker and Stanbury. Principles of Fermentation Technology.

2. Casida. Industrial Microbiology. Tata McGraw Hill**.**

3. Wulf Cruger, Biotechnology: A textbook of Industrial Microbiology.

4. McNeil and Harvey. 1990. Fermentation – A practical approach.

CORE IX - GENERAL VIROLOGY & MYCOLOGY-UMBT54

Credits :4 **Hours :5**

Objectives

- To know the basic concepts of viral structure, classification, gene expression and transmission. An understanding of some of the mechanisms involved in viral Pathogenesis
- Relationships among viruses, between individual viruses and their hosts and those among viruses and subviral pathogens.
- Describe general virus life cycle, Predict replication strategy of viruses based on genome composition, Apply concepts of virus structure to replication cycle and Evaluate different control measures of viral diseases
- Become familiar with basic concepts in mycology (e.g., fungal reproduction, physiology, taxonomy, etc.) to gain an overview of the research field.

Unit I

Brief outline on discoveries of viruses. General structure of bacterial viruses – Helical, Icosahedral, Filamentous capsids, Nucleic acid types – envelopes & enzymes – Cultivation, purification and assay methods, classification of virus.

Unit II

Reproduction of Bacteriophages - Lytic and Lysogenic cycle. Life cycle of M13, P1, T4 and Lambda phage – One step growth – application of phages in bacterial genetics.

Unit III

Animal viruses – Structure and life cycle of Rhabdo, Pox, Influenza, Herpes, Adeno, Hepatitis, Retro – HIV and Polio viruses.

Unit IV

Plant viruses: Structure and life cycle of TMV and CMV. Viroids, Virusoids, Satellite virus, Prions. Viruses of algae and fungi.

Unit V

Vaccines – Types of Viral vaccines – Interferons – types and mechanism of antiviral drugs.

Reference

1. Luria – Virology.
2. Brock T.D Madigan M.T. Biology of Microorganisms, Prentice Hall Inc.
3. Pelczar M.J., Chan E.C.S., Kreig N.R. Microbiology, McGraw Hill.
4. Morag C and Timbury MC. Medical Virology. Churchill Livingston, London.
5. Flintoff, Fundamentals of Virology.

CORE X- ENZYME AND ENZYME TECHNOLOGY-UMBT55

Credits :4 **Hours :5**

Objectives

- To understand the basic principles and classification of enzymes.
- Learn different techniques used in enzyme technology and enzyme engineering.
- To acquire knowledge on immobilized enxymes.
- To know the commercial use of immobilized enzyme.
- Become familiar with enzymes and their different types of inhibitions.

Unit I

Introduction to enzymes and historical development in enzymology- Functions, nomenclature and classification of enzymes- Extraction and purification of enzymes

Unit II

Enzyme kinetics – MM Equation. Vmax and Kmax derivation. Lineweaver Burk's

Unit III

Immobilization of microbial enzymes - Methods viz. adsorption, covalent bonding, entrapment & membrane confinement and their analytical, therapeutic & industrial applications. Properties of immobilized enzymes.

Unit IV

Enzyme inhibition and Co-factors - Irreversible, reversible, competitive, non-competitive and un-competitive inhibition with suitable examples.

Allosteric inhibition, types of allosteric inhibition and their significance in metabolic regulation

Unit V

Enzyme Engineering - Chemical modification and site - directed mutagenesis to study the structure - function relationship of industrially important enzymes. Applications of microbial enzymes - Microbial enzymes in detergents, textile, leather and paper industries.

Reference

1. William B. Jako.- Enzyme purification and related techniques -Academic Press, New York.
2. Kurganov. B.I. John Wiley. - Allosteric Enzymes - Kinetic Behaviour-Inc., New York.
3. Rehm H. Jand. Reed G. Verlag Chemie.- Enzymes in Biotechnology
4. Hand Book of Enzyme Biotechnology by Wiseman.
5. W.A. Wood, Methods in Enzymology ,Academic Press
6. Alan Fersht, Enzyme structure & mechanism

ELECTIVE III –CHOICE1: BIOINSTRUMENTATION-UMBE53

Credits :3 **Hours :3**

Objectives

- To know the fundamental principles and applications of basic instruments in biology
- To learn the types of electrophoresis and spectroscopy
- To understand, design and evaluate systems and devices that can measure, test and/or acquire biological information
- Ability to apply advanced control theory to practical research problems.

Unit I

Microscopy – parts and their function, resolving power, aperture – simple, compound, light and dark field, electron and phase contrast microscopes – their applications.

Unit II

Colorimetry: parts and their functions - Beer Lambert's Law. Spectroscopy – pH metry.

Unit III

Chromatography techniques – Principles and types – paper, TLC, Column, HPLC and GC.

Unit IV

Centrifugation techniques – principle, centrifuges and their uses, separation methods. Ultracentrifugation - applications

Unit V

Electrophoretic techniques – principle, electrophoresis of proteins and nucleic acids. Capillary electrophoresis.

Reference

1. Practical Biochemistry – Fifth edition Keith Wilson and John Wilson.
2. Analytical Biochemistry & Separation Techniques – Palanivelu.P
3. Fundamental Laboratory & Approach for Biochemistry & Biotechnology – Alexander.J Ninfa

ELECTIVE III-CHOICE2: NUTRITIONAL BIOCHEMISTRY-UMBE53

Credits :3 **Hours :3**

Objectives

- Explain mechanisms of digestion and absorption.
- Discuss factors influencing bioavailability and provide examples.
- Describe biochemical and physiological functions of the nutrient and illustrate roles of nutrients in these functions.
- Explain mechanisms of nutrient homeostasis in the body.
- Attain knowledge in Physiological role and nutritional significance of carbohydrates, lipids, vitamins

Unit I

Introduction and definition of food and nutrition. Basic food groups; Basic concepts of energy expenditure,unit of energy,measurements of food Stuffs by bomb calorimeter.

Unit II

Nutritive value of proteins; essential amino acids. Single cell proteins. Protein malnutrition and under nutrition, their preventive and curative measures.

Unit III

Hyperglycemia & hypoglycemia - Diabetes mellitus - definition, types, features, gestation diabetes mellitus , glucose tolerance test, glycosurias, Hypoglycemia & its causes

Unit IV

Composition of balanced diet and RDA for infants, children, adolescent, adult male and female, pregnant lactating woman and old age.

Unit V

Physiological role and nutritional significance of carbohydrates, lipids, vitamins (water and fat soluble) and minerals.

REFERENCES

1. Harper's physiological Biochemistry-Harper.
2. Textbook of physiology and nutrition -M.Swaminathan.
3. Illustrated physiology-Mackenna.
4. Principles of Biochemistry, Handler, P.: Smith E.I.; Stelten, D. W. Me. Grew Hill Book Co
5. Text book of Medical physiology -Guyton.

SKILL BASED STUDIES III – FOOD FERMENTATION TECHNIQUES (LAB)-

UMBS53

Credits :2 **Hours :2**

Objectives

- Concept and principles of Fermented Foods - Types, Advantages and Health Benefits
- Know the Preparation of milk based fermented foods – Buttermilk, Cheese
- Know Preparation of grain based fermented foods and vegetables based fermented foods
- To develop skill in Preparation of wine and beer

1. Fermented Foods – Definition, Types, Advantages and Health Benefits
2. Preparation of milk based fermented foods – Buttermilk, Cheese
3. Preparation of grain based fermented foods – Bread, Soy Sauce, Idli
4. Preparation of vegetables based fermented foods – Pickles, Jam
5. Preparation of wine and beer
6. Probiotic Foods – Definition and types

Reference

1. Handbook of food and fermentation technology, Hui YH, et. al. (2004)
2. Advances in Fermented foods and beverages, Holzapfel W (2014)

SEMESTER VI

CORE XI – RECOMBINANT DNA TECHNOLOGY-UMBT61

Credits :4 **Hours :5**

Objectives

- To understand the Molecular Cloning- Tools and Strategies and Methods in Molecular Cloning
- To learn the methods of DNA sequencing in prokaryotic and eukaryotic genomes
- To learn the Construction and Screening of Genomic libraries
- To gain theoretical knowledge in rDNA technology tools

Unit I

Introduction to gene manipulation – restriction enzymes – nomenclature, properties and applications.

Unit II

Cloning vectors - plasmids, cosmids, prokaryotic and eukaryotic expression vectors – broad host range and shuttle vectors.

Unit III

Cloning Strategies – Cloning in *E.coli* and Bacillus – Construction and screening of genomic library and DNA library – PCR – Site Directed Mutagenesis – Blotting, RFLP, RAPD Techniques

Unit IV

Post transcriptional (RNA splicing) and post translational (protein folding) modifications of expressed gene products.

Unit V

Applications of recombinant DNA technology in agriculture – Ti plasmids and their uses in pharmaceuticals, Insulin, Aminoacids, protein engineering and drug design – transgenic plants, animals and microbes – biohazards and biosafety.

Reference

1. Old R.W and Primrose S.B. 1998. Principles of Gene Manipulation.
2. Winnacker E.L. 1987. From genes to Clone.
3. Watson et al, 1991. Recombinant DNA.
4. Brown T.A. 1996. Gene Cloning – An Introduction.
5. Glick B.R and Pasternak J.J. 1998. Molecular Biotechnology.
6. Weaver R.F and Hedrick P.W. 1992. Genetics.
7. Sambrook. Molecular Cloning.

CORE XII - MEDICAL MICROBIOLOGY-UMBT62

Credits :4 **Hours :5**

Objectives

- To understand the basic principles of medical microbiology and infectious disease. It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora.
- The biology of bacterial, viral, fungal, and parasitic pathogens and the diseases they cause are covered. Relevant clinical examples are provided.
- The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.

Unit I

Bacteriology – Morphology, pathogenesis and laboratory Diagnosis of *Staphylococci, Bacillus anthrax, Corynebacterium, Clostridium, Streptococci, Mycobacterium, E.coli, Salmonella, Shigella, Pseudomonas,* and *Vibrio cholerae*.

Unit II

Parasitology: Morphology, pathogenesis and laboratory diagnosis of *E.histolytica*, *Plasmodium* (life cycle), *Giardia, Taenia solium, Ascaris*.

Unit III

Mycology: classification, superficial mycosis - Dermatophytes, rhinosporidiosis, Candidiosis and Aspergillosis. Viral diseases – Polio, Rabies, Dengue, AIDS, Influenza,Oncology.

Unit IV

Antimicrobial chemotherapy – development of chemotherapy – general characteristics of antimicrobial activity – mechanism of action of antimicrobial drugs – sulfonamides and sulfa drugs – penicillin, cephalosporin and tetracycline – factors influencing the effectiveness of antimicrobial drugs.

Unit V

Drug resistance: mechanism of drug resistance – the origin and transmission of drug resistance – MIC and MLC – Antimicrobial susceptibility testing – tube and agar dilutions – disc diffusion tests – Antiparasitic drugs – mechanism and action.

Reference

3. Chatterjee K.D. 1980. Parasitology and Helminthology
4. Jawetz and Melnich. 1986. Review of medical Microbiology.
5. Greenwood, Medical Microbiology.

CORE XIII - PLANT AND ANIMAL BIOTECHNOLOGY-UMBT63

Credits :4 **Hours :5**

Objectives

- Understanding the developments in Plant tissue culture
- To understand the techniques in plant transformation
- Understanding the principles of animal cell culture and its application.
- To understand the cloning techniques, large animal models for disease and development of therapies and treatments.

Unit I

Plant tissue culture, media preparation, surface sterilization, organ culture, embryo culture. Protoplast preparation - isolation and purification of protoplasts, viability test for protoplasts, protoplast culture and direct transformation of protoplasts by electroporation**.**

Unit II

Tumour induction in plants by *Agrobacterium*: Introducing binary vector by triparental mating - leaf disc transformation, uses of *Agrobacterium*. GUS expression in transformed tissues, Ri plasmid, transgenic plants

Unit III

Protoplast fusion, Micropropagation, somoclonal variation, organogenesis, somatic- embryogenesis, somatic hybridization, cybridization, anther and pollen culture, artificial seeds.

Unit IV

Cell synchronization – cell transformation- stem cell cultures, embryonic stem cell culture and their application – cell cultured vaccines. Genetic engineering in animals- Transgenic animals- cloning - Dolly, Polly, Tetra, transgenic mice and gene knock out techniques

Unit V

Somatic cell genesis – Apoptosis – Measurement of cell death. Use of nucleic acid probe and antibodies in clinical diagnosis and tissue typing - Mapping of human genome – PFLP and applications. Ethical issues in animal biotechnology.

Reference

1. Animal Biotechnology. L.A. Babnick & J.P. Philips
2. Animal cell culture – A practical approach. John R.W. Masters
3. Recombinant DNA- J. D Watson, Gilman, Zoller
4. Plant genetics transformation and gene expression, J. Draper et al

CORE PRACTICAL III - LAB IN APPLIED MICROBIOLOGY I-UMBP63

Credits :4 **Hours :5**

Objectives

- To train the students to know Generation of Microbial population in fruit juices and meat.
- To learn the technique to test Milk quality
- To be trained in Water analysis – sewage and drinking water in laboratory
- To develop skill in isolation, identification and enumeration of microbes

1) Generation of Microbial population in fruit juices, soft drinks, ice cream, pickles and meat.
2) Milk quality testing – dye reduction test
3) Water analysis – sewage and drinking water
4) Isolation of Rhizobium
5) Demonstration of Mycorrihaze in infected plant roots
6) Cultivation of Pleurotus sojar caju
7) Immobilization of yeast using sodium alginate
8) Wine production - Alcohol estimation and glucose estimation.
9) Determination of phage titer in a given stock
10) Clear plaque observation

Reference

1. Experiment in Microbiology, Plant Pathology Tissue Culture and Mushroom Cultivation – K.R Aneja, New Age International Ltd.

2. Cappuccino, G. James. and Natalie Sherman, Gram stain, Microbiology A Lab. Manual, 1999.

3. Atlas, M. Ronald, Alfred E. Brown. and Lawrence C. Parks, Gram stain, Experimental Microbiology, 1995.

4. Handbook of Microbiological Media – HiMedia.

CORE PRACTICAL IV - LAB IN APPLIED MICROBIOLOGY II-UMPB64

Credits :4 **Hours :5**

Objectives

- To be trained in distingwish the clinical pathogenic analysis
- To understand the techniques of blood counting
- To be skilled in Isolation techniques of nucleic acid
- To develop the skills in molecular biology techniques to apply in microbes

1) Blood cell counting
2) Clinical analysis of the following bacteria
    b) Staphylococcus
    c) Streptococcus
    d) Salmonella
    e) Pseudomonas
3) Gene transfer in bacteria – Transformation, Conjugation, Transduction
4) Restriction digestion of E. CorI and Isolation of restricted fragments.
5) MIC and MLC of antibiotics against pathogens.
6) PCR
7) Isolation and Gel electrophoresis
    a. Plasmid
    b. Chromosomal DNA
    c. Protein

Reference

1. Cappuccino, G. James and Natalie Sherman, Gram stain, Microbiology A Lab. Manual, 1999.

2. Atlas, M. Ronald, Alfred E. Brown. and Lawrence C. Parks, Gram stain, Experimental Microbiology, 1995.
3. Handbook of Microbiological Media – HiMedia

ELECTIVE IV –CHOICE1: BIOINFORMATICS-UMBE64

Credits :3 **Hours :3**

Objectives

- To learn the History, development and types of computers
- To learn basic tools on bioinformatics and biological databases
- To understand the construction Phylogenetic trees for evolutionary analysis and apply theoretical skill to practical application
- Have the skill about the bioinformatics tools, database for genomic and proteomics

Unit I

History, development and types of computers. General awareness of computer systems – hardware and software (CPU and other peripheral devices, computer arithmetic, computer logic, programming languages – machine language, assembly language, higher level languages). Introduction – Email – World Wide Web – Surfing.

Unit II

Introduction to bioinformatics, classification of biological databases, Biological data formats, application of bioinformatics in various fields. Introduction to single letter code of aminoacids, symbols used in nucleotides, data retrival – Entrez and SRS

Unit III

Sequence analysis – need and importance – pairwise alignment – dynamic programming – Global (Needleman – Wunsch) and Local (Smith Waterman) Alignment concepts – Database searching tools – Entrez, BLAST, FASTA – multiple alignment – Clustal – Construction of Phylogenetic trees.

Unit IV

Use of nucleic acid and protein data banks – NCBI, EMBL, DDBJ, SWISSPORT. 3D structural analysis of biomolecules – molecular visualization tools – RasMol.

Unit V

Evolutionary analysis; Distance – Clustering methods – Rooted and Unrooted tree representation – Bootstrapping strategies. Neural Networks

Reference

1. Bioinformatics – Principles and potential of a new multidisciplinary tool, TIBITE, 1996.
2. Computing for biologists – A. Fielding. 1985. Benjamin/Cuming Publ.Co.
3. Sequence Analysis in molecular Biology – G.Von Heijne.
4. Sequence analysis – A pioneer – Devereux and Gtribskov.
5. Introduction of Bioinformatics – Attwood T and Parry, D. 2002. Pearson Education Asia.

ELECTIVE IV –CHOICE 2: BIOSAFETY & IPR-UMBE64

Credits :3 **Hours :3**

Objectives

- To understand the Biohazards; Biosafety Levels; Biosafety guidelines
- To understand about criteria in applying and maintaining patents.
- To be familiarized with the law and enforcement in Intellectual Property Rights
- To know about IPR and also the importance of protecting their innovation and familiar with international and national law practiced and also recent issues on it.

Unit I Biosafety Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety guidelines

Unit II

Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

Unit III

Introduction to Intellectual Property Types of IP: Patents, Trademarks, Copyright & Related Rights. Introduction to History of GATT, WTO, WIPO and TRIPS. Protection of New GMOs.

Unit IV

Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation

Unit V

Basics of Patents, Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application

REFERENCES

1. Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
2. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
3. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press.ISBN-1555811804,9781555811808.
4. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.
5. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
6. Kankanala, K . C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd.,.Noida, India

SKILL BASED STUDIES IV – BIOINFORMATICS (LAB)-UMBS64

Credits :2 **Hours :2**

Objectives

- To become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.
- To provide practical training in bioinformatics methods including accessing the major public sequence databases, use of the different computational tools to find sequences, analysis of protein and nucleic acid sequences by various software packages.
- To provide a step by step, theoretical and practical introduction to the development of useful tools for automation of complex computer jobs, and making these tools accessible on the network from a Web browser.
- The students will be able to describe the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge

1. Sequence retrieval of Protein from NCBI
2. Sequence retrieval of gene from NCBI
3. Structure download of protein from PDB
4. Structure download of gene from PDB
5. Molecular viewer by visualization software
6. Database searching by – Fasta
7. Database searching by – BLAST
8. Phylogenetic tree construction
9. Multiple sequence alignment using ClustalW

Reference

1. Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring Harbor Laborator Press (New York), ISBN: 0-87969-608-7.
2. Bioinformatics and Functional Genomics (2003), 1st ed., Pevsner, J., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47121004-8.