

# MICROBIOLOGY (GENERAL) SYLLABUS

## First Semester

### Theory

Full Marks: 50

1) **Basic microbiology**- Landmark achievements in 20th century: Refutation of a biogenesis: discovery of penicillin: discovery of vaccination: proposal of one gene one enzyme hypothesis: discovery of double helix structure of DNA: discovery of recombinant DNA technology. (MM) [4]

2) **Major contribution of scientists**- Leeuwenhoeck, Edward Jenner, Alexander Flemming, Joshep Lister, Robert Koch, Louis Pasteur, Hargobind Khorana. (MM) [4]

3) **Scope of Microbiology** (MM) [2]

4) **Whittaker's five- kingdom concept of living organism**- (General characteristics of those five groups), characteristics and importance of yeast, moulds (*Penicillium*, *Aspergillus*), protozoa, *Giardia*, *Plasmodium*, plant diseases (brown spot of rice, stem rot of jute, black stem rust of wheat, apple scab, grey blight of tea, bacterial blight of rice, citrus canker).

- i) Characteristics of pathogenic fungi
- ii) Plant pathogenic toxin and their classification
- iii) Disease expression in a plant, gene for gene concept
- iv) Control of plant disease – physical, chemical, cultural and biological control, IPM (AKM) [6]

5) **Microscopy**- Principles and applications, dark field, bright field, resolving power, numerical aperture, chromatic aberration, phase contrast microscopy, fluorescent microscopy, inverted microscopy, stereo microscopy, electron microscopy, TEM and SEM. (SB) [6]

6) **Stains and staining**- Principles of staining, simple staining, negative staining, differential staining, Gram and acid fast staining, flagella staining, capsule and endospore staining. (SB) [8]

7) **Introduction to biomolecules**- Outline structure, function and examples of carbohydrate, lipid, protein (primary, secondary, tertiary and quaternary). Amino acids, DNA, RNA. (KS) [6]

8) **Control of microbes**- Sterilisation, disinfection, antiseptic, tyndallisation, pasteurization: Physical- dry heat, moist heat, UV light, ionizing radiation, filtration,

HEPA filter, Chemical-phenol and phenolic compounds, (halogen aliphatic alcohol, formaldehyde, ethylene oxide, heavy metals) anionic and cationic detergents.

(KS) [12]

- References: 1. Microbiology Pelczar, Chan and Krieg. (Indian edition)  
2. Microbiology Vol II Power and Dagainawala.  
3. Outlines of Biochemistry Cohn and Stumpf.  
4. Microbiology by Dubey & Maheswari  
5. Microbiology by Purohit.

### **Practical (1<sup>st</sup> Semester)**

**Full Marks: 25**

- 1) **Microscopy**– Description and operation of compound microscope, use of oil immersion objective. [8]
- 2) **Micrometry and cell measurement**- Use of ocular and stage micrometer, cell count (haemocytometer, Bacterial cell- *Bacillus subtilis*), fungal cell (*Saccharomyces*) and human blood cell). [8]
- 3) **Staining**- Simple and differential staining of bacteria. Simple staining – *Bacillus subtilis*, differential staining – *Bacillus and Ecoli*. Study of bacteria from contaminated water, study of Rhizosphere bacteria, study of bacteria from buccal cavity. Staining of yeast (methylene blue), lactophenol cotton blue, staining of mould (*Penicillium, Aspergillus*), agaricus. [8]
- 4) **Study of plant diseases** (Brown spot of rice) [8]

Reference: 1. Microbiological Techniques Aneja.

### **Second Semester**

#### **Theory**

**Full Marks: 50**

- 1) **Cell structure and sub cellular organelles of bacteria**– Slime layer, capsule, cell wall, flagella, pili, fimbriae, nucleoid, plasmid and episome (F, R, Ti as example) ribosome, cytoplasmic inclusions (inorganic and organic), endospore (*Bacillus subtilis*) structure. Semiconservative DNA replication (AKM) [16]
- 2) **Cultivation of bacteria**– Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Anaerobic (thioglycolate, anaerobic chamber, Robertson's media, microaerophilic), liquid shake culture of aerobic bacteria. (AKM & KS) [10]
- 3) **Virology**- General classification of virus, (structure, nucleic acid, cultivation of bacteriophage, coliphage), animal virus (chick embryo, tissue culture, plant virus, TMV

using carborandum). Importance of viruses, life cycle of viruses, lytic cycle (T4) and lysogenic (lambda). (KS) [10]

**4) Air microbiology-** Microorganisms in the air, sampling techniques, air borne pathogens. (SB) [6]

**5) Microbiology of water-** Microbiology of fresh water and wastewater (sewage), BOD, COD (definitions), general outline of water treatment process: septic tank, sedimentation Activated sludge and trickling filter process. Important water borne diseases– cholera, typhoid, (name of pathogen, preventive measures). Outlines of method for detection of microorganisms in drinking water (presumptive, confirmatory and completed tests). Distinction between fecal and non-fecal coliforms, IMVIC tests. (SB) (10)

References: 1. General Microbiology Stanier, Ingraham and Painter.  
2. Environmental Microbiology Maier, Pepper and Garba.  
3. Text Book of Microbiology Ananth Narayan & Panikar

### **Practical (2<sup>nd</sup> Semester)**

**Full Marks: 25**

- 1) **Sterilization-** Operation of autoclave, hot air oven, membrane filtration (demonstration only), culture room fumigation using formalin, surface sterilization of phenol. [4]
- 2) **Culture media preparation-** Nutrient broth, nutrient agar slant, potato dextrose agar. [8]
- 3) **Aseptic techniques-** Culture transfer from solid to solid, solid to liquid and liquid to liquid: Checking of possible contamination. [6]
- 4) **Culture techniques-** Streak plate, pour plate and spread plate (stab culture only demonstration) [6]
- 5) **Isolation of pure culture** by streak plate method. [2]
- 6) **Viable count** of bacteria by serial dilution and pour plating. [4]
- 7) Seminar presentation (continuous internal assessment)

Reference: 1. Microbiological Techniques Aneja

## Third Semester

### Theory

**Full Marks: 50**

**1) Growth of bacteria-** Definition, growth phases, kinetics of growth, direct and indirect measurement of growth, factors affecting growth (pH, temperature, oxygen) (KS)[4]

**2) Bacterial metabolism-** Aerobic and anaerobic respiration (definition, examples), fermentation (alcoholic, mixed acid, acetic acid, lactic acid), glycolysis, TCA cycle, Entner Duodruffs pathway, pentose phosphate pathway, electron transport chain, (components, sites of synthesis), bacterial photosynthesis (green and purple bacteria), biochemical nitrogen fixation– non-symbiotic, symbiotic (definition and examples), basic concept of nif –genes. Nod genes, nitrogenase complex, legheamoglobin.

(AKM, DD) [18]

**3) Soil microbiology-** Soil microorganisms, biogeochemical cycles, carbon, nitrogen, sulfur cycle (outline only), different kinds of association between soil microflora, between micro and macro organisms, methane production. (AKM, KS) (20)

**4) Central dogma of life-** transcription, translation, Lac operon, Trp operon. (SB) [12]

Reference: 1. Microbiology Prescott, Harley and Klein.

2. Microbiology Purohit

3. Agricultural Microbiology Rangaswamy and Bhagyaraj.

4. Genetics P.K.Gupta

### Practical (3<sup>rd</sup> Semester)

**Full Marks: 25**

**1) Bacteriological examinations of drinking water** (presumptive, confirmatory and completed tests). [14]

**3) Qualitative tests** of glucose, fructose (Benedict's test, Seliwanoff's test), sucrose (acid hydrolysis and benedict's test), proteins (peptone, egg albumin by biuret test, heat coagulation test), amino acids (glycine by ninhydrin), fats (coconut oil by saponification, emulsification), DNA (by DPA method) and RNA (by orcinol method).

**4) Turbidometric measurement** of bacterial growth (colorimetric measurement of OD versus time). [14]

Reference: 1. Practical Biochemistry Wilson and Walker

## Fourth Semester

### Theory

**Full Marks: 50**

**1) Food microbiology-** Microbial flora of fresh foods: Milk as a growth medium of bacteria, normal micro flora of milk, undesirable microorganisms in milk and normal micro flora of meat, poultry, eggs, fruits and vegetables.

Microbial spoilage of food- Fresh food, fresh milk, canned food and stored grains. Microbiological examination of food: microscopic examination and culture, phosphatase test of Pasteurized milk.

Preservation of food- High temperature (boiling, pasteurization, appertization), low temperature (freezing), dehydration, osmotic pressure, chemical preservations, radiation.

(DD) [16]

Microbiologically fermented food- Curd, cheese, idli, yogurt, acidophilic milk, microorganisms as food SCP- food borne diseases.

(KS) [8]

**2) Industrial microbiology-** Fermentation processes- batch and continuous, plug flow method, products of industrial fermentation: Outline of the production for ethanol, vinegar, citric acid, amylase, vitamin B, antibiotics (penicillin and streptomycin), brewing and wine making (flow sheet of the process).

(AKM) [10]

**3) Recombinant DNA technology-** Restriction endonucleases, cloning of desired gene using cloning vectors (pBR322, Ti plasmid), insertion of cloned gene into bacteria by gene gun method, electroporation, applications of RDT in the field of industry, agriculture and medicine.

(SB) [10]

Reference: 1. Food Microbiology Frazier and Westhoff  
2. Industrial Microbiology Prescott and Dunn.  
3. Text Book of Biotechnology R.C. Dubey.  
4. Applied Biotechnology Fr. Ignachimuthu.

### Practical (4<sup>th</sup> Semester)

**Full Marks: 25**

1) **Methylene blue reduction tests** of milk Samples. [4]

2) **Simple biochemical tests of bacteria-** Acid and gas production in glucose broth, production of indole by *E. coli*, starch hydrolysis by *Bacillus* sp., urea hydrolysis: catalase and oxidase test (use of appropriate negative controls). [8]

3) **Antibiotic sensitivity tests** by cup plate/paper disc method (antibiotics- amoxycillin, streptomycin, tetracycline, norfloxacin (any two) and test organisms (*Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* or any other non pathogenic strains). [14]

4) **Bacteriological examination of curd** [2]

Reference: 1. Practical Biochemistry Wilson and Walker

### Fifth Semester

#### Theory

**Full Marks: 25**

- 1) **Bacterial genome-** DNA as a genetic material, DNA replication in *E.coli*, rolling circle and Q structure, genetic code dictionary. (AKM) [12]
- 2) **Bacterial recombination-** Transformation, transduction and conjugation with examples. (KS) [8]
- 3) **Medical microbiology-** Normal micro flora of healthy human host, process of infection, defense mechanisms and immune response in the human body microbial diseases – Cholera, *Giardia*, AIDS, Tuberculosis and Dengue. (AKM) [16]
- 4) **Mutation-** Mutagenic agents and molecular basis of mutation, DNA damage by UV radiation and its repair. (SB) [6]

Reference: 1.Genetics Strickberger  
2.Microbiology Dubey and Maheshwari.  
3. Physical Biochemistry Freifelder

### Practical (5<sup>th</sup> Semester)

**Full Marks: 25**

- 1) **Project work based on Host pathogen interaction** between corp plant and bacteria/fungi (to be completed in 5<sup>th</sup> and 6<sup>th</sup> semester).
- 2) **SDS-PAGE technique** demonstration.
- 3) **Sputum sensitivity test**
- 4) **Blood group and Rh typing**
- 5) **Blood sugar determination (using kit).**

Reference: 1. Plant Pathology Agrios  
2. Microbiology Pelczar, Chan and Krieg.  
3. Biochemistry Lehninger

### Sixth Semester

#### Theory

**Full Marks: 25**

- 1) **Immune system-** Cell mediated immunity and humoral immunity (basic ideas), concept of antigen and antibody, antigen antibody reaction (basic ideas), detection by agglutination, precipitation, ELISA, vaccine (principle and types), vaccination and hypersensitivity (definition and examples). (KS & DD) [18]
- 2) **Basic principles of Phytoimmunology-** Raising of plant antigen and sero-diagnosis.

**Fungal diseases**

- a) Oomycetes – Phytophthora (late blight of potato)
- b) Zygomycetes – Rhizopus (Soft rot of fruits)
- c) Ascomycetes – **Cochliobolus** (Leaf spot of rice)
- d) Basidiomycetes – Puccinia (Black stem rust of wheat)  
**Ustilago** – Smut of wheat)
- e) Deuteromycetes – Pyricularia (Blast of rice)  
Fusarium (Wilt of tomato)

**Bacterial diseases** – Crown gall, Citrus cancer (Symptoms and control)

**Plant virus transmission** - TMV-RNA, DNA-CMV PSTV, Mollicute – coconut yellow.

**Plant nematode** – Meloidogyne (Root knot nematode)

(AKM) [18]

- 3) Multi component disease resistant mechanisms in plants (biological and chemical, genetical and cultural). (AKM) [6]

4) **Genetics**- Post-Mendelian genetics

- Variations from Mono + Dihybrid cross
- Epistasis- supplementary and complementary genes
- Population genetics
- Cytoplasmic inheritance
- Sex-limited, sex-influenced and sex-linked inheritance
- Holandric gene

(SB) [12]

Reference: 1. Immunology Kuby  
2. Immunology A.K.Chakraborty

**Practical (6<sup>th</sup> Semester)**

**Full Marks: 25**

- 1) **Mutagenesis** (by chromosomal aberration using physical and chemical mutagen)
- 2) **Replica plating**
- 3) **Squashing technique**- karyotype + ideogram

Reference: 1. Microbiology Laboratory Manual: Cappuccino and Sherman