

DEPARTMENT OF MICROBIOLOGY

B. Sc. II Semester-III syllabus

Microbiology Molecular Biology and Genetic Engineering

The examination shall comprise of two theory papers, one in each semester and one practical in each semester. Each theory paper will be of 3 hours' duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours' duration in one day and shall carry 50 marks. The following syllabus is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of semester-III (8 Marks).

Unit I:

Gene multiplication and expression a) Concept of gene – Definition of Gene, Muton, recon, cistron, gene within gene, split gene. b) Replication of DNA- Modes of replication, (Conservative, Semiconservative and Dispersive). Experiment of Meselson and Stahl to prove semiconservative mode of replication. Mechanism of replication with enzymes involved, models of replication: Knife and fork, rolling circle. c) DNA repair mechanisms- light and dark. d) Genetic code- Characteristic features of genetic code. e) Out line of Protein synthesis- Transcription and Translation.

Unit II: Gene: Regulation and Mutation

a) Gene regulation Mechanisms - lac operon, trp operon. b) Mutation- Definition & types of mutations - Base pair substitution, frame-shift, point, missense, nonsense & silent mutations, Random Vs. Directed mutation, Rate of mutation, Effect of Mutation on Phenotype, c) Genetic suppressions: - Intragenic (Intracodon suppression, reading frame Suppression) and extragenic suppression (Non sense and Missense Suppression). d) Molecular basis of spontaneous and induced mutations - Spontaneous mutation (Tautomerism), Induced Mutation (Chemical Mutagens) e.g. Base analogues, Nitrous Oxide, Hydroxylamine, Acridine dyes, Physical mutagens e.g. X-rays, Gamma rays, U.V. light.

Unit III:

Genetic recombination: Mechanism of recombination: Breakage and reunion, breakage and copying, complete copy choice. Transfer of genetic material in prokaryotes: a) Transformation: Experiment of Griffith. Avery, MacLeod and McCarty experiment to prove Genetic Transformation. Mechanism of Transformation. b) Transduction:

Experiment of Zinder and Lederberg. General mechanism of Transduction. Types of Transduction: Generalized and Restricted, Complete and Abortive, Low Frequency and High Frequency Transduction. Comparison between Transformation and Transduction. c) Conjugation: Experiment of Lederberg and Tatum, Experiment of Davis, Nature and function of F' Plasmid. Hfr formation. Various Mating types. Mechanism of conjugation: i) F⁺ x F⁻ ii) Hfr x F⁻. F' Plasmid and Sexduction.

Unit IV: Tools of Genetic Engineering:

a) Introduction to basic technique of genetic engineering. b) Enzymes for splicing: Restriction endonucleases. c) Range of DNA manipulating enzymes: Nucleases, Ligases, Polymerases, DNA modifying enzymes, Topoisomerases. d) Vectors: Ideal characters and types: Plasmid, Cosmid and Bacteriophage.

Unit V: Techniques of genetic engineering:

a) Isolation of Genomic and Plasmid DNA from bacteria, Analysis of DNA fragment size by agarose gel electrophoresis. b) Introducing DNA into host cell, competent cells, transduction of cells and identification of transformed cell (e.g. Antibiotic resistance gene in Plasmid) Selection of clones: Direct (colony hybridization) and Indirect method (southern blotting). c) Definition, method and applications of gene mapping, DNA sequencing (by microarray) and PCR. d) Introduction to expression of cloned genes. Construction of gene library. Cells for cloning.

Unit VI: Applications of Genetic Engineering:

a) Health care biotechnology: - Recombinant Insulin, Recombinant Hepatitis vaccine, Gene therapy, DNA probes in diagnosis. b) Agricultural biotechnology: - Transgenic plants. c) Environmental biotechnology: - Genetically engineered microbes for pollution control. d) Industrial biotechnology: - Strain improvement for industrial product.

Practicals

1. Isolation of genomic DNA from bacteria.
2. Demonstration of agarose gel electrophoresis.
3. Genetic recombination in bacteria. a) Transformation b) Conjugation
4. Estimation of DNA and RNA.
5. Isolation of fermentative mutant using physical mutagen (U.V. radiation).
6. Detection of streptomycin (antibiotic resistant mutant) by replica plating technique.
7. Transformation of plasmid DNA using CaCl₂.

Distribution of practical marks

1. Major experiment - 15 Marks
2. Minor experiment - 10 Marks
3. Viva-Voce - 10 Marks
4. Spotting - 10 Marks
5. Laboratory journal - 05 Marks ----- TOTAL 50 Marks

Books Recommended for SEM- III:**THEORY:**

1. Recombinant DNA: James. D. Watson, John. Tooze, David.Kutz
2. 2 Introduction to Genetic Engineering: - Nicholas
3. An Introduction to Genetic Analysis: - David Suzuki, Anthony. Griffiths
4. Biochemistry: - Lehninger
5. General Microbiology. Vol 1& II: - Powar & Dagainawala
6. Molecular Biology of the Cell: - J. D. Watson, D. Bray
7. The DNA Story: - J. D. Watson
8. Genetics of Prokaryotes: - Srivastava et.al
9. Genes: - Pramod Kumar
10. Genetic Engineering and its Applications -Joshi P.
11. Gene Transfer and Expression a Laboratory Manual: - Michael Kriegler
12. Concept in biotechnology: - D. Balasubramaniam
13. Essential Genetics: - Daniel. Hartl.

PRACTICALS:

1. Microbes in Action: Saley, Wandermark, Tarporewala, Bombay.
2. Medical Microbiology Vol. II: R. Cruickshank.
3. A manual of Microbiological: A. J. Salle. Methods.
4. Microbiological Methods: Collins
5. Difco manual

B. Sc. II Semester-IV syllabus

Medical Microbiology

The examination shall comprise of two theory papers, one in each semester and one practical in each semester. Each theory paper will be of 3 hours' duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours' duration in one day and shall carry 50 marks. The following syllabus is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of semester-IV (8 Marks).

Unit I:

Epidemiology a) Definition, classification and scope of epidemiology. b) Infection- Types of infection and modes of transmission. c) Normal flora of human body. d) Infection process, pathogenicity and virulence, Microbial virulence factors: toxins, enzymes e) Control of communicable diseases.

Unit II:

Immunology a) Organs and cells of immune system b) General Nonspecific factors- Physiological barriers, Natural cellular factors, Natural humoral factors. c) Immunity- Definition and classification d) Innate immunity- Species, Racial, Individual, Herd immunity. e) Acquired immunity- Active and passive immunity, f) Immune response and hypersensitivity

Unit III:

Serology a) Antigens- Definition, types and factors determining antigenicity, Bacterial antigens. b) Antibodies- Definition, Structure, classification, Properties and differences, monoclonal antibodies. c) Antigen Antibody reactions- Agglutination, Precipitation, Complement fixation test, ELISA and RIA.

Unit IV:

Pathogenic Bacteria Study of following bacteria with respect to their morphology, cultural and biochemical properties, antigenic structure, pathogenesis, laboratory diagnosis and prophylaxis:

a) *Staphylococcus aureus*.

b) *Clostridium tetani*.

c) *Salmonella typhi*.

d) *Mycobacterium tuberculosis*.

e) *Treponema pallidum*.

f) *Vibrio cholerae*.

Unit V:

Other Pathogenic organisms a) Viruses- AIDS, Hepatitis, Polio, Rabies. b) Rickettsias- *R. prowazekii* c) Protozoa- *E. histolytica* d) Fungi-*C. albicans*

Unit VI:

Antimicrobial chemotherapy a) Ideal characters of chemotherapeutic agents b) Major antimicrobial agents and its clinical uses: i) Antibacterial agents: Rifampicin, Chloramphenicol, Streptomycin and Ciprofloxacin ii) Antiviral agents: Azidothymidine, Amantadine. iii) Antifungal agents: Griseofulvin, Amphotericin B, Imidazoles. c) Basic mechanism of antibiotic action d) Antimicrobial susceptibility testing: Introduction to CLSI (NCCLS), MIC. Disc diffusion, agar dilution, broth dilution (macro and micro).

Practicals:

1. Studies of microbial enzymes and biochemical tests: a) Urease b) Coagulase c) Oxidase d) IMViC e) Sugar fermentation
2. Isolation and Identification of following bacteria: a) *Staphylococcus aureus* b) *E. coli* c) *Salmonella typhi*
3. Serological Tests: a) Widal b) Pregnancy test c) VDRL
4. Antibiotic sensitivity by Disc diffusion method.
5. Clinical investigations: a) Blood grouping and Cross matching b) TLC, DLC c) Hemoglobin estimation d) Test for carbohydrates and Proteins in Urine e) Blood glucose and cholesterol
6. Cultural examination of Urine, Blood, Sputum, Stool, Pus, CSF.
7. Isolation of pathogenic fungi
8. Study Tour.

Distribution of practical marks

1. Major experiment - 15 Marks
2. Minor experiment - 10 Marks
3. Viva-Voce - 10 Marks
4. Spotting - 10 Marks
5. Laboratory journal - 05 Marks ----- TOTAL: 50 Marks

Books Recommended for SEM- IV: -

THEORY:

1. Medical Bacteriology: Dey N.C. & Day T.K.
2. Medical Microbiology Vol. I & II: Cruickshank K.R.
3. Text Book of Microbiology: Ananthanarayan R. & C. E. Panikar
4. Medical Parasitology: Dey N.C. & Dey T.K.
5. Dorland's Pocket Medical Dictionary
6. Microbiology: Zinsser W.
7. Preventive & Social Medicine: Park & Park
8. General Microbiology & Immunity: S. G. Wilson. Vol. I & II
9. Medical Microbiology: R. Anantnarayan
10. Fundamental Principles of Bacteriology: A. J. Salle.
11. Microbes & Diseases of Man: W. C. Deb. (Helminthology)
12. Microbiology: B. D. Davis, R. Dulbecoco, H. N. Eisen, H. S. Ginsburg.
13. Parasitology: K. D. Chatterjee
14. Text Book of Medical Microbiology: H. L. Chopra.

PRACTICALS:

1. Microbes in Action: Saley, Wandermark, Tarporewala, Bombay.
2. Medical Microbiology Vol. II: R. Cruickshank.
3. A manual of Microbiological Methods: A. J. Salle.
4. Microbiological Methods: Collins
5. Difco manual