ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

MANGALORE UNIVERSITY

(Accredited by NAAC with 'A' Grade)

ಕ್ರಮಾಂಕ/No: MU/ACC/CR.29/2018-19/A8

ಕುಲಸಚಿವರಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ – 574 199
Office of the Registrar
Mangalagangothri – 574 199
ದಿನಾಂಕ/Date: 11.04.2019

NOTIFICATION

Sub: Syllabus of Microbiology an optional course for B.Sc Degree programme under Choice Based Credit System -reg

Ref: Decision of the Academic Council at its meeting held on 19.03.2019 vide Agenda No:4:198(2018-19)

Pursuant to the above, the Syllabus of Microbiology an optional course for B.Sc Degree programme under Choice Based Credit System which was approved by the Academic Council at its meeting held on 19.03.2019 is hereby notified for implementation with effect from the academic year 2019-20.

Copy of the Syllabus shall be downloaded from the Mangalore University Website. www.mangaloreuniversity.ac.in

REGISTRAR.

To:

1) The Principals of the Colleges concerned.
2) The Registrar (Evaluation), Mangalore University.
3) Dr. K. C. Pushpalatha, Chairperson, P.G. & U.G. BOS in Microbiology, Mangalore University & Associate Professor, Department of Studies & Research in Microbiology, P.G. Centre, Chikka Aluvara - 571232
4) The Superintendent, Academic Section, O/o the Registrar, Mangalore University.
5) The Director, DUIMS, Mangalore University – with a request to publish in the Website.
6) Guard File.

MANGALORE UNIVERSITY

B. Sc. CHOICE BASED CREDIT SYSTEM

COURSE PATTERN AND SCHEME OF EXAMINATION

MICROBIOLOGY

I SEMESTER

Group	Course Code	Title of Courses	Instruction hrs/week	Duration of Exam (hrs)	Max. Marks			Credits
					IA*	Exam	Total	
Group I Core Courses	BSCMBC 131	Basic Microbiology	4	3	20	80	100	2
	BSCMBP 132	Basic Microbiology Practicals	3	3	10	40	50	1
Group II Elective Courses	BSCMBCE 133	Bioinstrumentation	2	2	10	40	50	1

II SEMESTER

Group I Core Courses	BSCMBC 181	Microbial taxonomy and Culture techniques	4	3	20	80	100	2
	BSCMBP 182	Microbial taxonomy and Culture techniques Practicals	3	3	10	40	50	1
Group II Elective Courses	BSCMBCE 183	Microbial quality control in food and pharma industry	2	2	10	40	50	1

III SEMESTER

Group I Core Courses	BSCMBC 231	Basic Biochemistry, Microbial Physiology and Microbial genetics	4	3	20	80	100	2
	BSCMBP 232	Basic Biochemistry, Microbial Physiology and Microbial genetics Practicals	3	3	10	40	50	1
Group II Elective Courses	BSCMBCE 233	Clinical lab techniques	2	2	10	40	50	1

IV SEMESTER

Group I Core Courses	BSCMBC 281	Molecular Biology, Recombinant DNA Technology, Biostatistics and Bioinformatics	4	3	20	80	100	2
	BSCMBP 282	Molecular Biology and Recombinant DNA Technology Practicals	3	3	10	40	50	1
Group II Elective Courses	BSCMBCE 283	Elementary concepts of Microbiology	2	2	10	40	50	1

V SEMESTER

Group	Course Code	Title of Courses	Instruction hrs/week	Duration of Exam (hrs)	Max. Marks			Credits
					IA*	Exam	Total	
Group I Core Courses	BSCMBC 331	Agriculture Microbiology and Plant Pathology	4	3	20	80	100	2
	BSCMBC 332	Immunology and Medical Microbiology	4	3	20	80	100	2
	BSCMBP 333	Agriculture Microbiology, Plant pathology, Immunology and Medical Microbiology Practicals	4	4	20	80	100	2

VI SEMESTER

Group	Course Code	Title of Courses	Instruction hrs/week	Duration of Exam (hrs)	Max. Marks			Credits
					IA*	Exam	Total	
Group I Core Courses	BSCMBC 381	Food and Industrial Microbiology	4	3	20	80	100	2
	BSCMBC 382	Environmental Microbiology	4	3	20	80	100	2
	BSCMBP 383	Food, Industrial Microbiology and Environmental Microbiology Practicals	4	4	20	80	100	2

* Based on internal test or tests

Question paper pattern for B.Sc. Microbiology
University practical examination
(Common to I, II, III, IV Semester)

Time: 3 Hours Max. Marks: 40

Q. No. 1. Conduct the experiment A and report the result 12 Marks

Q. No. 2. Conduct the experiment B and report the result 8 Marks

Q. No. 3. Identify and comment on C, D, and E 5X3 = 15 Marks

Q. No. 4. Class record 5 Marks

V Semester

Time: 4 Hours Max. Marks : 80

Q. No. 1. Conduct the experiment A and report the result 15 Marks

Q. No. 2. Conduct the experiment B and report the result 10 Marks

Q. No. 3. Identify and comment on C, D, E, F and G 5X5 = 25 Marks

Q. No. 4. Class record 5Marks

Q. No. 5. Report on field Trip and Viva Voce 10 + 05= 15 Marks

Q. No. 6. Submission of two fungal slides (permanent) 05+05=10 Marks

VI Semester

Time ;4 Hours Max. Marks :80Marks

Q. No. 1. Conduct the experiment A and report the result 15 Marks

Q. No. 2. Conduct the experiment B and report the result 10 Marks

Q. No. 3. Identify and comment on C, D, E, F and G 5X5 = 25 Marks

Q. No. 4. Class record 5 Marks

Q. No. 5. Project report and Viva Voce 20 + 05= 25 Marks

Question paper pattern for B.Sc. Microbiology
Internal assessment practical examination
(I Semester)

Max. Marks :20

Q. No. 1. Conduct the experiment A and report the result 10 Marks

Q. No. 2. Conduct the experiment B and report the result 4 Marks

Q. No. 3. Submission of bacterial slides 2X3 = 06 Marks

(Common to II, III, IV Semester)

Max. Marks: 20

Q. No. 1. Conduct the experiment A and report the result 12 Marks

Q. No. 2. Conduct the experiment B and report the result 08 Marks

V and VI Semester

Max. Marks : 40

Q. No. 1. Conduct the experiment A and report the result 10 Marks

Q. No. 2. Conduct the experiment B and report the result 05 Marks

Q. No. 3. Identify and comment on C, D, E, F and G 5X5 = 25 Marks

Question paper pattern for B.Sc. Microbiology
University practical examination
(Common to I , II, III, IV, V and VI Semester)

Time - 3 Hours Max. Marks : 80

Part A

1**. Discuss any TEN out of Twelve from the following**: 2X10 = 20 Marks

Part B

Answer One set of questions from each unit

UNIT I

2 a. 5 Marks 15 marks
b. 10 Marks

OR

3 a. 5 Marks 15 marks
b. 10 Marks

UNIT II

4 a. 5 Marks 15 marks
b. 10 Marks

OR

5 a. 5 Marks 15 marks
b. 10 Marks

UNIT III

6 a. 5 Marks 15 marks
b. 10 Marks

OR

7 a. 5 Marks 15 marks
b. 10 Marks

UNIT IV

8 a. 5 Marks 15 marks
b. 10 Marks

OR

9 a. 5 Marks 15 marks
b. 10 Marks

Question paper pattern for B.Sc. Microbiology
Internal Assessment examination
(Common to I , II, III, IV,V and VI Semester)

Time-1:30Hours Max. Marks :40

Part A

1**. Discuss any 5 out of 8 from the following**: 2X5 = 10 Marks

Part B

Answer One set of questions from each unit

UNIT I

2 a. 5 Marks 15 marks
b. 10 Marks

OR

3 a. 5 Marks 15 marks
b. 10 Marks

UNIT II

4 a. 5 Marks 15 marks
b. 10 Marks

OR

5 a. 5 Marks 15 marks
b. 10 Marks

I SEMESTER:

BSCMBC 131: Basic Microbiology (Theory)

Total 48 hrs - 4 hrs/week

UNIT I: Introduction to Microbiology 12 hrs

1. Definition of Microbiology; History and scope of Microbiology as a modern science- Branches of Microbiology
2. Contribution of Antony Von Leewenhoek, Edward Jenner, Lazaro Spallanzani, Louis Pasteur, Joseph Lister, Robert Koch, Alexander Flemming and lwanovsky to the development of Microbiology
3. Microorganisms- Types and significance in general.(Beneficial and Harmful).

UNIT II: Microscopy 12 hrs

1. **Microscopy**: Principles of Microscopy- Magnification, Resolving power, Numerical aperture, Tube length and Focal length.
2. **Light Microscopy**: Principle , construction, working and applications of a)compound microscope c) Dark field microscope d) Phase contrast microscope e) Fluorescence Microscope f) Stereomicroscope; Disadvantages of Light Microscopes- Spherical and Chromatic aberrations
3. **Electron Microscopy**- Specimen preparation for electron microscope (Freeze etching and Metal shadowing); Principle , construction, working and applications of TEM and SEM

UNIT III: Sterilization Techniques 12 hrs

1. Definition of terms-sterilization, disinfectant, antiseptic, sanitizer, germicide, microbiocidal agents, micro biostatic agents and antimicrobial agent.
2. Physical methods of sterilization- Principle and applications of moist heat sterilization, Dry heat sterilization, Filtration, Radiation (Ionizing and Non ionising) with examples
3. Chemical methods: Alcohol, aldehydes, phenols, halogen, metallic salts, Quaternary ammonium compounds and sterilizing gases as antimicrobial agents.

UNIT IV: Staining Techniques 12 hrs

1. Stains, Definition Nature of stains, Types of stains, Mechanism of dye action
2. General procedure of staining of bacteria and fungi.
3. Classification of staining techniques: Principle, procedure and applications of a) Simple staining and negative staining b) Differential Staining- Grams and acid fast staining c) Structural staining – cell wall, endospore, flagella and capsular staining

I SEMESTER

BSCMBP 132: Basic Microbiology (Practical)

1. Safety measures in Laboratory
2. Study of compound microscope- Construction, working, principle, care to be taken while using the microscope. Use of oil immersion objective.
3. Study of instruments-Autoclave, hot air oven. Laminar air flow chamber, colony counter, inoculation loop and needle, Incubator, centrifuge, pH meter, and colorimeter/spectrophotometer.
4. Study of aseptic techniques-preparation of cotton plugs for test tubes and pipettes, wrapping of petriplates and pipettes, transfer of media and inoculum. Cleaning and sterilization of glasswares
5. Simple staining technique for bacteria and fungi
6. Negative staining technique
7. Gram's staining Technique
8. Endospore staining Technique
9. Study of bacterial motility by hanging drop technique
10. Submission of 3 bacterial slides (permanent) for the internal assessment examination

II SEMESTER

BSCMBC 181: Microbial Taxonomy and Culture Techniques (Theory)

Total 48 hrs - 4 hrs/week

UNIT I: General account of Bacteria and Cyanobacteria 12 hrs

1. Bacteriology, Size, Shape and arrangement of bacterial cells,
   Fine structure, composition and function of Eubacterial cell wall, cell membrane, ytoplasm, nucleoside, flagella, Pili/fimbriae, slime layer, capsule, spores and cysts
2. Classification of Bacteria, reproduction of bacteria
3. General characteristics, classification, cell structure and reproduction of Cyano bacteria Parallelism between bacteria and cyanobacteria

UNIT II: General account of Fungi and Protozoa 12 hrs

1. Mycology, Salient features, Ultra structure of fungal cell
2. Classification, reproduction and significance of major groups of fungi (Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes). Type study of *Rhizopus, Aspergillus, Penicillium, Yeast, Agaricus and Fusarium*.
3. Protozoa-General features, classification and significance.

UNIT III: Viruses, Rickettsia, Chlamydia, Mycoplasma, Actinomycetes and Archaea

08 hrs

1. Virology, General structure and properties of viruses, Lytic and Lysogenic Cycle
   Nature and significance of prions and viroids
2. General features and significance of Rickettsia, Chlamydia, Mycoplasma and Actinomycetes
3. Brief account of Archaea

UNIT IV: Culturing of microorganisms 16 hrs

1. Culture media- Characteristics, Types of media , Preparation of media
   Methods of isolation of bacteria and fungi-Serial dilution pour plate, spread plate and streak plate. Preservation and maintenance of cultures.
2. Nutritional requirements of microorganisms-Macronutrients, micronutrients and growth factors.
   Nutritional types of microorganisms: Autotrophs and heterotrophs, phototrophs and chemotrophs.
3. Physical factors affecting growth of microorganisms: Temperature, pH and Oxygen.
   Bacterial growth curve, synchronous growth, Continuous cultivation-chemostat and turbidostat

Counting of bacteria-Viable count- SPC, Total count-DMC and trubidimetric estimation.

II SEMESTER

BSCMBP 182: Microbial Taxonomy and Culture Techniques (Practical)

1. Preparation of media- Nutrient broth, Nutrient agar, PDA
2. Isolation of microorganisms: Spread plate, Pour plate techniques, Streaking technique, serial dilution agar plating technique
3. Study of colony characteristics of Bacteria.
4. Measurement of size of cells by micrometry
5. Enumeration of microorganisms by Haemocytometer
6. Study of bacterial growth curve
7. Study of effect of pH and temperature on bacterial growth
8. Type study of *Aspergillus, Pencillium, Yeast, Rhizopus and Fusarium* (Specimens)
9. Study of protozoa- Amoeba, Paramaecium and Euglena. (Permanent slides)
10. Study of Blue green algae- *Nostoc, Oscillatoria* and *Spirulina.* (Specimens)

III SEMESTER

BSCMBC 231: Basic Biochemistry, Microbial Physiology and Microbial Genetics

Total 48 hrs - 4 hrs/week

UNIT I: Basic Biochemistry 12 hrs

1. Biomoleules –Introduction, Properties of water, acids, bases, pH and Buffers.
   A brief account of the properties, classification and importance of carbohydrates, lipids and proteins.
2. Enzymes – Introduction, properties, nomenclature and classification, Mechanism of enzyme action, effect of various factors influencing enzyme activity, enzyme inhibition,
3. Bioenergetics – Free energy, ATP and its production, other high energy compounds, Oxidation – Reduction reactions, energy coupling reactions, exothermic and endothermic reactions

UNIT II: Microbial Physiology 12 hrs

1. Respiration: Glycolysis, TCA and ETS, oxidative phosphorylation, pentose phosphate pathway. Anaerobic respiration, Fermentation – Fermentative modes in microorganisms – alcoholic, Lactic acid – hetero and homo lactic acid fermentation.
2. Bacterial photosynthesis – photosynthetic pigments of prokaryotes, Types of bacterial photosynthesis- Cyclic and non-cyclic photophosphorylation, Oxygenic and anoxygenic photosynthesis
3. Comparision of photosynthesis in bacteria and green plants.

UNIT III: Microbial Genetics 12 hrs

1. .Fundamentals of Genetics, Genomic organisations in prokaryotes and eukaryotes.
2. Nucleic acids: Chemical compositions of DNA & RNA, Watson & Crick model of DNA, Types of DNA: A,B,C,D,Z and H, Supercoiling of DNA,Single stranded and Circular DNA Structure of RNA , Types of RNA-rRNA,tRNA (Clover Leaf Model),mRNA
3. DNA replication in Prokaryotes : Semi, Conservative and dispersive methods, Rolling circle model and Cairn's model (Theta model)., origin of replication, Primers and templates, replication fork, unidirectional and bidirectional replication.

UNIT IV: Genetic Recombination and Mutations 12 hrs

1. Genetic recombination in bacteria: Conjugation, F+ vs F- , Hfr + vs F-, F - vs F-, Transformation: Griffith's experiment and mechanism,

Transduction: generalized and specialized.

2. Mutations-Definition and types; Molecular basis of mutation, , detection and isolation of mutants (Replica plate method) . Transposable elements – a brief account
3. Genotypic and phenotypic variations in microorganisms

III SEMESTER

BSCMBP 232: Basic Biochemistry, Microbial Physiology and Microbial Genetics

1. Fermentation of carbohydrates by microorganisms
2. Starch hydrolysis test
3. Gelatin liquefaction test
4. Catalase test
5. Oxidase test
6. TSI agar test
7. IMViC test
8. Urease test
9. Estimation of reducing sugar glucose by DNS method
10. Estimation of protein by Biuret method

IV SEMESTER

BSCMBC 281: Molecular Biology, Recombinant DNA technology, Biostatistics and Bioinformatics

Total 48 hrs - 4 hrs/week

UNIT I: Molecular Biology 12 hrs

1. Central Dogma of Molecular Biology, gene concept, Genetic code,
2. Protein Synthesis in Prokaryotes- Ribosomes, types of RNA involved transcription, translation and mechanism of protein synthesis and inhibitors of protein synthesis. General account of reverse transcription.
3. Regulation of gene expression in prokaryotes- The operon concept, Induction and repression, The lac operon and tryptophan operon.

UNIT II: Recombinant DNA technology 12 hrs

1. History and fundamentals of r-DNA technology
   Tools for r-DNA technology- Restriction enzymes, Ligases and other DNA modifying enzymes
2. Gene cloning vectors-Salient features of Plasmids, Cosmids, Phagemids, shuttle vectors and bacteriophages
3. Applications of Genetic engineering- Production of insulin, hepatitis B vaccine, Gene therapy and transgenic plants. Potential hazards and safeguards-GM foods and genetically modified

UNIT III: Molecular Techniques 12 hrs

1. A brief account of macromolecular separation by chromatography-paper and TLC Electrophoresis, Principles and Types-gel and PAGE
2. Blotting techniques- Western, Southern and Northern , PCR and its applications,
3. Nano–biotechnology - Concept and application Nanotechnology using microorganisms.

UNIT IV: Biostatistics and Bioinformatics 12 hrs

1. Introduction, sample, population, sampling, data, tabulation and representation of data. Measures of central tendencies, mean, media and mode.
2. Bioinformatics – Introduction, history, biological sequences/ proteomics, genomics,
3. DNA chips, protein chips and search engines,databases,BLAST,,FASTA,HGP,3. Applications.

IV SEMESTER

BSCMBP 282: Molecular Biology and Recombinant DNA Technology

1. Preparation of buffers-citrate and phosphate buffers.
2. Estimation of DNA by Diphnylamine method.
3. Estimation of RNA by Orcinol method.
4. Test for antibiotic sensitivity and determination MIC of antimicrobial agents.
5. Separation of amino acids by paper Chromatography
6. Separation of amino acids/carbohydrate by Thin layer Chromatography
7. Demonstration of protein/DNA separation by gel electrophoresis
8. Extraction of DNA from yeast.
9. Study of effect of UV light on microorganisms
10. Charts on genetic engineering. a) pBR 322 b) pUC 18 and 19 c) SV 40
    d) Bacteriophages- Lambda e) Gene cloning f) Selection of recombinants by replica plate technique

V SEMESTER

BSCMBC 331: Agricultural Microbiology and Plant Pathology

Total 48 hrs - 4 hrs/week

UNIT I: Soil Microbiology 12 hrs

1. Soil composition, phsyico-chemical properties of soil, Soil as a habit for microbes, Soil microflora – bacteria, fungi, algae, protozoa and virusus.
2. Bio geochemical cycles- Carbon , Nitrogen, Phosphorus and sulphur.
3. Plant microbe interaction: Rhizosphere, Phyllosphere, mycorrhiza association. Interaction among microorganisms- neutrailism, commensalism, antagonism and parasitism.

UNIT II: Agricultural Microbiology 12 hrs

1. Introduction , Concepts and scope of Agricultural Microbiology. Microorganisms in agriculture- PGPR (plant growth promoting Rhizobacteria) and their uses.
2. Biofertilizers – General account and production of *Rhizobium, Azatobactor, Azospririllum* and Cyano bacteria.
3. Biopesticides- General account and production of *Trichoderma harzianum*, *Bacillus thuringenesis, Beaveria bassiana,*Organic matter decomposition -cellulose, hemicelluloses, lignin and chitin decomposition in soil.

UNIT III: Plant Pathology 12 hrs

1. History of Plant Pathology, Significance of plant diseases, Symptoms and types of plant diseases.
2. Parasitism, Disease Development and pathogenecity, Host range of pathogens, Disease triangle, Diseases cycle / Infection cycle, Host parasite interaction, role of secondary metabolites in disease development (toxins, hormones, enzymes),
3. Defence mechanism (Pre-existing structural and chemical defences, Induced structural and biochemical defences)

UNIT IV: Plant Diseases & their management 12 hrs

1. A study of symptoms, etiology, epidemiology and control of the plant diseases- TMV, sandal spike, Citrus canker,
2. Bacterial, blight of rice, Koleroga of areca nut, Rust of coffee, Powdery mildew of Cucurbits.
3. Integrated management of plant diseases

BSCMBC 332: Immunology and Medical Microbiology

Total 48 hrs - 4 hrs/week

UNIT I: Immunology 12 hrs

1. Introduction to Immunology: An overview of immune system, Phagocytes, Natural killer cells, mast cells, basophils and Dendritic cells
2. Immunity: Types: Innate immunity, Acquired immunity and non specific immunity. Humoral or antibody mediated immunity, cell mediated immunity.
   Antigens and Antibodies: properties of antigen,
3. Antibodies – structure, types and function, monoclonal antibodies and its clinical applications,

UNIT II: Medical Microbiology 12 hrs

1. Introduction to Medical Microbiology: History, Development and scope of Medical Microbiology.
2. 2.Microbial infections: Types of infections, modes of transmission, portal of entry: Urinary tract infection, Sexually transmissible infection, Infection of the central nervous system,
3. Infections of circulatory system, Oral cavity and respiratory infection, Gastrointestinal infection. Nosocomial infection

UNIT III: Infectious diseases 12 hrs

1. Epidemiology and Pathogenesis, Laboratory diagnosis and Prevention of diseases caused by Viruses: Chicken pox, Rabies, hepatitis, AIDS.
2. Bacteria: Tuberculosis, cholera, Typhoid, Botulism, Shigellosis, Salmonellosis, Tetanus.
3. Diseases caused by Fungi: Candidiasis, Dermatomycosis, Aspergillosis and Anthrax
   Emergent Diseases: Hemorrhagic fever, Swine flu, SARS, Chikun gunya, Ebola.

UNIT IV: Antibiotics 12 hrs

1. Antibiotics: Definition; Characteristics of antibiotics, antimicrobial spectrum of antibiotics
2. Mode of action; Penicillin(Cell wall affecting), streptomycin, tetracycline, (Protein synthesis inhibiting),polymyxin(cell membrane damaging), Nalidixic acid and quinonolones (Nucleic acid synthesis inhibiting), Trimethoprim (Enzyme system

inhibiting) Nystatin and Amphotericin B(Antifungal); Metronidazole (antiprotozoal), AZT (antiviral antibiotics)

3. Standardization of Antibiotics: MIC, Tube dilution method, Diffusion method-well and disc diffusion.

V SEMESTER

BSCMBP 333: Agricultural microbiology, Plant Pathology, Medical Microbiology and Immunology

1. Estimation of Organic Carbon by Chromic acid method.
2. Isolation of microorganisms from rhizosphere and non rhizosphere soil.
3. Isolation and identification of *Rhizobium* from root nodules.
4. Test for ammonification in soil.
5. Determination of soil moisture content.
6. Determination of foliar infection percentage by graphical and weighing method.
7. Estimation of inorganic Phosphate in soil by Acetone Ammonium Molybdate method.
8. Determination of quality of seeds by ferric chloride method
9. Determination of blood group – antigen antibody reaction.
10. Synders test for Dental caries.
11. Isolation of microorganisms from skin, mouth, and wounds.
12. Demonstration of Immuno-diffusion technique and ELISA
13. Submission of two fungal slides(permanent) for examination
14. Field trip related to agricultural research institute, hospital/diagnostic laboratories and submission of report.

VI SEMESTER

BSCMBC 381: Food and Industrial Microbiology

Total 48 hrs - 4 hrs/week

UNIT I: Food Microbiology 12 hrs

1. Introduction to food microbiology: Definition, concepts and scope. Food as substrate for microbes. Factors influencing microbial growth in food-Extrinsic and intrinsic factors.
2. .Principles of food preservation- Physical (anaerobic conditions, high temperatures, low temperatures, drying, Canning, processing, Heat treatment) and Chemical preservation, food additives
3. Contamination and food spoilage: Principles and general account
   A general account Hazard analysis critical control points (HACCP) and Good manufacturing process (GMP)

UNIT II: Dairy Microbiology 12 hrs

1. Microbiology of raw milk, Milk as a vehicle of pathogens, Sources of Contamination of milk, Prevention of contamination of raw milk,
   Microbial examination of milk-SPC, DMC,and reductase test,
2. Biochemical activities of microbes in milk,.Methods of milk preservation-sterilization and pasteurization,Microbiological standards for milk and milk products.
3. Fermented dairy products-Cheese,Yoghurt and butter milk.

UNIT III: Fermentation Technology 12 hrs

1. Introduction, Concepts and Scope. Construction of a typical fermenter and types of fermenters, Industrial Microorganisms: Screening, Isolation. Identification and characterization of industrially important microbes.
2. Strain improvement- mutation, recombination and genetic manipulation.
3. Media for Industrial Fermentations: Continuous and batch culture, Media formulation, growth factors, carbon, nitrogen, Energy and Mineral sources, buffers, inhibitors, precursors, inducers, Oxygen requirements, Antifoam agents and others,
   Sterilization: Media and Fermenter sterilization

UNIT IV: Industrial production of metabolites 12 hrs

1. Secondary metabolites, Industrial production of ethyl alcohol, wine, vinegar,
2. vitamin B-12, gibberellins and Penicillin. Production of biogas. Production of Fungal and Bacterial Amylase and proteases

3. Down stream processing: A general account of steps in recovery and purification of fermented products. Solid matter, Foam separation, Precipitation, Filtration, Centrifugation, Cell disruption, Solvent recovery.

VI SEMESTER

BSCMBC 382: Environmental Microbiology

Total 48 hrs - 4 hrs/week

UNIT I: Air microbiology 12 hrs

1. Environmental Microbiology: Concepts and scope of environmental microbiology. Microbiology of Air: Air microflora of indoor and outdoor environment,
2. Factors affecting airflora, Techniques of trapping air borne microorganisms.
3. Air as a medium for transmission of diseases-Mode, general symptoms and control. Allergy and air pollution

UNIT II: Aquatic Microbiology 12 hrs

1. Distribution of microorganisms in the aquatic environment,Water pollution- sources, Waste water (sewage)treatment, water purification and water treatment plants,
2. Determination of sanitary quality of water, Biological indicators of water pollution, BOD,COD.
3. Water as a medium for transmission of diseases-Mode, general symptoms and control

UNIT III: Microbes in extreme environment 12 hrs

1. Microbes in extreme environment: Diversity of microorganisms in extreme environments,
2. An account of Thermophiles, acidophiles, alkalophiles, halophiles. barophiles and their survival mechanisms (adaptations).
3. Space Microbiology: Historical development of space microbiology, Life detection methods a) Evidence of metabolism (Gulliver) b) Evidence of photosynthesis (autotrophic and heterotrophic).

UNIT IV: Geomicrobiology 12 hrs

1. Bioremediation -definition, Microbes in bioremediation, Factors affecting bioremediation and types, advantages and disadvantages.
2. A general account of microbial degradation of pesticides, petroleum products and Xenobiotics
3. Geomicrobiology: Bioleaching and bio-mining, Microbes in metal extraction, bioleaching of copper and microbes in petroleum product formation.

VI SEMESTER

BSCMBP 383: Food, Industrial and Environmental Microbiology

1. Enumeration of bacteria and fungi from spoiled fruits and vegetables, curds, canned food and spoiled food.
2. Isolation of microbes from air by plate exposure method.
3. Estimation of dissolved oxygen in water.
4. Estimation of BOD in water.
5. Estimation of CO_2 in water.
6. MBR test for milk.
7. Standard analysis of water.
8. Estimation of lactic acid content in milk.
9. Estimation of lactose content in milk.
10. Enumeration of bacteria in raw and pasteurized milk by SPC method.
11. Preparation of wine.
12. Estimation of alcohol percentage by specific gravity method.
13. Production and estimation of amylase by fungi by DNS method.
14. Minor project work and report shall be submitted for evaluation.

I SEMESTER

CORE ELECTIVE

BSCMBCE 133 BIOINSTRUMENTATION

Total 24 hrs - 2 hrs/week

Unit I **12 hrs**

1. Microscopy; Light and Electron microscopy,
2. Centrifugation: Principle - types of centrifuges - low speed, high speed, refrigerated and ultra centrifuge, Differential centrifugation - density gradient centrifugation. Applications of centrifuge.
3. Flow cytometry; Principle and applications. Biochemical analyser; Principle and applications.

Unit II **12 hrs**

1. Colorimetry – Principle, Beer – Lambert's law and Applications.
2. Spectrophotometry – UV &Visible, Types of Spectrophotometer – IR,
3. NMR & Atomic absorption spectrophotometry –Applications. Flame photometry Radioisotopes and their applications.

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1. Bajpai P. K. (2010). *Biological Instrumentation and Methodology*. Revised edition, S. Chand & Co. Ltd., New Delhi.
2. Palanivelu P (2004). *Analytical Biochemistry and Separation techniques*. Third edition, MKU Coop, Press Ltd., Palkalai Nagar, Madurai.
3. Subramanian MA (2005). *Biophysics - Principles and Techniques*. First edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai.
4. John G Webster (2004). *Bioinstrumentation. Student edition*. John Wiley and Sons, Ltd.
5. Upadhyay & Upadhyay. *Biophysical Chemistry*, (2010). Himalaya Publishing house
6. Keith Wilson and John Walker, 1994. Practical Biochemistry – principles and techniques. Cambridge Press, New York.
7. A. Geddes and L.E Baker; *Principles of Applied Biomedical Instrumentation* –John Wiley& Sons.
8. Den, Williard & Merrit; *Instrumental methods of analysis* –. Asian Edition.

II SEMESTER

BSCMBCE 183: MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

Total 24 hrs - 2 hrs/week

UNIT I **12 hrs**

1. Enrichment culture techniques for detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar
2. Microbial Standards for Foods and Water - BIS standards for common foods and drinking water.
3. Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion. Sterility testing for pharmaceutical products.

UNIT II **12 hrs**

1. Biosafety: -Introduction; Good microbiological practices, Introduction to Biological Safety Cabinets; Primary Containment for Biohazards;
2. Biosafety Levels; Biosafety Levels of Specific Microorganisms; Biosafety guidelines - Government of India.
3. Discarding biohazardous waste - Methodology of Disinfection, Autoclaving & Incineration

REFERENCES:

1. Baird R M, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt' Ltd.
3. Harrigan WF (1998) Academic Press. Laboratory Methods in Food Microbiologr, 3rd ed.
4. Jay JM, loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer.
5. Laboratory Exercises in Microbiology, George. A. Wistreich & Max.D. Lechtman, 3 rd Ed, Glencoe Press, London.
6. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
7. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
8. Gurumani, N. Research Methodology, For Biological Sciences . MJP Publishers, Chennai 2006

Important Links:

http://www.w3.org/IPR/; http://www.wipo.int/portal/index.html.en

http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in; www.iprlawindia.org/

III SEMESTER

BSCMBCE 233: CLINICAL LAB TECHNOLOGY

Total 24 hrs - 2 hrs/week

Unit I **12 hrs**

CLINICAL TECHNIQUES IN MICROBIOLOGY

1. Management of Clinical Microbiology Laboratory. Methods of Collection, transport and processing of clinical specimens - Blood, Urine, Sputum, Pus &Faeces for microbiological examination.
2. Examination of urine: sample collection, microscopic examination - crystals, casts, sediments, pregnancy test. Blood smear preparation: Staining & differential WBC count - absolute eosinophil count - E.S.R
3. . Blood indices - Platelet count: BT, CT, CRT – Prothrombin time. A.P.P.T and FDP estimation.

Unit II **12hrs**

1. Laboratory methods in Basic Mycology - Collection and transport of clinical specimens - Microscopy, examination of culture media
2. Serological test for fungi. Laboratory methods in basic Virology - Viral culture - Media and cells used - specimen processing-
3. Isolation and identification of Viruses. Viral Serology.

REFERENCES:

1. Bailey &Scott's (2014). Diagnostic Microbiology. 13th edition, The C.V. Mosby Company.
2. Abdul Khader. (2003). Medical Laboratory Techniques. First edition, Frontline Publications, Hyderabad.
3. Mukherjee, L. (1997). Medical Laboratory Technology. Volume I & II. Tata McGrew- Hill Publishing Company Limited, New Delhi
4. Sundararaj, T (2005). Microbiology Laboratory Perungudi, Chennai-96. Manual,
5. Godkar, P.B. (2003). Textbook of Medical Laboratory Technology, 2nd Edition, Bhalani Publication.
6. Seiverd, Charles, E. Hematology for Medical Technologies, 4th Edition, Lea & Febiger, US.
7. Ramink Sood, (2006). A Textbook of Medical laboratory Technology, Jaypee Brothers Medical Publishers (p).LTD, New Delhi.

IV SEMESTER

BSCMBOE 283: ELEMENTAL CONCEPTS OF MICROBIOLOGY

Total 24 hrs - 2 hrs/week

Unit I **12 hrs**

1. Introduction to Microbiology: Definition and History of microbiology – Antony von Leuwenhoek, Louis Pasteur - Robert Koch. Microscope (Applications only.)
2. Importance of staining. Classification of microorganisms. Normal human microflora. (Bacteria- *S. aureus* , *E. coli* . Fungi- Candida.)
3. Sterilization and Disinfection: Common Methods of sterilization: Physical (Heat, radiation) and chemical methods (Soaps, Detergents and ethanol).

Unit II **12 hrs**

1. Harmful role of microorganism in human life: Infections – Sources and transmission;
2. Diseases - Epidemic, Pandemic, Endemic. Common human diseases caused by Bacteria, Fungi, Protozoa and Viruses (examples to each and mentioning the respective causative agents),
3. Food spoilage and Food poisoning, Mushroom and Single cell protein, Role in .Agriculture- N_2 fixation and decomposition of waste.

REFERENCES:

1. Prescott L M, J P Harley and D A Klein (2005). Microbiology. Sixth edition, International edition, McGraw Hill.
2. Pelczar TR M J Chan ECS and Kreig N R (2006). Microbiology. Fifth edition, Tata McGraw-Hill INC. New York.
3. Ananthanarayanan, R. and Jayaram Panicker C.K. (2004) *Text book of Microbiology*. Orient Longman, Hyderabad.
4. Jawetz, Melnick, & Adelberg's. (2013). Medical Microbiology. 26th Edition. McGraw-Hill.
5. Patel AH (2005). Industrial microbiology. Published by Mac Millan India Ltd., Chennai.
6. Subba Rao NS (2004). Soil Microbiology. Fourth edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.