

JAMAL MOHAMED COLLEGE (*Autonomous*)
College with Potential for Excellence
Re-accredited (3rd Cycle) with 'A' Grade by NAAC
(Affiliated to Bharathidasan University)
Tiruchirappalli – 620 020



Since 1951

**P.G. & RESEARCH DEPARTMENT
OF MICROBIOLOGY**

**CHOICE BASED CREDIT SYSTEM
(2017 - 2018)**

B.Sc., MICROBIOLOGY: 2017-2018

SEM	COURSE CODE	PART	COURSE	COURSE TITLE	HOURS/ WEEKS	CREDITS	INT. MARKS	EXT. MARKS	TOTAL MARKS
I	17U1LT1/LA1/ LF1/LH1/LU1	I	Language- I		6	3	25	75	100
	17UCN1E1	II	English- I		6	3	25	75	100
	17UMB1C1	III	Core- I	Basic Microbiology	5	5	25	75	100
	17UMB1C2P	III	Core- II	Basic Microbiology Practical	3	2	20	80	100
	17UMB1A1	III	Allied- I	General Biochemistry	5	4	25	75	100
	17UMB1A2P	III	Allied- II	General Biochemistry Practical	3	2	20	80	100
	17UCN1VE	IV	Value Education	Value Education	2	2	-	100	100
TOTAL					30	21	140	560	700
II	17U2LT2/LA2/ LF2/LH2/LU2	I	Language- II		6	3	25	75	100
	17 UCN2 E2	II	English-II		6	3	25	75	100
	17 UMB2C3	III	Core- III	Bacteriology	6	5	25	75	100
	17UMB2C4P	III	Core- IV	Bacteriology Practical	3	2	20	80	100
	17 UMB2A3	III	Allied- III	Cell Biology	4	3	25	75	100
	17 UMB2A4P	III	Allied- IV	Cell Biology Practical	3	2	20	80	100
	17U MB2N1	IV	Environment al Studies	Environmental Studies	2	2	-	100	100
TOTAL					30	20	140	560	700
III	17U3LT3/LA3/ LF3/LH3/LU3	I	Language- III		6	3	25	75	100
	17UCN3 E3	II	English- III		6	3	25	75	100
	17UMB3C5	III	Core- V	Microbial Diversity	4	4	25	75	100
	17 UMB3C6	III	Core- VI	Haematology	3	2	25	75	100
	17UMB3A5	III	Allied- V	Microbial Metabolism	4	3	25	75	100
	17UMB3A6P	III	Allied- VI	Microbial Metabolism Practical	3	2	20	80	100
	17UMB3N1	IV	Non Major Elective- I	Basic Bioinformatics	2	2	-	100	100
	17UCN3S1	IV	Skill Based Elective- I	Soft Skills Development	2	2	-	100	100
TOTAL					30	21	145	655	800

IV	17U4LT4/LA4/L F4	I	Language- IV		6	3	25	75	100
	17 UCN4 E4	II	English- IV		6	3	25	75	100
	17UMB4C7	III	Core- VII	Clinical Microbiology	5	5	25	75	100
	17UMB4C8P	III	Core- VIII	Clinical Microbiology Practical	3	2	20	80	100
	17UMB4A7	III	Allied- VII	Immunology	5	3	25	75	100
	17UMB4A8P	III	Allied- VIII	Immunology Practical	3	2	20	80	100
	17UMB4N2	IV	Non Major Elective- II	Endocrinology	2	2	-	100	100
	17 U CN4EA	V	Extension Activities	NCC, NSS etc.	-	1	-	-	-
TOTAL					30	21	140	560	700
V	17 UMB5C9	III	Core- IX	Virology	6	5	25	75	100
	17 UMB5C10	III	Core- X	Environmental Microbiology	5	5	25	75	100
	17 UMB5C11	III	Core- XI	Soil and Agricultural Microbiology	5	5	25	75	100
	17 UMB5C12P	III	Core- XII	Virology, Environmental Microbiology, Soil and Agricultural Microbiology Practical	5	5	20	80	100
	17UMB5M1	III	Major Based Elective- I	Any one from list	5	4	25	75	100
	17UCN5S2	V	Skill Based Elective- II	Any one from list	2	2	-	100	100
	17UCN5S3	V	Skill Based Elective- III	Textile Microbiology / Mycology	2	2	-	100	100
	17UMB 5EC1		Extra Credit- I	Vermiculture Technology	-	4*	-	100*	100*
TOTAL					30	28	120	580	700
VI	17 UMB6C13	III	Core- XIII	Microbial Genetics	5	5	25	75	100
	17 UMB6C14	III	Core- XIV	Molecular Biology	5	5	25	75	100
	17 UMB6C15	III	Core- XV	Food and Dairy Microbiology	5	5	25	75	100
	17 UMB6C16P	III	Core- XVI	Microbial Genetics, Molecular Biology, Food and Dairy Microbiology Practical	5	5	20	80	100
	17UMB6M2	III	Major Based Elective- II	Any one from list	5	4	25	75	100
	17UMB6M3	III	Major Based Elective- III	Any one from list	4	4	25	75	100
	17UCN6GS	V	Gender Studies	Gender Studies	1	1	-	100	100
	17UMB 6EC2		Extra Credit- II	Mushroom Technology	-	4*	-	100*	100*
TOTAL					30	29	145	555	700
GRAND TOTAL					180	140	830	3470	4300
*Not considered for grand total & CGPA									

**Skill based Elective and Major based Elective for B.Sc Microbiology

Semester	Course	Course Title
V	MBE	Social and Preventive Medicine Medical Entomology
	Skill Based Elective- II	Textile Microbiology Mycology
	Skill Based Elective- III	Bioinstrumentation Parasitology
VI	Major Based Elective- II	Industrial Microbiology Phycology
	Major Based Elective- III	Genetic Engineering Cell culture techniques

**SEMESTER I: CORE I
BASIC MICROBIOLOGY**

Course Code : 17 UMB1C1

Hours/Week : 5

Credit : 5

Max Marks : 100

Internal Marks : 25

External Marks : 75

Objective: To make the students to understand the fundamentals on microbial techniques.

UNIT – I

15 hours

Introduction to Microbiology – History of Microbiology - Contribution of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Winogradsky, Fannie Eilshemius and John Tyndall. Theory of spontaneous generation, # Germ theory of disease# and Scope of microbiology. Compound Microscope.

UNIT – II

15 hours

Sterilization and Disinfection: Principles- Methods of Sterilization – Physical methods – Dry heat- Moist heat, Filtration (Membrane & HEPA) - Radiation – Chemical Sterilization - Chemical agents. Mode of action – #Phenol coefficient test- Sterility testing.#

UNIT – III

15 hours

Cultivation of Microbes - Nutritional requirements, Nutritional Types of bacteria- Phototrophs, Chemotrophs, Autotrophs, Heterotrophs and Obligate parasites. Media preparation -Solid and Liquid- Types of Media – Crude, Semi Synthetic, Synthetic, Enriched, Selective, Differential and Special Type of Media.

UNIT – IV

15 hours

Pure Cultures and Cultural Characteristics – Selective methods of selection- Chemical, Physical and Biological, Selection in nature. Pure culture techniques - Tube dilution, Pour plate, Spread plate, Streak plate and Micro manipulator. Anaerobic culture techniques– Wright's tube, Roll tube, #McIntosh Fildes jar method#.

UNIT– V

15 hours

Quantitative Measurement of Bacteria – Direct Microscopic Count, Electronic Enumeration of Cell Numbers, The Plate count method, Membrane – Filter Count, Turbidimetric methods, Determination of Nitrogen content, Determination of the dry weight of cells, Importance of quantitative measurement of growth.

#-- # Self study

Text books

1. Michael J. Pelczar, Jr. E.C.S. Chan, Noel R.Krieg. Microbiology. 5th edition, Tata Mc Graw Hill Edition (2006).
2. Prescott, L.M J.P. Harley and C.A. Klein's. Microbiology 7th edition Mc GrawHill. (2008).

Books for reference

1. Stainer R.Y. Ingraham J.L. Wheo lis H.H and Painter P.R. The Microbial world, 5th Edition. Eagle Works Cliffs N.J. Prentica Hall. (1986)
2. Wilson. K and Goulding. K. H. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London. (1986).

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 6
UNIT III	Text Book 1	Chapter 8
UNIT IV	Text Book 1	Chapter 7
UNIT V	Text Book 2	Chapter 41

SEMESTER I: CORE II
BASIC MICROBIOLOGY PRACTICAL

Course Code : 17 UMB1C2P
Hours/Week : 3
Credit : 2

Max Marks : 100
Internal Marks : 20
External Marks : 80

Objective: To provide knowledge on basic microbiology techniques.

1. Laboratory practice and precautions.
2. Cleaning of Glass wares.
3. Antiseptics and disinfectants.
4. Methods of sterilization and testing of sterility- demonstration.
5. Culture media preparation – Liquid and Solid medium.
6. Enumeration of bacteria from soil.
7. Study of colony morphology.
8. Measurement of microorganisms by the use of an ocular micrometer.
9. Enumeration Fungi from soil.
10. Enumeration of Actinobacteria from soil.
11. Pure culture techniques – streak plate method.
12. Staining of bacteria- Simple staining technique.

Practical manual

1. James G. Cappuccino, Natalie Sherman. Microbiology – A laboratory manual, The Benjamin (Cummings Publishing Company, Inc.).(1996).
2. Mackie and McCartney. Practical Medical Microbiology, Churchill Livingston. (1989).
3. Aneja K.R. Experiments in Microbiology Plant Pathology and Biotechnology. New Age International Limited.(2005)

**SEMESTER I: ALLIED I
GENERAL BIOCHEMISTRY**

Course Code : 17 UMB1A1
Hours/Week : 5
Credit : 4

Max Marks : 100
Internal Marks : 25
External Marks : 75

Objective: To provide knowledge and to understand the structure and function of carbohydrates, aminoacids, enzymes , lipids and nucleic acids.

UNIT - I **15 hours**

Carbohydrates: Biological significance, Occurrence, Classification of carbohydrates. Structure of glucose-Straight chain structure and Ring structure. Disaccharides- Maltose, Lactose and Sucrose. Polysaccharides – Glycogen.

UNIT –II **15 hours**

Amino acids: Classification and properties. Structure, Zwitterion nature. Proteins- Classification, Structure and function. Primary, Secondary, Tertiary and Quaternary structure. Proteolysis, [#]Transamination and Deamination[#].

UNIT- III **15 hours**

Enzymes: General characteristics. Factors affecting enzyme activity. Regulation of enzyme activity. Enzyme kinetics, Km value, activation and inhibition. [#]Coenzymes and cofactors[#]. Non-protein enzymes. Applications of enzymes.

UNIT- IV **15 hours**

Lipids: Saturated and unsaturated fatty acids. Structure, classification, properties and function of lipids. Distribution and functions of lipids in microorganisms. Beta-oxidation of fatty acid.

UNIT–V **15 hours**

Nucleic acid: Introduction- Nucleotides and their importances – Nucleosides and their importance – composition, structure and metabolism of nucleic acid.

^{#--#}**self study**

Text books

1. Ambika shanmugam . Fundamentals of Biochemistry for Medical students 7th Ed. Kartik offset Printers, Chennai. (1998).
2. Jeremy M. Berg, Jogh L.Tymoczko and Lubert Stryer, L. Biochemistry. 5th Ed. W.H. Freeman and Company, New York. (1995).
3. WilliamH. Elliott and Daphne C.Elliott. Biochemistry and Molecular Biology – 3rd Ed. Oxford university press.

Books for reference

1. Dawn, B. Markus,. Biochemistry. Harwal Publishing, New York. (1994)
2. Donald voet and Judith voet. Biochemistry. John Wiley and Sons, New York. (1990)
3. Henry, R. Mahler and Eugene, H. Cerdesz. Biological Chemistry. Harper International Edition, New York. (1966).

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 3
UNIT III	Text Book 2	Chapter 8
UNIT IV	Text Book 3	Chapter 14
UNIT V	Text Book 3	Chapter 1

SEMESTER I: ALLIED II

GENERAL BIOCHEMISTRY PRACTICAL

Course Code : 17 UMB1A2P

Hours/Week : 3

Credit : 2

Max Marks : 100

Internal Marks : 20

External Mark : 80

Objective: To provide knowledge on basic biochemistry techniques

1. Qualitative Analysis of Carbohydrates
2. Qualitative Analysis of Aminoacids.
3. Quantitative Analysis of glucose
4. Estimation of aminoacid - Ninhydrin method.
5. Estimation of ascorbic acid from biological sample - burette method.
6. Estimation of Protein by Lowry's method.
7. Estimation of Lipid by Zak's method.
8. Preparation of Phosphate Buffer.

Practical manual

1. Keith Wilson and John Walker. Principles & Techniques of Practical Biochemistry (4th edition). Cambridge University press, Britain. (1995).
2. Strolv, B.A. Makavora, V.C. Laboratory manual in Biochemistry. MIR Publisher, Moscow. (1989).

**SEMESTER II: CORE III
BACTERIOLOGY**

Course Code : 17 UMB2C3
Hours/Week : 6
Credit : 5

Max Marks : 100
Internal Marks : 25
External Marks : 75

Objective: To study the general structures of bacteria & to understand the microbial techniques.

UNIT – I

18 hours

Morphology and fine structure of Bacteria: Size, Shape and Arrangement of Bacterial cells. Bacterial Structures. Flagella and Motility- Hydrodynamics of Flagella, Swimming Motility Without flagella, Gliding Motility, Bacterial Chemotaxis, Pili, Capsules, Sheaths, Prosthecae and Stalks. Gram positive and Gram negative Eubacteria.

UNIT – II

18 hours

Structures Internal to the Cell wall: The Cytoplasmic Membrane, Protoplast and Spheroplasts, Membranous Intrusions and Intracellular Membrane Systems, Cytoplasm, Cytoplasmic inclusions and Vacuoles and Nuclear Material. Spores (Endospores) and Cysts.

UNIT – III

18 hours

Staining : Stains and Staining reactions – Types of staining – Simple, Differential (Grams, Spore, AFB), Capsule staining, #Nuclear and Flagella staining#. Staining of Actinobacteria, Mycoplasma (PPLO), Staining of Spirochetes by Fontana's method, Wet mount.

UNIT- IV

18 hours

Archaea : Introduction, Archaeal cell walls and membranes, Archaeal Taxonomy, Phylum crenarchaeota, Phylum Euryarchaeota – methanogens.

UNIT-V

18 hours

Maintenance and Preservation of culture – Physical condition required for growth- Temperature, Gaseous Requirements, Acidity and Alkalinity (pH). Periodic transfer to fresh media, Preservation by overlaying cultures with mineral oil, Preservation by Lyophilization (Freeze – Drying), Storage at Low temperatures, #Cryo preservation, Storage in sterile soil#, Storage in silica gel. Culture collections.

#-- # Self study

Text books

1. Michael J. Pelczar, Jr. E.C.S. Chan, Noel R.Krieg. Microbiology. 5th edition, Tata Mc Graw Hill Edition (2006).
2. Prescott, L.M J.P. Harley and C.A. Klein's. Microbiology 7th edition Mc GrawHill. (2008).

Books for reference

1. Stainer R.Y. Ingraham J.L. Wheo lis H.H and Painter P.R. The Microbial world, (5th edition). Eagle Works Cliffs N.J. Prentica Hall. (1986).
2. William claus. G.W. Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York. (1989).
3. Wilson. K and Goulding. K. H. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London. (1986).

Books for Study

UNIT I	Text Book 1	Chapter 2
UNIT II	Text Book 1	Chapter 5
UNIT III	Text Book 2	Chapter 4
UNIT IV	Text Book 1	Chapter 8
UNIT V	Text Book 2	Chapter 7

**SEMESTER II: CORE IV
BACTERIOLOGY-PRACTICAL**

Course Code : 17 UMB2C4P
Hours/Week : 3
Credit : 2

Max Marks : 100
Internal Marks : 20
External Marks : 80

Objective: To understand the micrometry and staining techniques.

1. Temporary wet mount (TWM) technique by hay infusion broth.
2. Motility of bacteria - Hanging drop technique.
3. Media Preparation – selective media and differential media.
4. Acid – fast staining.
5. Bacterial spore (endospore) staining.
6. Capsule staining
7. Negative staining technique.
8. Determination of bacterial growth by direct count.
9. Determination of bacterial growth by turbidity measurements (Spectrophotometric method).

Practical manual

1. James G. Cappuccino, Natalie Sherman. Microbiology – A laboratory manual, The Benjamin (Cummings Publishing Company, Inc.). (1996).
2. Aneja K.R. Experiments in Microbiology Plant Pathology and Biotechnology. New Age International Limited. (2005)

**SEMESTER II: ALLIED III
CELL BIOLOGY**

Course Code : 17 UMB 2A3
Hours/Week : 4
Credit : 3

Max Marks : 100
Internal Marks : 25
External Marks : 75

Objective: To understand the cellular components underlying cell division and cell signaling

UNIT- I **12hours**

Introduction to cells: Classification of cell types; Cell theory; Organization of plant and animals cells; Structural comparison of Microbial, Plant and Animal cells.

UNIT- II **12hours**

Ultra structure of cells: Prokaryotic and Eukaryotic- Sub cellular Organization; structure and function of Cytosol, Nucleus, Endoplasmic reticulum and Chloroplast, Mitochondria, Vacuoles, #Peroxisomes, lysosome#.

UNIT - III **12hours**

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

UNIT- IV **12hours**

Cell Signalling and messengers: Types of cell signaling – Juxtacrine, Paracrine, Autocrine and Endocrine signaling. Mechanism of cell signaling, Cell signaling through G- Protein Linked surface Receptors, Steroid Hormone Receptors and Second Messengers.

UNIT- V **12hours**

Cytological techniques: Smear preparation, Microtomy, Microtome- Types of Microtome. Fixation- Chemical fixation and Fixation by Freezing. Types of Stains- Acidic, basic and Neutral. H & E staining. Preparation of whole Mounts.

#-- # Self study

Text books

1. Gerald Karp, Cell Biology (7th Edition). Wiley publication. (2013).
2. Gerald Karp. Cell and Molecular biology: concepts and experiments(6th Edition).Wiley publication. (2010).

Books for reference

1. Aminul Islam. A Text Book of Cell Biology(1st edition). Books and Allied (P)Ltd, Kolkata.(2011).
2. Powar.C.B. Cell Biology. Himalaya publishing house, New Delhi. (1983).
3. Lester W.Sharp. Fundamentals of Cytology. Mc Graw Hill Company,New York.(1943).

Books for Study

UNIT I	Text Book 1	Chapter 1 Section 1.1
UNIT II	Text Book 1	Chapter 8 Section 8.3 &8.6
UNIT III	Text Book 1	Chapter 14 Section 14.1 & 14.2
UNIT IV	Text Book 2	Chapter 17
UNIT V	Text Book 2	Chapter 15

**SEMESTER II: ALLIED IV
CELL BIOLOGY PRACTICAL**

Course Code : 17 UMB 2A4P
Hours/Week : 3
Credit : 2

Max Marks : 100
Internal Marks : 20
External Marks : 80

Objective: To understand the cellular components and cell division.

1. Cell organelle separation by centrifugation methods.
2. Identification of various stages of cell division (mitosis) -Onion
3. Viability staining technique for bacteria.
4. Sectioning of plant stem, root and leaves.
5. Microscopic identification of chromosome in chironomous larvae.
6. Fraction of Cellular components.
7. Isolation of Chloroplast.
8. Isolation of Mitochondria.

Practical manual

1. James G. Cappuccino, Natalie Sherman. Microbiology – A laboratory manual, The Benjamin (Cummings Publishing Company, Inc.).(1996).
2. Aneja K.R. Experiments in Microbiology Plant Pathology and Biotechnology. New Age International Limited.(2005)
3. A manual on Molecular cloning by Sambrook et al., (1989)

SEMESTER III: CORE V
MICROBIAL DIVERSITY

Course Code : 17 UMB3C5
Hours/Week : 4
Credit : 4

Max Marks : 100
Internal Marks : 25
External Marks : 75

Objective: To provide with knowledge and to understand the evolution and diversity of organisms.

UNIT – I **18 hours**

Origin and evolution of life : Origin of life – timeline – Oparin and Haldane; theories of evolution; evidence of evolution; sources of variations (mutation, recombination, genetic drift, migration, natural selection); concept of species; #Specification and isolation (geographical and reproductive) #; origin of species.

UNIT – II **18 hours**

Diversity of Life: Types of classification (artificial, natural, polygenetic); biosystematics; binomial nomenclature; Three kingdom, Five kingdom and Eight kingdom concept, Classification and Characterization of bacteria according to Bergey's Manual of Systematic Bacteriology (9th edition).

UNIT – III **18 hours**

Protozoa: General characteristics, classification, reproduction and its economic importance of *Entamoeba*, *Euglena*, *Volvox*, *Chlamydomonas*, *Giardia* and *Plasmodium*.

UNIT – IV **18 hours**

Fungi: General Characteristics and classification of Fungi - Life Cycle of Yeasts, *Aspergillus*, *Mucor*, *Rhizopus*, *Phytophthora*, #*Penicillium* and *Agaricus*# - Modes of reproduction and its economic importance.

UNIT – V **18 hours**

Algae: General Characteristics and Classification basic knowledge on its reproduction and its economic importance of *Nostoc*, *Oscillatoria*, *Spirulina*, *Oedogonium*, #*Chlorella*#, *Gracilaria*.

#-- # Self study

Text books

1. Prescott, L.M J.P. Harley and C.A. Klein's. Microbiology 7th edition Mc GrawHill. (2008).
2. Michael J. Pelczar, Jr. E.C.S. Chan, Noel R.Krieg. Microbiology. 5th edition, Tata Mc Graw Hill Edition (2006).

Books for reference

1. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall. (1986).

Books for Study

UNIT I	Text Book 1	Chapter 19.1
UNIT II	Text Book 1	Chapter 19.2 & 19.5
UNIT III	Text Book 1	Chapter 19.4
UNIT IV	Text Book 2	Chapter 18
UNIT V	Text Book 2	Chapter 19

**SEMESTER III: CORE VI
HAEMATOLOGY**

Course Code : 17 UMB3C6
Hours/Week : 3
Credit : 2

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objective: To provide the information about the Haematology, composition of blood, RBC, WBC, preservation of blood and blood films.

UNIT –I

18 Hours

Introduction to Hematology: Definition, History and discovery of blood group system. ABO and Rhesus blood group system. Clinical significance of blood groups- Blood transfusion, Haemolytic Disease, [#]Transplantation and Detection of Culprits[#].

UNIT –II

18 Hours

Collection and preservation of blood: Different methods of collection – Skin prick and Venipuncture method, preservation, changes in stored blood. [#]Normal and absolute values[#], abnormal and various methods of estimation -Hb and ESR.

UNIT –III

18 Hours

Composition and function of blood: Definition of blood, composition of blood (cells, plasma /serum) Site of blood formation: [#]Erythropoiesis[#], Leucopoiesis and Thrombopoiesis.

UNIT –IV

18 Hours

RBC, WBC and Platelets: Definition, structure and function and normal value of RBC, WBC and platelets. [#]Anticoagulants[#]: Definition, uses, different types, mode of action, their merits and demerits.

UNIT-V

18Hours

Blood film: Different types, Methods of preparation, Theory of staining – Physical and Chemical, Types of Stains- Acidic, Basic and Neutral. Mechanism of staining, Dyes: Natural, mordants, metachromasia and metachromatic dyes.

#-- # Self study

Text book

1. Andrew Blann, Gavin knight and Gray Moore. Haematology. Oxford University Press (2010)
2. Shyamasundari K. and Hanumantha Rao, K. Histochemistry in focus A sourcebook of Techniques
And Research needs.MJP Publishers (2007)

Books for Reference

1. Kanai L Mukherjee.2010.Medical laboratory technique.Vol 1& 2(2 edition), Tata McGraw Hil
Education Private Ltd, New Delhi
2. Barbara J.Bain. 2006. Blood cells. Wiley Black well Publication.
3. A Victor Hoffbrand, A. Daniel Catovsky, Edward, GD. Tuddenham, and Anthony R. Green.
Postgraduate Haematology.Wiley-Blackwell Publication. (2010).

Books for Study

UNIT I	Text Book1	Chapter 1
UNIT II	Text Book1	Chapter 2, 3
UNIT III	Text Book1	Chapter 4, 8
UNIT IV	Text Book1	Chapter 2
UNIT V	Text Book2	Chapter 3

**SEMESTER III: ALLIED V
MICROBIAL METABOLISM**

Course Code : 17 UMB3A5
Hours/Week : 4
Credit : 3

Max Marks : 100
Internal Marks :25
External Marks:75

Objective: To provide the knowledge in microbial metabolism, nutrition growth curve, photosynthesis and metabolism.

UNIT – I

15 Hours

Utilization of Energy and biosynthesis :Bacterial motility, Transport of Nutrients by bacteria – Passive Diffusion, Facilitated Diffusion, #Group Translocation and Active transport#. Structure and Biosynthesis of a cell-wall Peptidoglycan.

UNIT – II

15 Hours

Different phases of growth: #Growth curve# – generation time – factors influencing microbial growth – temperature, pH, pressure, salt concentration, nutrients – synchronous growth, continuous growth, diauxic growth and oligodynamic action.

UNIT -III

15 Hours

Metabolism of carbohydrates : Anabolism – Photosynthesis – oxygenic - anoxygenic, synthesis of carbohydrates - catabolism of glucose – Embden Mayer-Hoff-Parnas pathway – Pentose pathway, Krebs' cycle (TCA) - Electron transport system and ATP production.

UNIT- IV

15 Hours

Metabolism of protein – metabolic pathways of nitrogen utilization, synthesis of aminoacids, peptides and proteins.

UNIT- V

15 Hours

Anaerobic respiration : Nitrate, sulphate & Methane respiration – Fermentations- alcohol, mixed acid, lactic acid fermentation – Anabolic and catabolic processes of lipids.

#-- # Self study

Text books

1. Michael J. Pelczar, Jr. E.C.S. Chan, Noel R.Krieg. Microbiology. 5th edition, Tata Mc Graw Hill Edition (2006).
2. Prescott, L.M J.P. Harley and C.A. Klein's. Microbiology 7th edition Mc GrawHill. (2008).

Books for Reference

1. Doelle .H.W.1975.Bacterial Metabolism (2nd edition) .Academic Press.
2. Moat. A.G.and Foster.J. W. 1988.Microbial physiology (2nd edition).Springer – Verlag.
3. Caldwell.D.R.1995, Microbial physiology and Metabolism.Wm.C Brown Publishers,England
- 4 Tortora ,Funke and Case . Microbiology an Introduction (8th edition) 2004.

Books for Study

UNIT I	Text Book 1	Chapter 11
UNIT II	Text Book 2	Chapter 6
UNIT III	Text Book 2	Chapter 9
UNIT IV	Text Book 2	Chapter 9
UNIT V	Text Book 2	Chapter 9

**SEMESTER III: ALLIED VI
MICROBIAL METABOLISM PRACTICAL**

Course Code :17 UMB3A6P
Hours/Week : 3
Credit : 2

Max Marks : 100
Internal Marks :20
External Marks :80

1. Effect of pH on microbial growth.
2. Effect of temperature on microbial growth.
3. Indole production test.
4. Methyl red test.
5. Voges Proskauer test.
6. Citrate utilization test.
7. Catalase test.
8. Oxidase test.
9. TSI test.
10. Nitrate reduction test.
11. Starch hydrolysis.
12. Gelatin hydrolysis.
13. Casein hydrolysis.
14. Urea hydrolysis.

Text Book

1. Aneja, KR. Experiments in Microbiology, Plant pathology and Biochemistry (4th Edition). New age International publishers, India 2003.
2. Cappuccino and James, G. Microbiology a laboratory manual (4th edition). Addison Wesley Publishing Company Inc., England, California. 1996.

**SEMESTER IV: NON MAJOR ELECTIVE I
BASIC BIOINFORMATICS**

Course Code : 17UMB 3N1
Hours/Week : 2
Credit : 2

Max Marks : 100
Internal Marks : -
External Marks: 100

Objective:

To enable the students to use the bioinformatics tools on Bio molecules.

UNIT – I 6 Hours

Bioinformatics : An overview, Definition & History; Information Networks – Internet in Bioinformatics – Bioinformatics databases & # tools on the Internet#.

UNIT – II 6 Hours

General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum)

UNIT – III 6 Hours

Biological Sequence analysis: Pair wise sequence comparison – Sequence queries against biological databases – BLAST and FASTA - Multiple sequence alignments - #Phylogenetic alignment#.

UNIT - IV 6 Hours

Protein secondary structure classification databases: HSP, FSSP, CATH, #SCOP#. Protein secondary structure prediction methods: GOR, Chou-Fasman, PHD, PSI- PRED, J-Pred.

UNIT - V 6 Hours

Protein Tertiary structure prediction methods: Homology Modeling, Fold Recognition. Protein folding, Molecular Dynamics of Protein, Molecular Docking of Protein, Small molecule and Nucleotide and #Concepts of Force Field#

#-- # Self study

Textbooks

1. Attwood, T.K. and Parry-Smith, D.J. Introduction to Bioinformatics, Pearson Education Ltd., New Delhi, 2004.
2. Westhead, DR. Paris, JH. and Twyman, RM. Instant Notes: Bioinformatics – Viva Books Private Ltd, New Delhi, 2003.
3. Murthy, C.S.V. Bioinformatics. Himalaya publishing house, 2003.
4. Rastogi, S.C. Mendiratta, N. and Rastogi, P. Bioinformatics – Concepts, Skills & Applications, CBS Publishers & Distributors, 2003.

Books for reference

1. Arthur M. Lesk. Introduction to Bioinformatics, Oxford University Press, New Delhi, 2003.
2. Higgins, D and Taylor, W. Bioinformatics- Sequence, structure and databanks, Oxford University Press, New Delhi, 2000.

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 2	Chapter 3
UNIT III	Text Book 3	Chapter 10
UNIT IV	Text Book 3	Chapter 7
UNIT V	Text Book 4	Chapter 15

**SEMESTER IV: CORE VII
CLINICAL MICROBIOLOGY**

Course Code : 17 UMB4C7
Hours/Week : 5
Credit : 5

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives:

1. To learn the pathogenesis and epidemiology of various types of infections and its causative agent.
2. To create awareness on microbial infection.

UNIT-I

18 Hours

Historical introduction- Host-parasite relationships- bacterial pathogenesis- attachment and colonization, invasion, growth and multiplication, leaving the host, regulation of bacterial virulence factor expression- pathogenicity islands- toxigenicity- #Host defense against microbial invasion#.

UNIT-II

18 Hours

Bacterial pathogenesis: Morphology, Pathogenicity and laboratory diagnosis- *Staphylococcus aureus*, *Streptococcus pyogenes*, #*Pneumococcus* sp.,# *Neisseria* sp.,# *Pseudomonas* sp., *Clostridium tetani* and *Mycobacterium tuberculosis*. *Vibrio cholerae*

UNIT-III

18 Hours

Pathogenesis of Enterobacteriaceae: #*E.coli*#, *Salmonella typhi*, *Proteus* sp., *Shigella* sp., and *Klebsiella* sp

UNIT-IV

18 Hours

Fungal disease and pathogenesis: Mycoses- superficial infections: *Dermatophytes*- *Microsporum*, *Trichophyton*, *Epidermophyton* and *Candidosis*. Deep mycosis- #*Mycetoma*#, *Chromyocosis*, *Sporotrichosis* and subcutaneous mycotic disease.

UNIT-V

18 Hours

Viral Diseases: Herpes viruses, #Pox viruses, Polio#, Measles, Mumps, Rabies, Dengue, chickungunya, Hepatitis B, H1N1 and HIV.

#-- # Self study

Text book

1. David Greenwood, Richard Slack and John Peutherer . Medical Microbiology (15th edition) ChurchHill Living stone Publication, 2000.
2. Jawetz E Melnic JL and Adelberg EA. A review of Medical Microbiology. Lange Medical Publications, USA,1998.
3. Anathanarayanan and Paniker. Text book of Microbiology (8th edition). Orient Blackswan Publication, 2005.

Books for Reference

1. Bailey and Scotts .Diagnostic Microbiology (9th edition). C.V. Moshby Publications,1994.
2. Mackie and McCartney. Medical Microbiology, Vol I and II Churchill Livingston , 1994.

Books for Study

UNIT I	Text Book 1	Chapter 1- 4 & 8
UNIT II	Text Book 1	Chapter 15-38
UNIT III	Text Book 2	Chapter 42-51
UNIT IV	Text Book 3	Chapter 60-63
UNIT V	Text Book 1	Chapter 64-69

SEMESTER IV: CORE VIII
CLINICAL MICROBIOLOGY PRACTICAL

Course Code : 17 UMB 4C8P
Hours/Week : 3
Credit : 2

Max Marks : 100
Internal Marks: 20
External Marks: 80

Objective:

To expand the knowledge on isolation of pathogens and biochemical disorders in human beings.

1. Isolation and identification of microbes from urine sample
2. Isolation and identification of microbes from wound sample.
3. Isolation and identification of microbes from Pus sample.
4. Testing sensitivity of bacteria to antibiotics.
5. Assessing Minimum Inhibitory concentration of antibiotics.
6. Determination of Minimum bactericidal concentration of antibiotics.
7. KOH mount for Dermatophytes.
8. Germ tube test.

Practical manual

1. Balows, A., Hauser Jr. K.L., Isenberg, H.D., Shalomy, H.J. Manual of Clinical Microbiology, ASM, Washington DC, 1991.

**SEMESTER IV: ALLIED VII
IMMUNOLOGY**

Course Code : 17 UMB4A7

Hours/Week : 5

Credit : 3

Objective:

To understand the key concepts on the role of immune system and immunological disorders.

Max Marks : 100

Internal Marks: 25

External Marks: 75

UNIT –I

12 Hours

Introduction of Immune System- Historical Perspective, Organs of Immune system- primary and secondary lymphoid organs. Cells of Immune system: Lymphoid cells types and function-T cells, B cells, [#]NK cells and granulocytes[#].

UNIT –II

12 Hours

Immune Response- types of Immunity- Innate and acquired. Antigens- Properties of antigen, Immunogen, [#]Hapten and Adjuvants[#]. Immunoglobulins- Structure and types of antibody. Complement system.

UNIT –III

12 Hours

Transplantation: Structure, function of Major histocompatibility complex and HLA system. Transplantation- organ transplantations in humans, [#]HLA typing methods[#], Graft rejection- Graft disease (GVHD).

UNIT –IV

12 Hours

Immunological reaction: Hypersensitivity- Immediate and delayed type- classification based on different mechanisms of pathogenesis- Type I, Type II, Type III and [#]Type IV Hypersensitivity[#]. Autoimmune diseases-systemic and organ specific.

UNIT –V

12 Hours

Antigen and Antibody Reactions- Agglutination, Neutralization and precipitation reactions- RID, pattern identity, Immuno-electrophoresis, Immunofluorescence, Enzyme-linked immunosorbent assay, [#]Radioimmunoassay and complement fixation test[#], Ammonium sulphate precipitation of Ag-Ab Complex.

#--- # Self study

Text Books

1. David male, Jonathan Brostoff, Roth, D.B. and Ivan Roitt. Immunology (7th edition) Mosy Elsevier publication, Canada. 2006.
2. Benjamin, E., Coico, R. and Sunshine, G. Immunology (5th edition). Wiley Publication, USA. 2003.
3. Donal, M. Weir, John Steward. Immunology (8th edition). ELBS, London, 1993.

Books for Reference

1. Ivan M. Roit . Essential Immunology – Blackwell Scientific Publications, Oxford, 1994.
2. Kuby J. Immunology (4th edition) – WH Freeman and Company, New York, 2001
3. Richard M. Hyde. Immunology (3rd edition) National Medical series, Williams and Wilkins, Harward Publishing company, 1995.
4. David male, Jonathan Brostoff, Roth, D.B. and Ivan Roitt. Immunology (7th edition) Mosy Elsevier publication, Canada. 2006.

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 2
UNIT III	Text Book 2	Chapter 9
UNIT IV	Text Book 3	Chapter 19
UNIT V	Text Book 2	Chapter 5

**SEMESTER IV: ALLIED VIII
IMMUNOLOGY PRACTICAL**

Course Code : 17 UMB 4A8P

Hours/Week: 3

Credit : 2

Max Marks : 100

Internal Marks: 20

External Marks: 80

Objectives:

1. To learn the principles and methodology for antigen, antibody and their interaction.
2. To Practically perform and interpret the Immunological techniques for diagnosis.

1. Haemagglutination reaction- Blood grouping and Rh typing.
2. Latex agglutination-CRP Test.
3. Precipitation reactions in gels- single radial Immunodiffusion,
4. Double immunodiffusion- Pattern identity.
5. Immunoelectrophoresis and staining of precipitation lines.
6. Purification of Immunoglobulins: Ammonium sulphate precipitation.
7. Demonstration of ELISA.

Practical manual

Tizard, I.R. Immunology An Introduction, 2nd edition. W.B.Saunders, Philadelphia, 1998.

SEMESTER IV: NON MAJOR ELECTIVE II

ENDOCRINOLOGY

Course Code : 17 UMB4N2

Hours/Week : 2

Credit : 2

Max Marks : 100

Internal Marks :-

External Marks : 100

Objective: To provide the knowledge and to understand the Endocrine glands and Hormones.

UNIT - I

6 Hours

Hormones: Definition, Classification, Biosynthesis and circulation in blood. Mechanism of hormone action. Mechanism of steroid hormone receptors – Mechanism of action of steroid hormone.

UNIT –II

6 Hours

Pituitary gland – Morphology, Thyrotropin releasing hormone (TRH), Gonadotropin releasing Hormone, Control of GH Secretion, Dopamine and control of prolactin secretion. Thyroid gland : Biosynthesis of Thyroid hormone, Iodine Trapping, Incorporation of Iodine, Mechanism of thyroid hormone action, #Control of thyroid function#.

UNIT –III

6 Hours

Hormonal regulation of fuel metabolism: Body fuels – Glucose, Glycogen, Protein and fat. Overall regulation of blood glucose concentration (Short- term regulation, Long – term regulation)

UNIT- IV

6 Hours

Hormonal control of pregnancy and lactation : Puberty, Menstrual cycle – Menopause. Types and functions of placenta. Human Chorionic gonadotropin (HCG), Human chorionic Somatomammotropin (HCS), Corticotropin releasing hormone (CRH), Growth and development of mammary glands, #Milk Production #.

UNIT–V

6 Hours

Reproductive Health: Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; #Demographic terminologies used in family planning#.

###self study

Text books

1. Maurice Goodman, H . Basic Medical Endocrinology. 4th Ed. Academic press (2009)
2. Balinsky, B.I. An Introduction to Embryology, Holt saunders, NEW York. (1981)

Books for reference

1. Verma, S. and Agarwal, V.K. Chordate Embryology, S.Chand &Co., New Delhi. (2000)

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 2
UNIT III	Text Book 1	Chapter 3
UNIT IV	Text Book 2	Chapter 2
UNIT V	Text Book 2	Chapter 10

**SEMESTER V: CORE IX
VIROLOGY**

Course Code : 17 UMB5C9
Hours/Week : 6
Credit : 5

Max Marks : 100
Internal Marks : 25
External Marks : 75

Objective: To understand mechanism of virus infection and diagnosis

UNIT – I **18 Hours**

Introduction – Definition, early development of virology. #General properties of viruses#– Structure of virus- naked icosahedral, naked helical, enveloped icosahedral, helical and complex- replication of viruses- cultivation of viruses – tissue cultures, embryonated cultures.

UNIT – II **18 Hours**

Baltimore system of Viral Classification- Bacterial Viruses – Structure of bacteriophage, #The Lytic life cycle# (T-Even coliphages) – Lysogenic life cycle (*Escherchia coli*, #Lambda phage#).

UNIT – III **18 Hours**

Plant Viruses, common plant viral diseases: TMV, Bunchy top of banana, Satellite virus, Viroid – Double stranded DNA virus – #Assay methods#.

UNIT – IV **18 Hours**

Human viral disease: Morphology, pathogenesis and laboratory diagnosis of Rubella, Pox and Polio. Zoonotic disease: Morphology, pathogenesis and laboratory diagnosis of Prions, Rinder pest, Blue tongue, Foot and Mouth Disease. Viral Vaccines. Prevention and treatment of viral diseases. #Antiviral agents#.

UNIT –V **18 Hours**

Virus detection: Purification assay of virus- differential and density gradient centrifugation- precipitation of virus- denaturation and digestion of contaminants- #characterization of viruses#, separation and characterization of viral components and quantification of viruses.

#-- # Self study

Text books

1. Prescott, L.M J.P. Harley and C.A. Klein. Microbiology (2nd edition) Wm, C. Brown publication 1995.
2. Alan J.Cann. Principles of Molecular virology. (2nd edition).Academic press, California. 1997.
3. DimmockN.J.Primrose S.B. Introduction to Modern Virology (IV edition).Blackwell Scientific Publications, Oxford. 1994.

Books for Reference

1. Morag, C. Timbury Medical Virology. X edition. Churchill Livingston. 1994.
2. Nicklin, J. Greame-Cook and Killington, R. Instant Notes in Microbiology. (2nd Edition).Viva Books private limited, New Delhi. 2003.
3. Robert I. Krasner. The microbial challenge: Human Microbe Interactions, American Society for Microbiology, Washington. 2002.
4. Roger Hull. Mathews' Plant Virology. (4thEdition).Academic press-A Harcourt Science and technology company, New York. 2002.
5. Topley & Wilson. Principles of Bacteriology, Virology and Immunity (8thedition). Vol.IV Virology, Edward Arnold, London. 1990.

Books for Study

UNIT I	Text Book1	Chapter 16
UNIT II	Text Book1	Chapter 16.6
UNIT III	Text Book 1	Chapter 17.1
UNIT IV	Text Book2	Chapter 6
UNIT V	Text Book 3	Chapter 8

SEMESTER V: CORE X
ENVIRONMENTAL MICROBIOLOGY

Course Code : 17 UMB 5C10

Hours/Week : 5

Credit : 5

Max Marks : 100

Internal Marks: 25

External Marks: 75

Objectives:

1. To understand the vital role and application of various microbial ecosystem.
2. To learn the microbial processes on Bioleaching and treatment of waste materials

UNIT – I

15 Hours

Structure of ecosystem- Ecosystem types- natural, artificial - Introduction to microbial ecosystems- unculturable and culturable bacteria-conventional and molecular methods of studying microbial diversity.

UNIT – II

15 Hours

Microbiology of air- layers of atmosphere- Source of Microorganism in air- airborne microorganism- Enumeration of bacteria from air- Air sampling methods- impingement, impaction, centrifugation, filtration and deposition – #Air sanitation#.

UNIT – III

15 Hours

Microbiology of water- bacteriological analysis of water- MPN technique- eutrophication- water purification – natural- storage, oxidation and settlement- artificial- physical, chemical and filtration- #water borne disease and their control measures#- recycling of water.

UNIT- IV

15 Hours

Microbiology of Sewage- chemical and biochemical characteristics of sewage – BOD and COD – sewage treatment – physical, chemical and biological (trickling filter, activated sludge and oxidation pond) treatment- #Disposal of wastes#- applications of waste treatment.

UNIT – V

15 Hours

Bioremediation: Introduction- biodegradation of Xenobiotics – bioaccumulation – Biodegradation of paper, plastic, oil and pesticide- #Bioleaching of ore# – Bioconversion of cellulosic ethanol.

#--- # Self study

Textbooks

1. Atlas R.M and Bartha, R. Microbial Ecology Fundamentals and Application (4th edition) - LPE, pearson Education.Inc, 2005.
2. Alexander, M. Microbial Ecology. John Wiley and Sons Inc, New York, 1971.
3. Forster, C.F. Biotechnology and Wastewater Treatment. Cambridge University Press. Cambridge, 1985.

Books for reference

1. Grant W.D. and Long P.L. Environmental Microbiology. Blackie Glasgow. London, 1981.
2. Marshall, K.C. Advances in Microbial Ecology. Vol.8, Plenum press, 1985.

Books for Study

UNIT I	Text Book 1	Chapter 3
UNIT II	Text Book 1	Chapter 5
UNIT III	Text Book 2	Chapter 4
UNIT IV	Text Book 3	Chapter 5
UNIT V	Text Book 3	Chapter 12

**SEMESTER V: CORE XI
SOIL AND AGRICULTURAL MICROBIOLOGY**

Course Code : 17 UMB 5C11
Hours/Week : 5
Credit : 5

Max Marks : 100
Internal Marks : 25
External Marks : 75

Objectives:

1. To understand the properties of soil.
2. To know the role and application of microorganisms in soil regions.

UNIT – I **15 Hours**
Introduction to soil microbiology – properties of soil (structure, texture & formation). Types and significance of soil microbes – bacteria, fungi, algae, protozoa, nematodes, actinobacteria, viruses. #Factors affecting microbial population#.

UNIT – II **15 Hours**
Biogeochemical cycles – carbon cycle, #phosphorus cycle#, nitrogen cycle and sulphur cycle. Biological nitrogen fixation – nitrogen fixer, root nodule formation, nitrogenase and hydrogenase.

UNIT – III **15 Hours**
Microbial interaction: Neutralism, Commensalism, Synergism, Mutualism, Amensalism, Competition, Parasitism, Predation. Interaction of microbes with plants – Rhizosphere, mycorrhizae. # Interaction of microbes with insects & rumen#.

UNIT – IV **15 Hours**
Plant diseases- Bacterial-Blight of Rice, Citrus canker. Fungal diseases- Blast of Rice, Late Blight of Potato, #Rust of wheat#, red rot of sugarcane, Wilt of cotton, Tikka leaf spot of groundnut. Viral disease

UNIT – V **15 Hours**
Bioinoculants- *Rhizobium*, *Azotobacter*, Cyanobacteria, *Azolla*- Mass multiplication and crop response. Biopesticide- Bacterial, fungal and viral.

#--- # Self study

Textbooks

1. Atlas, R.I.M.. Microbiology fundamentals and applications. Mac. Millan Publishing Co, 1989.
2. Agrios, G.N. Plant Pathology (2nd edition). Academic Press NY, 1978.
3. Dirk J, Elas V, Trevors JT, Wellington, EMH. Modern Soil Microbiology. Marcel Dekker INC, New York, Hong Kong, 1997.
4. Rangaswami, G. and D.J. Bhagyaraj, 2001. Agricultural Microbiology. 2nd Edition. Prentice, Hall, New Delhi.

Books for reference

1. Ainsworth, G.C. Introduction to the history of plant pathology Cambridge, Univ. 1981. Press, Cambridge.
2. Prescott, L.M, Harley, J.P, Klein, D.A . Microbiology, WCB Mc Graw Hill, 1999.

Books for Study

UNIT I	Text Book 1	Chapter 27
UNIT II	Text Book 1	Chapter 31
UNIT III	Text Book 2	Chapter 4
UNIT IV	Text Book 2	Chapter 7
UNIT V	Text Book 3 & 4	Chapter 11

SEMESTER V: CORE XII
VIROLOGY, ENVIRONMENTAL MICROBIOLOGY, SOIL AND AGRICULTURAL
MICROBIOLOGY PRACTICAL

Course Code : 17 UMB 5C12P

Hours/Week :5

Credit :5

Max Marks : 100

Internal Marks: 20

External Marks:80

Objective:

To understand the principles and methodology of Microbial ecosystem.

1. Isolation and characterization of Bacteriophage and cyanophage from natural resources.
2. Phage titration - T4 or Lambda
3. Isolation and staining of AM fungi colonization in plant root.
4. Isolation and culturing of Rhizobium from root nodules.
5. Isolation and testing of antagonistic microorganisms from soil.
6. Isolation of microorganisms from Rhizosphere and phyllosphere.
7. Isolation of cellulase producing microbes from soil.
8. Isolation and identification of air-borne bio-particles
9. Isolation of Cyanobacteria
10. Effect of high salt concentration on microbial growth.
11. Oligodynamic action of heavy metals on bacteria.
12. Algae as indicators of water pollution.
13. Assessment of water quality by MPN technique.

Practical manual

1. Aneja, KR. Experiments in Microbiology, Plant pathology and Biochemistry (4th Edition). New age International publishers, India 2003.
2. Cappuccino and James, G. Microbiology a laboratory manual (4th edition). Addison Wesley Publishing Company Inc., England, California. 1996.

**SEMESTER V: MAJOR BASED ELECTIVE I
SOCIAL AND PREVENTIVE MEDICINE**

Course Code : 17 UMB5M1
Hours/Week : 5
Credit : 4

Max Marks : 100
Internal Marks : 25
External Marks : 75

Objective: To understand the concepts of health and disease.

UNIT-I

15 hours

Man and medicine- Medicine in antiquity- Dawn of scientific medicine- Modern medicine- Indian Medicine - Homeopathy, Ayurvedic, Siddha, Unani, Naturopathy, Self Medication- Medical revolution- Concepts of health and disease – Dimensions of health- Natural history of disease- #Disease classification by ICD#.

UNIT-II

15 hours

Epidemiology principles and methods: Aim and approach, measurement in epidemiology- tools- rates, ratios and proportions- mortality measurement- morbidity measurement- incidence, prevalence- Epidemiologic methods- descriptive, analytical and experimental epidemiology. #Association and causation#. Use of epidemiology.

UNIT-III

15 hours

Introduction to infectious disease: General mechanism of disease cycle, disease transmission- human, animal and reservoir in non living things- indirect transmission- vehicle borne, vector borne, air borne & fomite borne. #disease prevention and control#. Disinfection- types- natural, physical and chemical agents.

UNIT- IV

15 hours

Genetics and Health – Genetic Diseases, Role of genetic predisposition in common disorders – preventive and social measure. Social factors in diseases – social factors predisposing to disease and premature death - Social factors preventing the early detection and correct diagnosis of diseases – #social factors delaying recovery, perpetuating illness or aggravating disability#.

UNIT- V

15 hours

Demography and Family planning. Preventive medicine in obstetrics, pediatrics and geriatrics- antenatal care, intranatal care, postnatal care- care of children- infancy, neonatal care- factors affecting infant mortality. Environment and occupational health. #Health information and basic medical statistics and health care of the community#.

#-- # Self study

Text books

1. Park, K. Text book of preventive and social medicine , M/s. Banarsidas Bhanot Publishers, Jabalpur, India.

Books for reference

1. Scigerist henry, 1951.A History of medicine, Vol .Oxford university press, London.
2. Ahmed, P.I and Coelho, G.V.1979.Toward a new Definition of Health, Pleum, New Yark.
3. Roht, L.H.1982. Principles of epidemiology, a self– teaching guide .London academic press.
4. Lilienfeld, A.M. and Lilienfeld, D.E.1980.Foundations of epidemiology, (2nd edition).oxford University.

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 3
UNIT III	Text Book 1	Chapter 4
UNIT IV	Text Book 1	Chapter 5
UNIT V	Text Book 1	Chapter 8

**SEMESTER V: SKILL BASED ELECTIVE II
BIOINSTRUMENTATION**

Course Code : 17 UCN5S2
Hours/Week : 2
Credit :2

Max Marks : 100
Internal Marks: -
External Marks:100

Objectives:

1. To know the principles of Microscopy including Light microscopes and Electron.
2. To provide the knowledge of the instrumentation and method development for the identification and quantification of natural and anthropogenic compounds at trace level.

UNIT – I

6 Hours

Microscopy– Principles, Mode of operation and applications – Bright field, Dark field, Phase contrast, #Fluorescence Microscope#, Electron Microscope- SEM, TEM and Confocal Microscope.

UNIT – II

6 Hours

Principles, Mode of operation and applications of Autoclave, Hot air oven, Incubator, Laminar air flow, BOD incubator, #Metabolic shaker and Incinerator#. pH meter and Lyophilizer

UNIT –III

6 Hours

Centrifugation– Basic principles of centrifugation, Instrumentation of Ultra centrifuge (Preparative, Analytical), Factors affecting sedimentation velocity, Standard sedimentation coefficient, Rate – Zonal centrifugation, #Sedimentation equilibrium centrifugation#.

UNIT –IV

6 Hours

Principles, Mode of operation and applications of Colorimetry, Spectrometry, Adsorption spectroscopy- simple theory of the absorption of light by molecules, Beer- lambert law, Instrumentation for measuring the absorbance of visible light, #Factors affecting the absorption properties of a chromophore#. NMR Spectroscopy – Basic principle, Experimental technique and instrumentation of NMR.

UNIT-V

6 Hours

Separation and identification of materials – Concept of Chromatography - Paper, Thin layer, Column, Ion-exchange, GLC, #Affinity and HPLC#. Electrophoresis- Agarose Gel Electrophoresis and SDS-PAGE.

#--- # Self study

Text book

1. Gedder, A. and L. E. Balser, John Wiley and Sons, Principles of applied Biomedical instrumentation.(1989).
2. Keith Wilson & John walker. Principles and Techniques of Biochemistry and Molecular Biology.6th edition Cambridge university press. (2008).

Books for Reference

1. Fritschen, L.J and L. W. Gay. Springer, Verlag, Environmental Instrumentation. New York, 1979.
2. Padmini,. Biochemical Calculations and Biostatistics Books and Allied 1st edition, 2007.

Books for Study

UNIT I	Text Book 1	Chapter 4 & 8
UNIT II	Text Book 1	Chapter 5&6
UNIT III	Text Book 2	Chapter 3
UNIT IV	Text Book 2	Chapter 9
UNIT V	Text Book 2	Chapter 11

SEMESTER V: SKILL BASED ELECTIVE III

TEXTILE MICROBIOLOGY

Course Code : 17 UCN5S3

Hours/Week : 2

Credit : 2

Max Marks : 100

Internal Marks :-

External Marks : 100

Objective: To provide the knowledge and to understand the Bioprocessing of natural fibres, Hygienic and health care textiles.

UNIT - I

6 Hours

Textile Industry – Introduction, types of microorganisms found on textile fibres, conditions favoring the action of microorganisms, types of destruction caused by microorganisms (cotton and wool), Prevention of growth of microorganisms.

UNIT –II

6 Hours

Bioprocessing of natural fibres: Bioprocessing of cotton and their characteristics-Physical and Chemical properties of cotton, Desizing of cotton fabric, Scouring of cotton fabrics, Enzymatic bleaching. Bioprocessing of wool and their characteristics- Classification by sheep, physical and chemical properties of wool fibres, Properties of woollen clothing, wool quality assessment.

UNIT –III

6 Hours

Bioprocessing of organic cotton textiles: Warp yarn sizing and fabrication. Effect of biodesizing process variables- Box Behnken design. Bioscouring of organic cotton with alkaline pectinase, #Bioscouring of organic cotton fabric using lipase enzyme#, Bioscouring of organic cotton fabrics through specific mixed enzymatic system.

UNIT- IV

6 Hours

Biomaterials for hygienic and health care textiles: Medical textiles, Dressing types and usage, Dressing for wound healing, Modern wound dressings- Polymeric wound dressings, Chitosan. Enzymes in medical applications. # Future trends in medical textiles#.

UNIT–V

6 Hours

Textile and fabric antimicrobial microbiology testing: Antimicrobial assessment on textile materials (AATCC 30), Assessment of Antimicrobial Finishes on textile materials (AATCC 100), Parallel streak method (AATCC 147), #Microbial Enumeration test (USP 61), Test for specified microorganisms (USP 62) #. Safety and precaution in handling enzymes: First – aid treatment, Safety in enzyme therapy.

#---# **self study**

Text books

1. Vigneswaran,C. Ananthasubramanian, M. and Kandhavadiyu,P. Bioprocessing of Textiles.Woodhead Publishing India PVt. Ltd . (2014).

Books for reference

1. Stainer R.Y. Ingraham J.L. Wheo lis H.H and Painter P.R. The Microbial world, 5th Edition. Eagle Works Cliffs N.J. Prentica Hall. (1986).
1. Presscott, L.M J.P. Harley and C.A. Klein. Microbiology 2nd edition Wm, C. Brown and publishers. (1995).

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 3
UNIT III	Text Book 1	Chapter 7
UNIT IV	Text Book 1	Chapter 5
UNIT V	Text Book 1	Chapter 6 &14

**SEMESTER V: EXTRA CREDIT I
VERMICULTURE TECHNOLOGY**

Course Code : 17UMB 5EC1
Hours/Week : Nil
Credit : 4*

Max Marks : 100*
Internal Marks: -
External Marks: 100*

Objectives:

1. To provide knowledge on application of vermi composting
2. To promote the students to become an entrepreneurship

UNIT- I

Selection of suitable species: Epiges (*Eisenia foetida*), Endoges (*Eudrilus eugeniae*), Aneciques. Basic characteristics of suitable species. Role of earth worms in soil structure, fertility and productivity.

UNIT- II

Vermicompost preparation: Vermicomposting materials – preliminary treatment of composting material – Requirement for vermicomposting – small scale vermi composting – large scale vermicomposting – #collection of vermicompost# and vermin wash.

UNIT- III

Earthworms burrows and casts. Effect earthworms in soil structure – carbon, nitrogen and phosphorous Transformations. Earthworms as bio-indicators of soil types.

UNIT -IV

Earthworms in organic waste management: Management of sewage sludge by earthworms. Management of animal, vegetable and industrial organic waste by earthworms. Earthworm composts as plant growth media and its marketing. #Role of earthworms in processing organic wastes applied to agricultural and other land#.

UNIT -V

Advantages of Vermiculture: Production of cheap animal protein – soil and vermicast – Decomposition of Biodegradable wastes – #Vermiculture in pollution Abatement#.

#--- # Self study

Text books

1. Arvind kumar.Vermitechnology, Aph Publishing Corporation, 2005.
2. Edwards, C.A and Bohlen, P.J . Biology and ecology of earthworms III Edn. Chapman & Hall publications New York, 1996.
3. Edwards, C.A and Lofty J.R. Vermicology – The Biology of earthworm, Chapman & Hall Publications New York. 1997.

Books for reference

1. National institute of industrial Research. The Complete Technology Book on Vermiculture and Vermicompost, 2007.
2. Mary violet Christy. A. Vermitechnology, MJP publishers, 2008.

Books for Study

UNIT I	Text Book 1	Chapter 2
UNIT II	Text Book 2	Chapter 10
UNIT III	Text Book 1	Chapter 6
UNIT IV	Text Book 2	Chapter 12 & 11
UNIT V	Text Book 3	Chapter 5

**SEMESTER VI: CORE XIII
MICROBIAL GENETICS**

Course Code : 17UMB 6C13
Hours/Week: 5
Credit : 5

Max marks : 100
Internal Marks: 25
External Marks: 75

Objectives:

1. To provide key concepts on Genetics and genetic materials.
2. To understand the principles of genetics exchanges and its expression in host.
3. To provide an idea about gene regulations and its control.

UNIT – I

15 Hours

Genetics - Historical introduction– Mendel's laws of inheritance. DNA as genetic material: experiments of Griffith, Avery, Hershey Chase experiment. RNA as a genetic material- Fraenkel- Conrat & Singer experiment.

UNIT – II

15 Hours

DNA Replication: Basic rules- Semi conservative model- Meselson and Stahl experiment, replication of circular DNA molecule- conservative, rolling circle mechanism, θ mode of replication. Enzymes involved in DNA replication. # Control of replication#.

UNIT – III

15 Hours

Bacterial Genetics: concepts of haploid genomes, genetic exchange through transformation, Conjugation– Hfr, triparental mating, #self transmissible and mobilizable plasmids and pili# and transduction (generalized and specialized).

UNIT – IV

15 Hours

Molecular mechanism of Transcription in prokaryotes and Eukaryotes - Translation in prokaryotes and #Eukaryotes# - activation of amino acid, attachment- stages- initiation, elongation & termination - modification of released polypeptide chain.

UNIT – V

15 Hours

Gene regulation: Concept of gene regulation – Lac operon- functioning of lac operon, structure of operon- role of cyclic AMP in catabolite repression, #tryptophan operon#, attenuation control – promoters – repressors.

#--- # Self study

Text books:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. Principles of Genetics. John Wiley & sons, 1991.
2. David Frifelder. Microbial Genetics, Narosa publishing house, New Delhi, 1990.
3. Daniel, L. Hartl and Elizabeth W. and Jones. Genetics-Analysis of Genes and Genomes, Jones and Bartlett publishers, UK, 2001.
4. Jeremy M. Dale. Molecular Genetics of Bacteria (3rd edition). John Wiley and sons, New York, 1998.
5. Old, R.S. and Primrose, S.B. Principles of Gene Manipulation, 4th Ed., Blackwell Scientific Publications, London, 1989.
6. Veer bala rastogi, Fundamentals of molecular biology, Ane's student edition, India, 2008.

Books for Reference

1. Larry Synder and Wendy Champness. Molecular Genetics of Bacteria (2nd edition). American Society for Microbiology, Washington, 2003.
2. Lodish, H., Baltimore, D. Berk, A. Zipsury, S.L., Matsudaira, P. Darnell, J. Molecular Cell Biology. Scientific American Books, 1995.
3. Malor Sr, Cronan Jr. JE. Freifelds D. Microbial Genetics. Jones and Bartlett Publishers, 1994.
4. Monroe W. Stickberger. Genetics (3rd edition). Prentice/Hall of India Pvt. Ltd., New Delhi, 2003.

Books for Study

UNIT I	Text Book 1	Chapter 7
UNIT II	Text Book 2	Chapter 9
UNIT III	Text Book 3	Chapter 14
UNIT IV	Text Book 4	Chapter 2
UNIT V	Text Book 5 & 6	Chapter 12&13

**SEMESTER VI: CORE XIV
MOLECULAR BIOLOGY**

Course Code : 17UMB 6C14
Hours/Week : 5
Credit : 5

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives:

1. To know key concepts and structure of nucleic acids.
2. To understand the principles on mutation and DNA repair.
3. To provide an idea about research on molecular genetics

UNIT – I

15 Hours

Introduction to Nucleic acid: DNA- structure- physical and chemical properties- RNA- structure- types- tRNA, mRNA and rRNA. Genetic code and wobble hypothesis. #Code is triplet – Molecular evidence#.

UNIT – II

15 Hours

Mutations- definition and types- spontaneous mutation and induced mutation, basis pair changes, frame shifts, deletions, inversions, tandem duplications, insertions, useful phenotypes (auxotrophic, conditional lethal, resistant), #reversion vs. suppression#.

UNIT – III

15 Hours

DNA repair mechanism: Systems that safeguard DNA. DNA methylation and DNA repair mechanisms – excision repair, direct repair, mismatch repair, recombinational repair, SOS response, #photoreactivation#, recombination repair and glycosylase system.

UNIT – IV

15 Hours

Genetic recombination: requirements, molecular basis, genetic analysis of recombination in bacteria- site specific, homologous, non-homologous recombination, #reciprocal and nonreciprocal recombination#.

UNIT – V

15 Hours

Transposons – Insertion sequences and composite transposons, phages as transposons, replicative, non-replicative and conservative transposition. Mechanism of transposition, controlling elements of maize –autonomous and non-autonomous elements. #Types of transposons and their properties#.

#--- # Self study

Textbooks

1. Daniel L. Hartl and Elizabeth W. Jones. Genetics-Analysis of Genes and Genomes, Jones and Bartlett publishers, UK,2001.
2. Gardner E.J., Simmons M.J., Snustad D.P. Principles of Genetics. John Wiley & sons, 1991.
3. Friedberg ,E.C., Walker, C.C., Siede, W. DNA repair and mutagenesis – ASM Press,1995.
4. David Frifelder. Microbial Genetics, Narosa publishing house, New Delhi, 1990.

Books for Reference

1. Jeremy M. Dale. Molecular Genetics of Bacteria (3rd edition).John Wiley and sons,NewYork, 1998.
2. Larry Synder and Wendy Champness. Molecular Genetics of Bacteria (2nd edition).American Society for Microbiology, Washington,2003.
3. Malor, S.R., Cronan, J.E. and Freifelds, D. Microbial Genetics. Jones and Bartlett Publishers,1994.
4. Old, R.S. and Primrose, S.B. Principles of Gene Manipulation, 4th Ed., Blackwell Scientific Publications, London, 1989.

Books for Study

UNIT I	Text Book 1	Chapter 4 & 5
UNIT II	Text Book 2	Chapter 3
UNIT III	Text Book 1	Chapter 3
UNIT IV	Text Book 3	Chapter 6
UNIT V	Text Book 4	Chapter 4

SEMESTER VI: CORE XV
FOOD AND DAIRY MICROBIOLOGY

Course Code : 17UMB 6C15
Hours/Week : 5
Credit : 5

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives:

1. To familiarize the primary sources of microorganisms in meat, poultry and vegetable products as well as the establishment's environment.
2. To create awareness about food contamination and food borne illness and control measures.

UNIT – I

15 Hours

Food as a substrate for microbes – hydrogen ion concentration (pH), moisture requirement: concept of water activity, oxidation reduction potential, nutrient content, inhibitory substances and biological structure, combined effect of factors affecting the growth. Microbes involved in food microbiology- mold, yeast, # bacteria#.

UNIT – II

15 Hours

Methods of food preservation- classification of preservation factors- applications to food preservation- Principles- asepsis, removal, anaerobic conditions- Physical methods- high temperatures, low temperatures- drying, # food additives#- chemical methods- radiation.

UNIT – III

15 Hours

Contamination of foods- from green plants and fruits, animals, soil, water, air- Food spoilage- contamination and spoilage– vegetables, fruits, meat and meat products, egg and canned foods. # Detection of spoilage and characterization #.

UNIT – IV

15 Hours

Microorganisms in milk and milk products – koumiss, kefir, butter and cheese, #quality control of milk – MBRT & SPC#. Production and application of SCP and Baker's products in food industry.

UNIT – V

15 Hours

Food borne illness – bacterial diseases- *Bacillus*, *Clostridium*, *Salmonella*, *Vibrio parahaemolyticus*, food borne poisonings, infections and intoxications- mycotoxins, aflatoxin, patulin, ochratoxin- #Food sanitation and its control measures#.

#--- # Self study

Textbooks

1. Frazier, W.C, Westhoff, D.C. Food Microbiology, TATA Mc Graw Hill, 1988.
2. Adams, M.R. and Moss M.O. Food Microbiology, The Royal Society of Chemistry, Cambridge, 1995.
3. Banwart ,G.J. Basic food microbiology, Chapman & Hall, New York, 1989.

Books for reference

1. Baumberg. S., Hunter. I.S. and Rhodes, P.M. Microbial Products -New approaches. Cambridge Univ. Press. Cambridge, 1989.
2. Robinson, R.K. Dairy Microbiology, Elsevier, 1990.

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 11
UNIT III	Text Book 1	Chapter 16
UNIT IV	Text Book 2	Chapter 9
UNIT V	Text Book 3	Chapter 7

SEMESTER VI: CORE COURSE XVI
MICROBIAL GENETICS, MOLECULAR BIOLOGY, FOOD AND DAIRY
MICROBIOLOGY PRACTICAL

Course Code : 17UMB 6C16P
Hours/Week : 5
Credit : 5

Max marks : 100
Internal Marks: 20
External Marks: 80

Objective:

To train and develop the skills on Microbial genetics, Molecular Biology & Food microbiology experiments.

1. Isolation of bacterial Genomic DNA.
2. Isolation of Plasmid DNA.
3. Electrophoretic analysis of DNA.
4. Quantitative estimation of DNA by DPA method.
5. Restriction digestion and analysis.
6. Scoring of auxotrophic mutant.
7. Isolation of Protoplast.
8. Isolation of Spheroplast.
9. Methylene blue reductase test.
10. Detection of food borne pathogens from spoiled tomato, grapes, pickles.
11. Detection of *Salmonella* spp. and *Shigella* spp. from fish.

Practical manual

1. Aurubels . Current protocols in Molecular Biology, John Wiley, 1998.
2. Sambrook, J. Fritsch, E. F. And Maniatis, T. Molecular cloning- A Laboratory Manual 2nd edition. Cold Spring Harbor Laboratory press, USA, 1989.
3. James G. Cappuccino, Natalie Sherman. Microbiology- A laboratory manual. 6th edition. 2006.

**SEMESTER VI: MAJOR BASED ELECTIVE II
INDUSTRIAL MICROBIOLOGY**

Course Code : 17 UMB6M2
Hours/Week : 5
Credit : 4

Max Marks : 100
Internal Marks : 25
External Marks : 75

Objectives:

1. To promote understanding of basic and advanced concepts in industrial Microbiology.
1. To provide the knowledge and interest on fermentation types and product recovery.

UNIT –I **15 Hours**
General concepts of industrial microbiology- History and scope of industrial microbiology. Screening techniques of industrially important microorganisms – Primary screening and Secondary screening. Microbial Strain Improvement – Mutation and Mutant selection, Recombination and Protoplasmic fusion.

UNIT –II **15 Hours**
Industrial Sterilization- Principles of sterilization, Sterilization of Equipment, Production media and Air. Fermentation media formulation strategies, carbon, nitrogen, vitamin and mineral sources, role of buffers, precursors, inhibitors, #inducers and antifoams#, Screening for production media.

UNIT -III **15 Hours**
Fermentor – Factors involved in fermentor design, Fermentor configurations - Batch fermentor, Continuous stirred tank fermentor, Tubular fermentor, Fluidised bed fermentor, Air-Lift Bioreactor, Cylindro–Conical Bioreactor, Cyclone Column Bioreactor, #Hollow–fibre Bioreactor#.

UNIT –IV **15 Hours**
Production of beverages – beer and wine. Antibiotics- Penicillin and Streptomycin. Enzymes- Amylases and Proteases. Single cell proteins - Bacterial proteins-Hydrogen utilizing bacteria, Methanol utilizing bacteria and Photosynthetic bacteria. #Yeast proteins- Brewers yeast and Bakers yeast#. Algal proteins.

UNIT –V **15 Hours**
Downstream process- Intracellular product- Cell disruption-Physical, chemical and enzymatic method. Extracellular product - Solid liquid separation – flotation, flocculation, filtration and centrifugation, #Concentration- evaporation, Liquid- Liquid extraction#, Membrane filtration, precipitation and adsorption, Purification by chromatography- gel filtration, Ion exchange and affinity, Formulation- drying, freeze drying and crystallization.

#--- # Self study

Textbooks

1. Patel, A.H. Industrial Microbiology. Macmillan India Ltd, 2005.
2. Stanbury, P.F., Whitaker A and Hall S.J. Principles of Fermentation Technology, Butterworth- Heinemann Press, 2003.

Books for Reference

1. Demain, A.L and Davies, J.E. Manual of Industrial Microbiology & Biotechnology, ASM press, 1999.
2. Prescott and Rehm. Industrial Microbiology. Wiley and Sons, 1979.
3. Sikyta, B. Methods in Industrial Microbiology, Ellis Horwood Limited, 1983.
4. Casida, L. E. Industrial Microbiology. New Age International Publishers, 1968.

Books for Study

UNIT I	Text Book 1	Chapter 3
UNIT II	Text Book 1	Chapter 7
UNIT III	Text Book 1	Chapter 10 &12
UNIT IV	Text Book 1	Chapter 16 &17
UNIT V	Text Book 2	Chapter 10

**SEMESTER VI: MAJOR BASED ELECTIVE III
GENETIC ENGINEERING**

Course Code : 17UMB 6M3
Hours/Week : 4
Credit : 4

Max Marks : 100
Internal Marks: 25
External Marks: 75

Objectives:

1. To improve the knowledge on genetic engineering and applications in advanced Molecular Biology research.
2. To gain information on tools involved in genetic manipulation of organisms

UNIT- I

12 Hours

Biotechnology and Gene manipulation – Definition – Concepts – History, Development and application. Restriction Enzymes- Discovery, Types (Type I, II and III) and Mode of Action. #Ligases and Methylases#.

UNIT –II

12 Hours

Vectors – cloning vectors: #Plasmids- pBR322 & pUC vectors#. λ Phage based Vectors, Bacteriophages vectors - M13 vector and Lambda vector. Hybrid Vectors- Phagemid and Cosmid. Map of a generic expression vector and its application. Biological in vitro package method.

UNIT –III

12 Hours

Gene cloning: strategies of gene cloning- Genomic Library and cDNA Library construction by phage. Mechanism and application of PCR, Types- inverse PCR, Real-time PCR, Reverse Transcriptase PCR, Multiplex PCR. DNA finger printing- #RFLP and RAPD#.

UNIT –IV

12 Hours

Gene Transfer Techniques: Transfection- Physical – Biolistic Method, electroporation, electrofusion, microinjection Chemical- Calcium phosphate mediated uptake, and protoplast fusion –DEAE, DMSO Mediated and #Liposomes#.

UNIT- V

12 Hours

Screening and Selection of recombinants- Insertional inactivation, Selection by colony hybridization, FISH, Marker inactivation Methods, Immunological and Genetic Methods. #Blotting (Southern, Western, Northern) Techniques#.

#--- # Self study

Textbooks

1. Old, R.W. and Primrose. Principle of Gene Manipulation, (5th edition). Blackwell Scientific Publication, Boston, 1995.
2. Winnecker, E.D. From gene to clones, Introduction to Gene Technology. VCH Publication, FRG, 1987.
3. Brown, T.A . An introduction to Gene Cloning (3rd edition).Chapman andHall, 1995.

Books for Reference

1. Glick, B.R. and Pasternak, J.J. Molecular Biotechnology. Principles and Application of Recombinant DNA, ASM Press, Washington, 1994.
2. Jeremy M. Dale. Molecular Genetics of Bacteria (3rd edition).John Wiley and sons, NewYork,1998.

Books for Study

UNIT I	Text Book 1	Chapter 1
UNIT II	Text Book 1	Chapter 3-5
UNIT III	Text Book 2	Chapter 3
UNIT IV	Text Book 3	Chapter 8
UNIT V	Text Book 3	Chapter 9

**SEMESTER VI: EXTRA CREDIT II
MUSHROOM TECHNOLOGY**

Course Code : 17UMB 6EC2

Hours/Week : Nil

Credit : 4*

Max Marks : 100*

Internal Marks: -

External Marks: 100*

Objectives:

1. To provide knowledge on application of mushroom
2. To promote the students to become an entrepreneurship

UNIT I

Scope and development of mushroom - classification of edible mushrooms- medicinal value of mushrooms- Edible mushroom cultivation – Types of edible mushroom available in India – *Calacybe indica*, *Volvariella Volvacea*, *Pleurotus sp*[#], *Agaricus bisporus*[#]

UNIT II

Food value and composition of mushroom- protein, vitamins, minerals, carbohydrates, fibre, fat- Pure culture- preparation of media (PDA and Oatmeal agar media) sterilization – Preparation of test tube slants to store mother culture – culturing of *Pleuretus* mycelium on petriplates – [#]Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication[#].

UNIT III

Cultivation Technology- Infra structure, Substrates (locally available) polythene bag, vessels, Inoculation hood –low cost stove – sieves – Cultural rack mushroom unit (Thatched house) – Mushroom bed preparation – Paddy straw, sugarcane trash, maize straw, banana leaves- post harvest technique- packing- transport- storage- short term storage- long term storage- [#]Cultivation of button mushroom[#].

UNIT IV

Pests and diseases of Edible mushrooms- fungal diseases- dry bubble, wet bubble, cob web disease, green moulds, competitor moulds- bacterial diseases- bacterial blotch- viral diseases- insect- sciarid flies, phorid flies, cecid files- mushroom mites- beetles- [#]nematodes[#].

UNIT V

Economics of mushroom cultivation (fixed assets, recurring expenditure, labour, economics of cultivation throughout the year and seasonal growing formulation of project report for getting finance from funding agencies). Precautions in mushroom cultivation. [#]Mushroom recipes- western and indian recipes, pickles, powders, jams[#].

#-- # Self study

Text Books

1. Edwards, C.A and Bohlen, P.J . Biology and ecology of earthworms III Edn. Chapman & Hall publications N.Y.U.S.A, 1996.
2. Reeti singh U.C. Singh, modern mushroom cultivation, Agrobios publications, India, 2005.

Books for Reference

1. Arvind kumar. Vermitechnology , Aph publishing corporation,2005.
2. Marimuthu. Oyster Mushrooms, Dept. of Plant pathology, TNAU, Coimbatore, 1991.
3. Mary violet Christy . A . Vermitechnology, Mjp publishers, 2008.
4. Nita Bahl. Hand book of Mushrooms, II edition, Vol. I & II, 1988.
5. Paul Stamets, J.S. and Chilton, J.S. Mushroom Cultivator: A practical guide to growing mushrooms at home, Agarikon Press, 2004.
6. Swaminathan M. Food and Nutrition, Bappco. The Bangalore Printing and Publishing Co. Ltd., Bangalore, 1990.
7. Tewari and Pankaj Kapoor S.C. Mushroom cultivation, Mittal Publications, Delhi, 1988.

Books for Study

UNIT I	Text Book 1	Chapter 2 &11
UNIT II	Text Book 1	Chapter 10
UNIT III	Text Book 1	Chapter 13
UNIT IV	Text Book 2	Chapter 10& 11
UNIT V	Text Book 2	Chapter 12