

SYLLABUS UNDER AUTONOMY

TYBSc MICROBIOLOGY (2013-14)

GENETICS, MOLECULAR BIOLOGY & BIOINFORMATICS

60 LECTURES

COURSE: S.MIC. 6.01

OVERALL LEARNING OBJECTIVES

- Basic understanding of recombination in bacteria
 - Understand and apply tools and techniques involved in Genetic Engineering and Bioinformatics
 - Develop analytical skills, problem solving & critical thinking
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UNIT 1: TYPES OF GENETIC EXCHANGE

15 LECTURES

LEARNING OBJECTIVES

- Understand the basic concept of genetic exchange -transformation, transduction & conjugation
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1. Transformation 5L

- Introduction and History
- Types of transformation in prokaryotes
 - i. Natural transformation in *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Bacillus subtilis*,
 - ii. Artificial transformation in *E. coli*
- Mapping of bacterial genes using transformation
- Problems based on transformation

2. Conjugation 5L

- Discovery of conjugation in bacteria
- The conjugation machinery
- Hfr strains, their formation and mechanism of conjugation
- F' factor, origin and behavior of F' strains, Sexduction
- Mapping of bacterial genes using conjugation (Wolman and Jacob experiment)
- Problems based on conjugation

3. Transduction 5L

- Introduction and discovery
- Generalized transduction, Use of Generalized transduction for mapping genes
- Specialized transduction – HFT & LFT
- Problems based on transduction

UNIT 2: GENETIC RECOMBINATION & PLASMIDS 15 LECTURES

LEARNING OBJECTIVES

- Understand the consequences of recombination in bacteria
 - Understand transposition in bacteria
 - Knowledge of different plasmids
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1. Types of recombination 5L

- Legitimate -
 - i. Homologous or general recombination - Holliday model, recombination enzyme system
 - ii. Site specific recombination – λ phage integration & Hin inversion
- Illegitimate Recombination

2. Transposition 5L

- Types - Insertion sequence (IS) element & Composite & complex transposons (Tn) in prokaryotes
- Structure and properties
- Mechanism of transposition – Replicative & Non-replicative
- Demonstration of transposition
- Ty elements of yeast

3. Plasmids 5L

- Properties of plasmids
- Detection and isolation of plasmids
- Plasmid incompatibility
- Plasmid curing
- Cell to cell transfer of plasmids
- Types of plasmids
 - i. F factor
 - ii. Resistance Plasmids,
 - iii. Plasmids encoding Toxins and other Virulence Characteristics

- iv. Col factor
- v. Degradative plasmids
- vi. Ti plasmid

UNIT 3: BASIC TECHNIQUES IN RECOMBINANT DNA TECHNOLOGY 15 LECTURES

LEARNING OBJECTIVES:

- Understand the basic steps involved in gene cloning
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1. Model Organisms 1L

- Characteristics of a model organism
- Examples of model organisms used in study

2. Restriction & Modification in bacteria 2L

- Restriction endonucleases – Type 1, 2 & 3
- Modification enzymes – methylation by methylase enzyme

3. DNA techniques and Gene Cloning

- PFGE, 2-d electrophoresis
- Southern, Northern & Western blotting
- DNA sequencing – Sanger's manual & automated methods
- Vectors – cloning & expression vectors (plasmids, phages, cosmids, shuttle vectors, YAC, BAC)
- Restriction enzymes, ligases, adaptors and linkers
- Basic PCR and different types of PCR (RT-PCR, qPCR, LA-PCR)
- Genomic and cDNA libraries, DNA synthesizer
- Overview of the steps involved in gene cloning
- Screening methods for identification and isolation of recombinant clones and products

UNIT 4: APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY & BIOINFORMATICS - PROTEIN SEQUENCE ANALYSIS 15 LECTURES

LEARNING OBJECTIVES:

- Understand the applications of gene cloning
 - Understand the applications of bioinformatics in genomic and proteomic studies
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1. Applications of Recombinant DNA Technology 7L

- Strain Improvement to increase fermentation yield
- Transgenic plants - Bt cotton, Golden rice
- Animal Pharming
- Insulin production
- Metagenomics
- Gene therapy
- DNA fingerprinting

B. Bioinformatics 10 LECTURES

1. Pair-wise sequence alignment – Revise Retrieval of sequences & tools used to analyze nucleotide and protein sequences
2. 16SrRNA analysis
3. Multiple sequence alignment - PIR - CLUSTAL W, T-COFFEE
4. Phylogenetic analysis - Phylogenetic tree
5. PDB
6. Use of Bioedit and Spdbv software

CIA: Problem Solving & Quiz

References: -

1. Genetics – a molecular approach, Peter Russell, 3rd edition, Pearson Publications
2. Molecular Biology of the gene, JD Watson, Baker, Bell, 4th / 5th edition, Pearson Education Publications
3. Concepts of Genetics 7th edition, Klug & Cummings, Pearson Education Publications
4. Genes IX, Lewin, Oxford Publications
5. Genetics a conceptual approach, Benjamin A. Pierce (2008), 3rd ed., W. H. Freeman and company
6. Lehninger's Principles of Biochemistry, D. Nelson & M. Cox, 5th edition, Macmillan Worth Publications
7. Advanced Molecular Biology, R. M. Twyman, Viva Books Private Limited
8. Brock Biology of microorganisms, M. Madigan, J. Martinko, J. Parkar, (2009), 12th ed., Pearson Education International
9. Genetics, Fairbanks and Anderson, (1999), Wadsworth Publishing Company
10. Principles of genetics, R. H. Tamarin, (2004), Tata McGraw Hill
11. Introduction to Bioinformatics, Arthur Lesk, 3rd edition, Oxford University Publications
12. Introduction to Bioinformatics, T. K. Attwood & D. J. Parry-Smith, (2003), Pearson Education Publications

13. Bioinformatics, David Mount, 2nd edition, Cold Spring Harbor Laboratory Press

MEDICAL MICROBIOLOGY AND IMMUNOLOGY: II

60 LECTURES

COURSE: S.MIC.6.02

OVERALL LEARNING OBJECTIVES

- Study significant microbial pathogens with respect to the various systems of the human body (except respiratory tract) and the infections caused by them
 - Understand the significance of Nosocomial infections, their modes of spread and control
 - Understand basic principles and concepts of immunization and transplantation
 - Understand concepts of clinical immunology and immunohematology
 - Knowledge of antigen antibody reactions and their applications
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UNIT 1: GASTRO INTESTINAL AND CNS INFECTIONS (15 LECTURES)

LEARNING OBJECTIVES

- Understand with respect to the gastro-intestinal and central nervous systems:
 - The anatomy and function of the system and its defenses against microorganisms
 - The clinical syndromes that characterize the tract related infections
 - The modes of transmission, pathogenesis, diagnosis, prophylaxis and treatment with respect to some significant etiological microbial pathogens that infect the system
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Note: All infections labeled **ii.** to be covered with respect to all details - emphasis on Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab Diagnosis, Prophylaxis, Treatment.

All infections labeled **iii.** to be covered with respect to General aspects

1. Gastro – Intestinal Infections 9L

- i. The anatomy and function of the gastro intestinal tract and its host defenses
- ii Infectious diseases caused by *Salmonella*, *Shigella* , *Vibrio*
Food Poisoning: Staphylococcal, Botulism
- iii Infectious diseases caused by *E.coli*, *Helicobacter pylori*, *Campylobacter*, Rota virus, *Hepatitis A & E*, *E.histolytica*

2. Central Nervous System Infections 6L

- i. The anatomy and function of the central nervous system and its host defenses

- ii. Tetanus, Polio, Rabies
- iii. Meningitis: viral, bacterial -Meningococcal, Pneumococcal and *Haemophilus*

UNIT 2: SEXUALLY TRANSMITTED, HOSPITAL & URINARY TRACT INFECTIONS AND INFECTIONS WITH SKIN AS THE PORTAL OF ENTRY

15 LECTURES

LEARNING OBJECTIVES

- Understand with respect to the genitourinary tract and skin :
 - The anatomy and function of the system/ skin and its defenses against microorganisms
 - The clinical syndromes that characterize the tract/skin related infections
 - The modes of transmission, pathogenesis, diagnosis, prophylaxis and treatment with respect to some significant microbial pathogens that infect the system
 - Understand the significance of nosocomial infections, the pathogens involved, modes of spread, methods of control and hospital waste management.
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Note: All infections labeled **ii.** to be covered with respect to all details - emphasis on Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab Diagnosis, Prophylaxis, Treatment

All infections labeled **iii.** to be covered with respect to General aspects

1. Sexually transmitted Infections 5L

- i. The anatomy and function of the genitourinary system and its host defenses
- ii. HIV infection, Syphilis
- iii. Gonorrhoea, Herpes, Hepatitis B

2. Hospital Infections 2L

- Nosocomial Infections
- Modes of Transmission
- Methods of Control
- Hospital waste management

3. Urinary Tract Infections 3L

- The anatomy and function of the urinary tract and host defenses
- Pathogens & Factors Involved
- Diagnosis, Prevention, Treatment

4. Infections with skin as the portal of entry 5L

- i The anatomy and function of the skin and its host defenses
- ii. Pyogenic Staphylococcal, Streptococcal infections, Leprosy, Malaria
- iii. Candidiasis, Dermatophytosis, Pseudomonas infections, Leptospirosis, Dengue

UNIT 3: IMMUNE SYSTEM IN HEALTH AND DISEASE – PART -I

15 LECTURES

LEARNING OBJECTIVES

- Knowledge of monoclonal antibodies and their applications
 - Knowledge of types of vaccines
 - Basic knowledge of transplantation immunology
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1. Monoclonal antibodies 2L

- Preparation
- Applications
- Engineered antibodies.

2. Vaccines 10L

- Active and passive immunization
- Types of vaccines - Killed and attenuated vaccines, Whole organism vaccines, Purified macromolecules as vaccines, recombinant vector vaccines, DNA vaccines, anti-idiotypic vaccines
- Use of adjuvants in vaccines
- New vaccine strategies
- Ideal vaccine
- Routes of vaccine administration, Vaccination schedule, Failures in vaccination.

3. Transplantation immunology 3L

- Immunological basis of graft rejection,
- Types of graft rejection, Clinical manifestation of graft rejection,
- General and specific immunosuppressive therapy

UNIT 4: IMMUNE SYSTEM IN HEALTH AND DISEASE – PART -II

15 LECTURES

LEARNING OBJECTIVES

- Understand the principles and uses of a range of immunological techniques in current use.

- Understand basic concepts of transfusion medicine
 - Knowledge of autoimmune disorders and hypersensitivity reactions.
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1. Antigen- Antibody reactions 5L

- Precipitation,
- Agglutination, passive agglutination, agglutination inhibition,
- Complement Fixation,
- Radioimmunoassays (RIA),
- Enzyme immunoassays (EIA),
- Immunofluorescence,
- Flow cytometry,
- Western blot technique,
- Immunoelectron microscopy,
- Toxin antitoxin assays.

2. Immunohematology 4L

- Human blood group systems, ABO, secretors and non secretors, Bombay Blood group. Rhesus system and list of other blood group systems.
- Haemolytic disease of new born, Coombs test.
- Blood Transfusion, Major and Minor Cross matching, transfusion reactions

3. Hypersensitivity – 4L

- Coombs and Gells classification
- Type I to Type IV hypersensitivity- Mechanism and manifestation.

4. Autoimmunity 2L

- Definition of immune tolerance,
- Immune suppression and autoimmunity
- Spectrum of autoimmune diseases,
- Mechanism and treatment of autoimmune diseases.

CIA: Quiz, Assignment

References:-

1. Textbook of Microbiology, Ananthanarayan and Paniker, (2009), 8th Edition. Universal Press
2. Medical Microbiology, Cedric Mims et al, 3rd Edition Mosby
3. Microbiology, Prescott, Harley, Klein, 6th Edition McGraw Hill
4. Diagnostic Microbiology, Koneman, 5th and 6th Edition. Lippincott

5. Understanding Viruses, Teri Shors Jones, Bartlett Publishers
6. Introduction to Microbiology, Ingraham and Ingraham, 2nd Edition, Thomas Learning Inc
7. Immunology, Richard A. Goldsby, Janis Kuby, 6th Edition. W. H. Freeman and Company.
8. The elements of Immunology, Fahim Halim Khan, Pearson Education.
9. Immunology, An Introduction Ian R. Tizard, 4th - Edition, Saunders College Publishing
10. Immunobiology, Janeway, C, 6th edition, Garland Science Publishers

SEMESTER 6

COURSE: S.MIC.6.PR

CLASSICAL GENETICS, MOLECULAR BIOLOGY & BIOINFORMATICS

1. Preparation of competent cells and transformation
2. Restriction analysis
3. PCR (Demo)
4. Western Blot (Demo)
5. Conjugation (Demo)
6. Genetics problems
7. Bioinformatics
 - A. Off Line
 - i. Sequence Alignment, dot plot, exercises using Bioedit
 - ii. Visualizing and manipulating Protein structure database files using SPDBV
 - B. On Line
 - i. Visiting NCBI and EMBL - Retrieving nucleotide and protein sequences, sequence alignment, use of BLAST and FASTA for sequence analysis
 - ii. Multiple sequence alignment – CLUSTAL W, phylogenetic tree
 - iii. Understand every item mentioned in the report generated its significance and use in interpretation of results as well as limitations of the results.

CIA: Bioinformatics

MEDICAL AND IMMUNOLOGY II

1. Schematic /diagrammatic representation of Urinary tract, Gastro-intestinal tract, Central Nervous System, Skin

2. Diagnostic Cycle of any one infection of the above systems
3. Case study and problem solving for identification of the pathogen and antibiotic sensitivity with reference to each of the infections
4. Blood Grouping, Direct & Reverse Typing
5. Determination of Isoagglutinin titre
6. Coombs test – direct & indirect method
7. Compatibility test – cross matching.
8. Preparation of Typhoid vaccine and sterility checking
9. Antigen – Antibody Reactions: Agglutination – Widal (Demonstration); RPR Qualitative and Quantitative (Demonstration); Immuno diffusion - Ouchterlony; SRID
10. Pregnancy test – ELISA (Demonstration)
11. Rheumatoid arthritis test (Demonstration)

CIA: Immunohaematology/Antigen antibody reactions

Educational Visits/ Blood bank internship