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Dated: 01-06-2013.

NOTIFICATION


Sub: Changes in the existing Syllabus of B.Sc. Microbiology.

Ref: 1. Proceedings of Faculty of Science & Technology Meeting held on
21-02-2013.
2. Proceedings of the Meeting of Academic Council held on 27-03-2013.

The Board of Studies in **Microbiology (UG)** at its meeting held on 07-12-2012
has recommended minor changes in the existing syllabus of B.Sc. Microbiology from the
academic year 2013-14.

The Faculty of Science and Technology and the Academic Council at their meetings
held on 21-02-2013 and 27-03-2013 respectively approved the above proposals and the
same is hereby notified.

The copy of Changes in the existing syllabus of B.Sc. Microbiology is annexed
herewith.


REGISTRAR. 3/6/2013

To

1. The Registrar (Evaluation), University of Mysore, Mysore.
2. The Chairperson, BOS/DOS in Microbiology, MGM.
3. The Dean, Faculty of Science & Technology, DOS in Zoology, MGM.
4. The Principals of the Affiliated Colleges running B.Sc. course.
5. The Director, College Development Council, UOM, Mysore
6. The Deputy/Assistant Registrar (Evaluation), University of Mysore, Mysore.
7. Sri Narasimha Murthy, Statistician, E.B. UOM, Mysore.
8. The Supdt. AC.1 & AC.2, A.B., Academic Section, UOM., Mysore.
9. The P.A. to the Vice-Chancellor/Registrar/Registrar(Evaluation), UOM., Mysore.
10. The Case Worker, AC.7, Academic Section, University of Mysore, Mysore.
11. The Section Guard File(Supdt.AC.2), A.B., A.C., UOM.
12. The Schedule File.

AC2.Eng.25-4.R

SUBJECT – MICROBIOLOGY SYLLABUS

SEMESTER SCHEME OF B.Sc. SCHEME OF INSTRUCTION OPTIONAL SUBJECT : MICROBIOLOGY

I SEMESTER

Microbiology Theory Paper I

42 hrs (3 hrs per week)

GENERAL MICROBIOLOGY

- I. History of Microbiology **10 hrs**
- a. Milestones of the historical development of Microbiology- Discovery of Microorganisms- Contributions of Antony von Leeuwenhoek. Theory of spontaneous generation and biogenesis. Contributions of Edward Jenner, Louis Pasteur, Joseph Lister, Robert Koch, Metchnikoff, Beijerinck, Ivanowsky, Alexander Fleming, Selman Waksman (in brief). Recent developments in the field of Microbiology.
 - b. Branches of Microbiology.
 - c. Scope of Microbiology.
- II. Light Microscopy : **9 hrs**
Different types of microscopes, their construction and working principles, Simple microscope (dissection microscope), Compound microscope (Types of microscopy Bright field, Dark field, Phase contrast and Fluorescence), Stereomicroscope.
- III. Electron Microscopy : **03 hrs**
Principles, construction and mode of operation of Scanning and transmission electron microscope, limitations. Preparation of specimens for electron microscopic studies.(ultra thin sectioning, negative staining, shadow casting and freeze etching – in brief)
- IV. Microbiological stains and Staining techniques for light microscopy: **08 hrs**
- a) Types of stains and principles of staining .
 - b) Preparation of bacterial smears for light microscopy: Fixation, Simple staining (positive and negative), differential staining (Gram's staining and acid – fast

staining), structural staining (Capsule, Flagella, Cell wall and Endospore of bacteria), nuclear staining.

- c) Wet mounting method – staining of algae and fungi.
- d) Hanging drop method.

V. Principles and methods of sterilization:

A. Physical Methods and their mode of action

12 hrs

- i) Heat – a) Dry heat – Hot Air Oven.
 - b) Incineration.
 - c) Moist heat – Autoclave, Pressure Cooker.
 - d) Tyndalization (fractional sterilization).
- ii) Filtration – Types of filters, Laminar air flow.
- iii) Radiation methods : UV radiation, γ -rays and cathode rays.

B. Chemical methods :

12 hrs

- a) Definition of terms – disinfectant's, antiseptics, Sanitizers, microbicides – bactericide, virucide, fungicide and sporicide, microbistatic-bacteriostatic and fungistatic agents.
- b) Use and mode of action of – alcohols, aldehydes, halogens, phenols, heavy metals, Detergents: quaternary ammonium compounds.

I SEMESTER

PRACTICAL – 1 GENERAL MICROBIOLOGY

Experiments based on theory syllabus 14 Practicals (one practical of 3 hrs/ week)

Expt. No.

1. Laboratory safety General rules and regulations.
2. Study of simple and compound microscopes, their handling including oil immersion objective
3. Preparation of stains, mordant and mounting media – Methylene blue, Crystal violet, Safranin, Nigrosin, Carbol Fuchsin, Malachite green, Gram's iodine, Cotton blue, Glycerine & Lactophenol.
- 4-7. Preparation of microorganisms for light microscopic observation – simple (direct and indirect) staining, differential staining (Gram-staining), Structural staining – capsule and endospore of bacteria)
8. Staining and mounting of algae (e.g., spirogyra/ Nostoc) and fungi (e.g., Rhizopus/ Aspergillus)
9. Observation of bacterial motility by Hanging drop method.
- 10-11. Microscopic measurements of microorganisms/ spores using stage and ocular micrometer.
12. Demonstration of laboratory equipments – autoclave, pressure cooker, hot air oven, incubator, Inoculation hood/ chamber, Inoculation loop, Inoculation needle, membrane filter and colony counter.
13. Preparation of chromic acid and its use. Use and mode of action of detergents, disinfectants – phenol ethyl alcohol, formaldehyde, mercuric chloride and iodine.
14. Display of photographs of microscopes mentioned in the theory.

INTERNAL ASSESSMENT

10 Marks

Break-up

Record	05 Marks
Continuous assessment	05 Marks

II SEMESTER

Microbiology Theory Paper II

42 hrs (3 hrs per week)

MICROBIAL DIVERSITY

- I The Microbial World : **06 hrs**
- i) Groups of microorganisms : Viruses, Prokaryotes (Cyanobacteria, Bacteria), Eukaryotes (Algae, Fungi, Protozoa)
 - ii) Study of ultra structure of typical prokaryotic cell and eukaryotic cell, comparative account.
 - iii) General Principles of classification and nomenclature of microorganisms (Haeckel's three kingdom classification and Whittaker's five kingdom classification)
- II Viruses : **06 hrs**
- i) Definition, history of virology, General characteristics of viruses – size, shape and chemical composition, properties used for classification of viruses, isolation and identification of viruses.
 - ii) Study of structure and replication of viruses :
 - a) Bacteriophages - T4 phage.
 - b) Cyanophages. - LPP
 - c) Phytophagenae - TMV.
 - d) Zoophagenae – Influenza and HIV.
 - iii) Importance of viruses.
 - iv) Viroids and Prions.
- III Bacteria : **12 hrs**
- i) Occurrence, shape and arrangement of bacterial cells, Structure of bacterial cell – cell wall (Gram positive or Gram negative), capsule, cell membrane, cytoplasm, ribosomes, nucleoid, plasmids, flagella, pili (fimbriae), inclusion bodies, multiplication by cell division, endospore formation
classification in brief as per Bergey's Manual of Systematic Bacteriology.
 - ii) Study of the following in brief with examples:
 - a) *Rickettsiae, Chlamydias, Mycoplasma, Spirochaetes, Actinomycetes*
 - b) Cyanobacteria : occurrence, structure, reproduction of the following : *Microcystis, Spirulina, Anabaena.*
- IV Algae : **07 hrs**
- i) Distribution, structure of typical algal cell (Eg : *Chlamydomonas*) A brief account of reproduction.
 - ii) Study of thallus structure, reproduction (in brief) and life cycle of the following :
Chlorella, Cosmarium, Scenedesmus, Spirogyra, Diatoms and Gracilaria.
- V Fungi : **08 hrs**
- i) Outline classification as per Alexopoulos and Mims
 - ii) Study of thallus structure, reproduction (in brief) and life cycle of the following:
Pythium, Rhizopus, Saccharomyces, Aspergillus, Penicillium, Fusarium, Agaricus
- VI Protozoa: **03 hrs**

General account, structure and reproduction of – *Euglena*, *Paramecium* and *Entamoeba*.

II SEMESTER

Practical II: MICROBIAL DIVERSITY

Experiments based on theory syllabus 14 Practicals (One Practical of 3 hrs/week)

Expt No.

- 1.2. Study of Cyanobacteria – *Microcystis*, *Spirulina*, *Anabaena*.
- 3-6. Study of the following algae- *Chlorella*, *Cosmarium*, *Scenedesmus*, *Spirogyra*, Diatoms and *Gracilaria*.
- 7-10. Study of the following fungi – *Pythium*, *Rhizopus*, *Saccharomyces*, *Penicillium*, *Aspergillus*, *Fusarium*, *Agaricus*.
11. Study of virus infected Plant materials T.M.V./ Bean mosaic
- 12-13. Study of the following protozoa – *Euglena*, *Paramecium*, *Entamoeba*.
14. Display of Photographs/materials of bacteriophages, TMV, HIV, *E.coli*, *Rickettsia*, *Chlamydia*, *Mycoplasmas*, *Spirochaetes* and *Actinomycetes*.

INTERNAL ASSESSMENT

10 marks

Break-up

Record	05 marks
Continuous assessment	05 marks

III SEMESTER

Microbiology Theory Paper

42 hrs (3 hrs/week)

III MICROBIAL GROWTH AND GENETICS

MICROBIAL GROWTH

- I Microbial Nutrition **03 hrs**
 - a) Major nutritional types of microorganisms.
 - b) Nutritional requirements of microorganisms.
 - c) Uptake of nutrients – passive transport : facilitated, active transport, group translocation, iron uptake.
- II. Microbial Growth : **05 hrs**
 - a) Growth rate and generation time, growth curve – phases of growth and their significance
 - b) Physical and chemical factors affecting growth : temperature, light, pH, oxygen and saline requirements.
 - c) Measurement of growth by cell number (Haemocytometer) and cell mass (Turbidometer, photometer) .
- III Cultivation of Bacteria :
 - a) Media – types, cultivation of aerobic and anaerobic bacteria **02 hrs**
 - b) Pure cultures and cultural characteristics: **02 hrs**
 - Serial dilution, Pure cultures by isolation -i) pour plate ii) spread plate iii) streak plate and iv) micromanipulator techniques : colony characteristics

- c) Maintenance and preservation of pure cultures – subculturing, overlaying with mineral oil and lyophilization. **02 hrs**

MICROBIAL GENETICS

IV A) Historical Review on Genetics: **06 hrs**

- a) Chromosomes : Prokaryotic and eukaryotic organisation.
- b) Cell Division, mitosis, meiosis and cell cycle in brief.
- c) Segregation and assortment of genes in haploid organisms compared to diploids

B) Recombination in Bacteria : **04 hrs**

- a) Transformation, Transduction (types) and Conjugation process – F – factor, Sexduction, Transposons.
- b) Extrachromosomal genetic elements and their importance with an example

V. Genetic material – structure, types and replication:

- a) Chemical basis of heredity – evidence for DNA and RNA as genetic material, Watson and Crick model of DNA, DNA types, types of RNA, structure and its functional importance. **06 hrs**
- b) Replication – mode and mechanism, replication in prokaryotic DNA – general methodology . **02 hrs**
- c) Gene – protein relationship : one gene – one enzyme and one gene – polypeptide concept, colinearity of genes and proteins. Protein synthesis – transcription and translation, genetic code – features, triplet code, Wobble hypothesis, nonsense codon, evolution of genetic code. **06 hrs**
- d) Regulation of gene expression in prokaryotes – Lac operon **02 hrs**

VI Mutations :

- i) Nature and types, mutagenic agents: physical and chemical mutagens, damage and repair of DNA : Photoreactivation & SOS repair. **02 hrs**

III SEMESTER

PRACTICAL III MICROBIAL GROWTH AND GENETICS

Experiments based on theory syllabus 14 Practicals (One Practical of 3 hrs/week)

Expt. No.

1. Cleaning and sterilization of glassware.
2. Preparation of media – nutrient broth, nutrient agar, potato dextrose agar, Czapek dox agar, MacConkey's agar.
3. Cultivation of microorganisms on agar plate (point inoculation), broth, anaerobic cultivation (Candle jar/GasPak method)
4. Preparation of physiological saline and serial dilution.
5. Isolation of microorganisms by spread plate, pour plate and streak plate methods.
6. Maintenance of stock culture-on fresh agar slants, overlaying with mineral oil, stab culture.
7. Effect of temperature on growth of microorganisms.
8. Effect of pH on growth of microorganisms.
9. Effect of carbon sources on growth of microorganisms.
10. Measurement of growth by cell mass using turbidometer/ photocolorimeter/ spectrophotometer.

11. Measurement of growth by cell number using Haemocytometer.
12. Study of mitosis in onion root.
13. Study of meiosis from flower buds of onion/ Chlorophytum/ Tradescantia – (permanent slides)
14. Demonstration of the following models/ photographs – DNA, DNA replication t-RNA, transcription and translation.

INTERNAL ASSESSMENT 10 Marks

Break-up

Record	05 marks
Continuous assessment	05 marks

IV SEMESTER

Microbiology Theory Paper IV

MICROBIAL METABOLISM AND GENETIC ENGINEERING

42 hrs (3 hrs per week)

MICROBIAL METABOLISM

- I Microbial Enzymes: **04 hrs**
 Definition, nomenclature, classification, properties, mode and mechanism of enzyme action, factors affecting enzyme action, enzyme regulation, inhibition : competitive and non-competitive and allosteric enzymes, their importance, cofactors and coenzymes.
- II Photosynthesis : **03 hrs**
 Definition, photosynthetic microorganisms, oxygenic and anoxygenic types, photosynthetic pigments and apparatus in prokaryotes Mechanism of photosynthesis in bacteria.
- III a) Anaerobic Respiration : **04 hrs**
 Definition, breakdown of glucose to pyruvate – EMP, HMP and ED pathways, Fermentation- conversion of pyruvate to ethanol and lactic acid.
- b) Aerobic Respiration: **04 hrs**
 Introduction, Ultrastructure of mitochondria, formation of acetyl CoA from pyruvate, TCA Cycle, Electron transport and oxidative phosphorylation, efficiency of aerobic and anaerobic respiration as energy yielding processes.
- IV a) Nitrogen Metabolism : **04 hrs**
 Biological Nitrogen fixation – symbiotic and asymbiotic nitrogen fixation, nodule formation, bacteroids, leghaemoglobin, mechanism and biochemistry of N₂ fixation, amino acid synthesis, proteolysis, urea cycle
- b) Lipid Metabolism : **02 hrs**
 Biosynthesis of fatty acids, acyl carrier protein, fatty acid synthetase complex, biosynthesis of triglyceriods and phospholipids, degradation of fatty acids, oxidation of fatty acids.

GENETIC ENGINEERING

- V. A) Genetic engineering – definition, historical perspectives and objectives **01 hrs**
B) Tools involved in genetic engineering: **07 hrs**
- a. Modifying enzymes : (1) Restriction enzymes (2) ligases (3) methylases.
 - b. Cloning vehicles – (1) Naturally occurring plasmids (2) cloning plasmids (PBR 322 and PUC 18) (3) Viruses as cloning vehicles (DNA, M 13) (4) hybrid vectors (cosmid, yac).
 - c. Cloning host (E.coli).
- VI A) Techniques in genetic engineering: **10 hrs**
- a. Gene cloning: DNA isolation, gel electrophoresis: Agarose gel-principle and method transformation methods.
 - b. DNA libraries: Brief account of Genomic and c DNA libraries – applications
 - c. Blottings: Southern, Northern, Western
 - d. Gene screening and isolation: DNA Hybridisation methods – Colony and Plaque hybridization
 - e. DNA sequencing : Brief account of Maxam and Gilbert’s methods, Sanger’s method, automated sequencing method.
 - f. Restriction fragment length polymorphism (RFLP)
- B) Applications of genetic engineering in : **03 hrs**
- Antigense technology delayed fruit ----- Agriculture, Waste water management, Industries, Human health, Potential problems of genetic engineering; social ethical impact of genetic engineering.

PRACTICAL IV

MICROBIAL METABOLISM AND GENETIC ENGINEERING

Experiments Based on theory syllabus 14 Practicals (One practical of 3 hrs per week)

Expt. No.

1. Study of root nodules for bacteroids.
2. Acid and gas production from carbohydrates – demonstration of fermentation of lactose.
3. Starch hydrolysis.
4. Gelatin hydrolysis.
5. Catalase activity.
6. Demonstration of fermentation of glucose using Kuhne’s fermentation vessel.
- 7-9 Qualitative tests for the detection of the macromolecules
 - Glucose – Benedict’s test, Molisch’s test, Fehling’s test, Picric acid test
 - Protein – Biurette test, Ninhydrin test, Millon’s test, Xanthoproteic test
 - Lipids – Acroetin test, Sudan III test, emulsification test and solubility test
- 10-11. Quantitative determination of carbohydrates and proteins in microbial samples by colorimetric method.
12. Isolation of DNA Demonstration
13. Detection of amino acids by paper chromatography.
14. Demonstration of plasmids, episomes, bacteriophages through charts/photographs, Replica plating technique, DNA sequencing

INTERNAL ASSESSMENT **10 marks**

Break – up

Record

05 marks

Continuous assessment

05 marks

V SEMESTER

Microbiology Theory Paper V

42 hrs (3 hrs per week)

ENVIRONMENTAL MICROBIOLOGY

I Microbiology of air:

- i) Introduction : Definition, history and development, aim and scope of aerobiology **02 hrs**
- ii) Microbes and atmosphere : Atmospheric layers, sources of microorganisms, Air spora of indoor and outdoor environment, factors affecting air spora, significance of air-borne microbes, management of air-borne microbes. **06 hrs**
- iii) Techniques of trapping air-borne microorganisms: Gravity slide, Petri plate exposure, Vertical cylinder spore trap, Hirst spore trap, Rotorod sampler, Anderson sampler, impingers and filtration. **06 hrs**

II Microbiology of water:

- i) Introduction: natural waters, distribution of microorganisms in the aquatic environment **02 hrs**
- ii) Water pollution : Sources, water-borne diseases-viral (jaundice), bacterial (cholera) and protozoan, (amoebic dysentery) Biological indicators of water pollution. **05 hrs**
- iii) Determination of sanitary quality of water: SPC, Tests for coliform, MPN, IMViC reactions, membrane filter technique. **05 hrs**
- iv) Water purification in municipal water supply. **02 hrs**

III Microbiology of waste water:

- i) Introduction: Sources of waste water- domestic, agricultural and industrial, physical, chemical and microbiological characteristics of waste water. **03 hrs**
- ii) Waste water treatment : Single dwelling unit – septic tank : municipal waste water treatment- Primary (screening, coagulation and sedimentation), secondary (trickling filter, activated sludge process, oxidation pond), Tertiary (reverse osmosis, ion exchange method) and reclamation of waste water. **06 hrs**
- iii) Solid waste recycling : Anaerobic digestion process, Biogas and composting **05 hrs**

V SEMESTER

Microbiology Theory Paper VI

42 hrs (3 hrs per week)

SOIL AND AGRICULTURAL MICROBIOLOGY

I Microbiology of Soil

- i) Introduction : Definition, types, soil profile and physical characteristics of soil- mineral particles, organic residues, water and gases **02 hrs**
- ii) Microbial flora of soil : a brief account of bacteria, fungi, algae, actinomycetes, protozoa and viruses **02 hrs**
- iii) Role of microbes in soil process : Biogeochemical cycles – Nitrogen and phosphorous cycles, biodegradation- pectin, cellulose and lignin **05 hrs**
- iv) Rhizosphere microorganisms : Rhizosphere and rhizoplane, interactions among microorganisms – neutralism, mutualism, commensalisms, antagonism and parasitism **04 hrs**
- v) Plant – microbe interaction – mycorrhizae **01 hrs**

II Microorganisms in agriculture:

- i) Biofertilizers: Definition, types- Nitrogen fixing, Phosphate solubilizing and cellulolytic microbes, mass production of bacterial inoculants (*Rhizobium*, *Azotobacter*, *Azospirillum*, *cyanobacteria*) mode of applications, advantages and limitations. **07 hrs**
- ii) a) Biological control: Introduction, mechanism of antagonism, amensalism, competition predation and parasitism (mycoparasitism, nematophage, mycophagy), application of biological control on field) **05 hrs**
- b) Biopesticides: Definition, types – bacterial, viral, fungal and protozoan, mode of action, factors influencing, genes involved, target pests, use of transgenic plants
- c) Microbial herbicides
- III Plant pathology:
- i) Introduction : Historical developments in brief, classification of plant diseases, principles of infection and spread of diseases in general **06 hrs**
- ii) Plant disease: Study of symptoms, etiology, epidemiology and management of the following diseases – Bean mosaic, Sandal spike, Citrus canker, Downy mildew of grapes, Powdery mildew of mulberry, Rust of sorghum, Blast disease of paddy, Tikka disease of groundnut. Brief account of post-harvest pathology.

SEMESTER V
MICROBIOLOGY PRACTICAL PAPER VII
ENVIRONMENTAL, SOIL AND AGRICULTURAL MICROBIOLOGY

Experiments Based on theory papers V & VI – 14 Practicals (One practical of 3 hrs per week)
Expt. No.

1. Isolation of air-borne microorganisms (bacteria and fungi) by Petri plate exposure method.
2. Demonstration of air samplers – equipment/photographs of vertical cylinder spore trap, Rotorod sampler, Hirst spore trap, Anderson sampler, Liquid impingement method (bead bubbler), Membrane filter.
3. Microscopic observation of different water samples for biological indicator microorganisms of water pollution
4. A) Standard analysis of water samples
 B) Determination of MPN
5. IMViC reactions
6. A) Water quality testing by H₂S strip test
 B) Display of photographs of water purification process (Baffles, Flocculator, Clarifier, Sand filter, Back wash, chlorinometer and chloroscope)
7. Determination of BOD and COD of sewage
8. A) Estimation of total solids of sewage
 B) Display of photographs- Septic tank, Trickling filter, activated sludge process, oxidation pond, sedimentation tank, anaerobic digester.
9. A) Isolation and identification of fungi from soil by serial dilution method.
 B) Isolation and enumeration of bacteria from soil by serial dilution method
10. A) Study of VAM and biofertilizer samples
 B) Study of *Anabaena* from *Azolla*
11. Study of antagonism between microorganisms
- 12-13 Study of the plant diseases: Gram staining of citrus canker specimen and mounting of fungal specimens – Downy mildew of grapes, powdery mildew of mulberry, rust of sorghum, blast disease of paddy and tikka disease of groundnut)

14. Visit to water treatment plant/sewage treatment plant/ industrial effluent treatment plant and agricultural research station. Each student shall submit an independent report on the visit along with practical record for internal assessment.

INTERNAL ASSESSMENT

20 marks

Break – up

Record	05 marks
Report	05 marks
Continuous assessment	10 marks

VI SEMESTER

MICROBIOLOGY THEORY PAPER – VIII

42 hrs (3 hrs per week)

FOOD MICROBIOLOGY AND INDUSTRIAL MICROBIOLOGY

FOOD MICROBIOLOGY

I A) Introduction to food microbiology **02 hrs**

Definition, concepts and scope. Food as a substrate for growth of microorganisms (Factors that inhibit or favour the growth of microorganisms)

Sources of contamination, principles of spoilage

B) Microbial spoilage of food and food preservation techniques **08 hrs**

a) Microbial spoilage of food – Fruits, vegetables, meat, poultry, canned foods.

b) Important methods of food preservations.

Physical method- High temperature, Canning, Low temperature, Drying (Solar drying, Drum drying, Spray drying) and Radiation.

Chemical method- Chemical preservatives-Salient features of the chemical preservatives (propionates, benzoates, sorbates, nitrates and nitrites, sulfur dioxide and sulphites, sugar and salt)

II Mycotoxin **05 hrs**

a) Origin, types and importance of toxins with reference to Aflatoxin, Staphylococcal intoxication, Botulism, Salmonellosis.

b) Food safety and quality control.

c) A brief account of food laws and standards.

III a) Introduction to microbiology of milk b) Sources of milk contamination c) Methods to detect microbial spoilage by SPC, Reductase test d) Biochemical changes of milk – souring, gassy fermentation, proteolysis, lipolysis and ropiness, Phosphatase test, Clot on boiling test. Starter culture and its role. e) Fermented dairy products (A brief account or characteristics and therapeutic value) Acidophilus milk, Yogurt, Butter milk, Srikhand. Types of cheese, Preparation of cheese f) Preservation of milk and milk products – Pasteurization, Sterilization. **06 hrs**

INDUSTRIAL MICROBIOLOGY

IV a) Introduction, Definition and scope b) Microorganisms of industrial importance c) Types of stock culture d) Strain improvement e) Fermentation media : A brief account of Production medium, Inoculum medium, Raw materials – Molasses and types, corn steep liquor, sulphite waste liquor and whey, Buffers, Precursors, Inhibitors, and Antifoam agents. **04 hrs**

V a) Design of typical fermentors : Devices for aeration, agitation b) Fermentation process- Surface, Submerged and Solid state fermentation: Types-Batch and Continuous fermentation. Down stream processing – Precipitation, filtration, centrifugation, distillation, cell disruption, solvent recovery, drying, crystallization. **09 hrs**

VI Industrial production and its uses of the following:

- i) a) Ethyl alcohol, Wine b) Antibiotics – Penicillin c) Organic acid – Lactic acid d) Enzymes – Amylase, Protease e) Single Cell Protein (Salient features and nutritional value) – *Spirulina, Chlorella*.
ii) Mushroom cultivation – Oyster mushroom (bag method), Nutritional value
iii) Role of microorganisms for production and recovery of minerals and petroleum. **08 hrs**

VI SEMESTER

MICROBIOLOGY THEORY PAPER – IX

42 hrs (3 hrs per week)

IMMUNOLOGY AND MEDICAL MICROBIOLOGY

IMMUNOLOGY

- I. a) Historical account and introduction to immune system b) Types of immunity-Innate (non-specific) and Adaptive Immunity (specific). Antibody (humoral) mediated immunity and Cell mediated immunity c) Cells and tissues of immune system – Structure and role of primary lymphoid organs (bone marrow, thymus), secondary lymphoid organs (spleen, lymph nodes and tonsils) B&T lymphocytes, phagocytes, killer cells, NK cells. **08 hrs**
- II a) Antigens – nature and types. Antibodies – Structure of IgG. Classes of antibodies and their functional diversity b) Human blood types and Rh factors c) Antigen-antibody reactions-salient features. Agglutination reaction – Widal test, Neutralisation test, Opsonisation. Precipitation reaction-VDRL Test. Immunotechniques – RIA, ELISA. Complement system (in brief) – complement fixation test **10 hrs**
- III Immunoprophylaxis – Vaccine-Types – Killed, Live attenuated (bacterial and viral) and Toxoid with an example each. National immunization schedule (Tabular form) **03 hrs**

MEDICAL MICROBIOLOGY

- IV a) History and development of medical microbiology. Normal flora of human body
b) Infection – types of infection, modes of transmission, portal of entry
c) Pathogenesis – Virulence – attenuation and exaltation with an example each **04 hrs**
- V Pathogen –morphology, cultural and biochemical characteristics, classification, resistance pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of the following. **14 hrs**
- a) Bacterial diseases – Tuberculosis, Cholera, Typhoid, Syphilis.
b) Viral diseases – Hepatitis, Poliomyelitis, AIDS.
c) Fungal diseases-Candidiasis, Dermatormycosis (Tinea – ringworm infection).
d) Protozoan diseases – Malaria, Trichomoniasis.

VI Chemotherapy : General characteristics and types of antibiotics. Mode of action of Penicillin, Streptomycin and Chloramphenicol **03 hrs**

**VI SEMESTER
MICROBIOLOGY PRACTICAL PAPER – X**

**FOOD MICROBIOLOGY, INDUSTRIAL MICROBIOLOGY, IMMUNOLOGY AND
MEDICAL MICROBIOLOGY**

Experiments Based on Theory Papers VIII and IX 14 practicals
(one practical of 3 hrs per week)

1. a. Isolation and enumeration of bacteria from food utensils.
b. Isolation and identification of fungi from food utensils.
2. a. Isolation and enumeration of bacteria from spoiled vegetables .
b. Isolation and identification of fungi from spoiled vegetables.
3. a. Isolation and enumeration of bacteria from spoiled fruits.
b. Isolation and identification of fungi from spoiled fruits.
4. a. Isolation and identification of *Aspergillus* on groundnut by blotters method.
b. Microscopic examination of idli batter.
5. Quantitative examination of bacteria in raw and pasteurized milk by SPC method.
6. a. Turbidity test to detect boiled and unboiled (raw) milk.
b. Methylene blue reductase test to determine the quality of milk.
7. a. Preparation of wine from grapes.
b. Preparation of alcohol using jaggery/ molasses.
c. Preparat and estimate of citric acid by aspergillus
8. a. Estimation of % alcohol in a given sample by specific gravity bottle method.
b. Preparation of banana juice by pectinase.
9. Culturing of *Spirulina* / *Chlorella*.
10. Determination of blood group and Rh factor.
11. Demonstration of precipitation reaction – double diffusion in two dimension (ouchterlony procedure).
12. Microbial flora of human skin and oral cavity (tooth and mouth).
13. a. Antibiotic sensitivity test
b. Material / Microscopic observation / display of photographs of Human pathogens – *Mycobacterium tuberculosis*, *Vibrio cholerae*, *Treponema pallidum*, *Salmonella typhi*, hepatitis virus, Polio virus, HIV, *Candida albicans*, Tinea, *Plasmodium*, *Trichomonas vaginalis*, Food, dairy and industrial products – cheese, yogurt, srikhand, bread, molasses, wine.
14. Visit to food industries / food research laboratories, dairy industries, distilleries, pharmaceutical and pathological laboratories. Each student shall submit an independent report on the visit along with the practical record for the internal assessment.

INTERNAL ASSESSMENT	20 marks
Break- up	
Record	05 marks
Report	05 marks
Continuous assessment	10 marks

REFERENCES

- Alexopoulos, C.J. Mims, C.W. (1979) Introductory Mycology, Third edition, Wiley Eastern Limited New Delhi.
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