

Sardar Patel University

B.Sc SEMESTER –VI Microbiology

US06CMIC21

Molecular Biology

(4 credits,4 hours/ week)

Effective form June2020

Unit:1: Genetic Exchange -I

- (a) Horizontal Gene transfer, creating variability the asexual way, fate of donor DNA during HGT
- (b) Molecular Recombination:
Recombination at molecular level: Homologous recombination double stranded break model and Non reciprocal homologous recombination, site specific recombination.
- (c) Bacterial Transformation.
Introduction, Definition, competence, mechanism of transformation in *S.pneumonia*, *N. gonorrhoea* and *H. influenzae*
- (d) Bacterial Conjugation
Introduction, Role of F-plasmid and secretory system, $F^+X F^-$, Hfr conjugation, F' conjugation, other examples of conjugation.
- (e) Transduction
Introduction, Generalized transduction, specialized transduction.

Unit: 2: Gene Exchange-II

- (a) Plasmids: types and characteristics of:
F plasmid, Col plasmid, Vi plasmid, Metabolic and resistance plasmids.
- (b) Transposable elements:
Insertion sequences, composite transposons,
Mechanisms of transposition: simple and replicative transposition
- (c) Development of Antibiotic resistance in bacteria:
Introduction, origin and mechanism of development of drug resistance in bacteria, and transmission of drug resistance
- (d) Microbes as tools of molecular biology
- (e) Gene Mapping:
Interrupted mating for mapping of the bacterial genome

Unit: 3 Genetic engineering-I

- (a) Outlines of Gene cloning
- (b) Isolation of DNA and RNA
- (c) Enzymes and steps in gene cloning:
 - (1) Restriction endonucleases:
Types, nomenclature, recognition sequences and cleavage pattern
 - (2) DNA ligase and ligation, Modifications of cut ends
- (d) DNA sequencing : Maxam Gilbert and Sanger sequencing
- (e) Salient features of ideal vector
- (f) Vectors used in genetic engineering
 - plasmids(pBr 322, pUC 18)
 - Bacteriophages : lambda, cosmids,

 - Artificial chromosome vectors: YAC and BAC
- (g) C-DNA library preparation

Unit:4 Genetic engineering-II

- (a) Salient feature of Host
- (b) Methods of introduction of DNA into Host cell:
Transformation, transduction, transfection, electroporation, electron gun, micro injection
- (c) DNA probes:
Definition, radioactive and non- radioactive labelling of probes.
- (d) Identification of nucleic acid: Southern blotting, Northern blotting,
- (e) Selection of recombinant clones:
Colony hybridization, marker inactivation, Reporter gene
- (f) DNA fingerprinting and applications
- (g) Gene amplification using Polymerase chain reaction:
Principle, procedure, types, application, advantages and limitations.

Reference Books:

1. Principles of Microbiology – R.M. Atlas
2. Practical Biochemistry: Principles and Techniques – K. Wilson and Walker, 5th Edition, (Cambridge low price ed)
3. Biotechnology – B.D.Singh, B.Sc edition, Kalyani publishers 3rd revised and enlarged reprint- 2008
4. Biotechnology: The biological principles, M.D. Trevan and Gould. 11th reprint 2002
5. Microbiology by Prescott Harley Klein 8th edition.

Course Learning Outcomes: A the conclusion of this course the students have

1. Developed understanding of recombination of bacteria. Understood about the three well known mechanisms by which the genetic material is transferred among the microorganisms namely transformation transduction and conjugation.
2. Are able to describe different types of plasmids and understand the consequences of recombination
3. Develop, understand and apply tools and techniques involved in Genetic engineering.
4. Understand the basic steps involved in gene cloning and its applications

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B.Sc SEMESTER –VI Microbiology

US06CMIC22

Immunology and Medical Microbiology

(4 credits,4 hours/ week)

Effective from June2020

Unit:1 Fundamental of Immunology-I

Non Specific Host Defense Mechanisms:

Phagocytosis, Complement, Inflammation,

Cytokines & Acute Phase Proteins, Central [Primary] lymphoid organs,

Peripheral [Secondary] lymphoid organs, Cells of Lympho reticular system,

B Cell maturation, T Cell maturation, Null cells.

Unit:2 Fundamental of Immunology II

Antigens: its types & properties

Antibodies - (Immunoglobulins - Definition, Structure & Function, Classes of Immunoglobulins.

Antigen-Antibody Reactions: General Features, Measurement of Antigen & Antibody.

Serological Reactions: Precipitation Reactions, Definition, Mechanism - Zone Phenomenon & Lattice Hypothesis. Applications- Precipitation in Liquid Medium.

Agglutination reactions- Definition, Applications-Slide agglutination test. Tube agglutination test, Passive agglutination test.

Primary & Secondary Antibody response.

Unit:3 Human Microbe Interactions-I

Origin of the normal flora, Normal Flora and human host.

Germfree and Gnotobiotic life, Effect of Antimicrobial Agents.

Characteristics of normal flora organisms.

Distribution and occurrence of normal flora skin, eye, Respiratory tract, mouth, Intestinal tract, Genitourinary tract.

Pathogenicity, Virulence and infection.

Microbial Adherence: Examples of Adherence of pathogenic bacteria, Examples of adherence of viruses.

Penetration of epithelial cell layers: Passive penetration into the body
Active penetration into the body.

Events in infection following penetration: Growth in underlying Tissue, Infection of the lymphatic system, Infection of the blood.

Microbial virulence factors : Antiphagocytic factors, Exotoxins, Endotoxins, Other virulence factors

Unit:4 Human Microbe Interactions-II

Principle of Epidemiology.

Study of following diseases with respect to causative agent, pathogenesis, symptoms and treatment of:

Airborne diseases: Tuberculosis, Influenza [Orthomyxo virus].

Food and waterborne diseases: Typhoid, Hepatitis A & B.

Contagious diseases: AIDS.

Insect borne diseases: Malaria, Dengue.

Zoonoses: Rabies.

Reference Books:

1. Microbiology -Prescott, Harley, and Klein's Microbiology, J. M. Willey, L. M. Sherwood, C. J. Woolverton 7th & 10th Edition (2007), McGraw Hill Higher Education- USA
2. Textbook of Microbiology: 7th & 10th ed Ananthnarayan & Paniker
3. Medical Microbiology- Murray and Drew.
4. Microbiology by Michael J. Pelczar 5th ed.

Course Learning Outcomes: US06CMIC22

After successful completion of the course the student will be able to:

- Conceptualize their understanding of host defense mechanism
- Understanding of Antigens & Antibody
- Understand the structure of immunoglobulin and antigen-antibody reaction.
- Explain the importance of normal flora of human body
- Understand the importance of pathogenicity and virulence.
- Understand importance of human diseases.

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B.Sc SEMESTER –VI Microbiology

US06CMIC23

Agricultural and Environmental Microbiology

(4 credits, 4 hours/ week)

Effective from June2020

Unit:1 Microbes in agriculture

- (a) Introduction to Nitrogen cycle
- (b) Nitrogen fixation- Structure and Function of Nitrogenase.
- (c) Symbiotic and asymbiotic N₂ fixation.
- (d) Introduction of Biofertilizers
- (e) Azotobacter and Rhizobia (With production).
- (f) Advantages of biofertilizers.
- (g) Microbial insecticides over chemical fertilizers.

Unit:2 Plant microbe interactions:

- (a) General symptoms of plant disease
- (b) Physiology of infection, Enzymes and Toxins
- (c) Biochemical defence mechanisms in plants
- (d) Transmission of plants diseases

Unit:3 Environmental microbiology-1

- (a) Concept of Xenobiotics and recalcitrance
- (b) Introduction and types bioremediation
- (c) Bioremediation of contaminated soils and waste lands
- (d) Biodegradation of environmental pollutants.
- (e) Microbially enhanced oil recovery.
- (f) Biodegradable polymers.
- (g) Genetic engineering for more efficient bioremediation.
- (h) Bioremediation of petroleum hydrocarbons and Chlorinated compounds.

Unit:4 Environmental microbiology-II

- (a) Renewable and non renewable energy resources.
- (b) Bio fuels:
Introduction, types of bio fuels, Features of bio fuels – advantages and disadvantages.
- (c) Biogas as a renewable energy source:
Substrate, microorganisms and digester used in biogas production.
Process of biogas production.
Factors affecting biogas production.
Advantages and disadvantages of Biogas production
- (d) Global environmental problems: Green house effect and global warming.
- (e) Bioleaching-Organisms, mechanism and commercial process.
Bioleaching of copper.

References Books:

1. Principles of Microbiology – R.M Atlas
2. A Textbook of Biotechnology – R.C.Dubey
3. Microbial Ecology by Atlas & Bartha 4th edition
4. Biotechnology by U. Satyanarayan
5. Biotechnology by B. D. Singh (B.Sc Edition)
6. Introduction to biodeterioration by Dennis Allsopp and Kenneth J. Seal
7. Plant Pathology by R.S. Mehrotra and Ashok Aggarwal
8. Plant Pathology by R. S. Singh

Course Learning out come:

After the successful completion of the course a student will be able to,

- Learn about nitrogen cycle, types of nitrogen fixation and significance of nitrogen fixation in the soil
- Know about bio fertilizers & their advantages in agriculture
- Get knowledge regarding interactions between plants and microbes
- Learn various types of bioremediation, how to improve bioremediation using microbes and biodegradation of environmental pollutants.
- Understand about biofuels as energy sources
- Gain knowledge regarding global environmental problems.

Sardar Patel University

B.Sc SEMESTER –VI Microbiology

US06CMIC24

Fermentation Technology -II

(4 credits, 4 hours/ week)

Effective from June2020

Unit:1 Strain improvement of industrially important microorganisms

- (a) Selection of natural variant, Induced mutations (Physical and Chemical).
- (b) Recombination in Bacteria, parasexual cycle in fungi, protoplast fusion and genetic technology.
- (c) Isolation of mutants producing primary and secondary metabolite.
- (d) Improvement of strains by modifying properties other than yield of products
- (e) Regulation of metabolic pathways
- (f) Maintenance and preservation of industrial cultures.
- (g) List of culture collection centers in India

Unit:2 Assay and Quality control of fermentation products

- (a) Bioassay of fermentation product
- (b) Introduction to Quality assurance, Quality Control, Good Manufacturing Practice
- (c) Sterility testing and Endotoxin testing by LAL Test
- (d) Biosafety, Fermentation economics, Introduction to IPR and patenting
- (e) Methods of Immobilization of microbial cells

Unit:3 Industrial effluent treatment

- (a) Nature of effluent generated by fermentation industries
- (b) Dissolve oxygen as an indicator of water quality.
- (c) Site surveys, Strength of fermentation effluent.
- (d) Treatment and disposal of industrial effluents- Sea and rivers, Spray irrigation, Land fills and incineration, disposal of effluent in sewers
- (e) Effluent treatment processes: Physical, Chemical and Biological
- (f) By products- Distilleries and Breweries

Unit:4 Fermentative production of specific microbial products

- (a) Microbial Biomass : Brewers and Baker's Yeast
- (b) Primary Metabolites : Glutamic acid, Cyanocobalamine, Ethanol
- (c) Secondary Metabolite: Penicillin
- (d) Enzyme: Alpha amylase
- (e) Biotransformation: Steroid Transformation
- (f) Recombinant Product: Insulin
- (g) Fermented Foods: Yoghurt

Reference Books:

1. Principles of Fermentation Technology 2nd edition P.F. Stanbury, A. Whitaker and S.J. Hall.
2. Fermentation Technology- Vol I & Vol II – H.A. Modi.
3. Industrial Microbiology. 1st edition, A.H. Patel.
4. Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Crueger W and Crueger A .
5. An Introduction to Industrial Microbiology 1st edition.P.K. Sivakumar, M.M.Joe and K. Suresh.

Course Learning Outcomes: US06CMIC24

After successful completion of the course the student will be able to:

- Learn various strategies through which natural isolates can be transformed in to a hyper producing strain with respect to desired product.
- Learn various methods related to the biological assay of various products at different stage of their fermentative production.
- Recognize the importance of Good Manufacturing Practice at the various stages of fermentative production and before releasing the product in to the market which type of quality checks are essential.
- Sensitize for various safety levels which are required to be considered during the fermentative production.
- Learn how by using technologies like immobilization, efficiency of bioprocesses can be increased.
- Appreciate the economic considerations involved in bioprocess industry
- Know about the generation of industrial waste water, parameters to be monitored and learn various methods to treat such effluent in order to reduce its toxicity.
- Learn detailed fermentative production of some typical Primary and secondary metabolites to get the panoramic view of entire fermentation process.

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B.Sc SEMESTER –VI Microbiology

US06CMIC25

Microbiology Practical

(6 credits, 12 hours/ week)

Effective from June 2020

1. Isolation of Actinomycetes.
2. Bioassay of Streptomycin.
3. Pure culture study of *E.coli*, *Enterobacter aerogenes*, *Salmonella typhi*, *S. typhi para-B*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *S. aureus*, *B. subtilis*.
4. Isolation of Plant pathogen (*Xanthomonas citri*)
5. Estimation of gluconic acid by titrimetric method
6. Estimation of blood glucose by GOD/POD method.
7. Estimation of serum urea.
8. Estimation of total serum cholesterol.
9. Estimation of serum Creatinine.
10. Chemical analysis of urine.
11. Blood grouping.
12. Hemoglobin estimation by Sahli's method.
13. Total count of W.B.Cs.
14. Differential count of leukocytes
15. Demonstration of sterility testing.
16. Widal slide agglutination test – qualitative (demonstration of quantitative test)

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B.Sc SEMESTER –VI Microbiology

Disipline Specific Elective

US06DMIC26

Applied Medical Technolgy and Clinical Management

(2 credits, 2 hours/ week)

Effective form June2020

Unit:1 Haematology & Blood banking

Haematology: Components of blood & their function,
Hematopoiesis, Homeostasis, Anticoagulants ,
Immunohematology-ABO & Rh blood group system
Coombs Test, Principle of blood banking, Safety in blood transfusion

Unit:2 Techniques in Clinical Microbiology

Complement fixation reaction, Immunofluorescence
Enzyme linked immunosorbent assay (ELISA),
Radio immunoassay (RIA), Western blot
Recent advances in diagnostic microbiology

Unit:3 Clinical Microbiology & Biochemistry

Collection, handling and transport of clinical specimen
Identification of microorganisms from specimen
Microscopic Method, Bacteriophage typing,
Serotyping ,Antibiogram
Clinical biochemistry: Kideny function test, Liver function test
Cardiac function test

Unit:4 Applied Medical Microbiology

Health care associated infection: common types of health care associated infection, Sources and reservoirs of health care associated infections, Mode of transmission of microorganisms, Measure to control infection in the health care setting, Vaccine.

Emerging and reemerging infections: Transmission from animals to humans, Zika virus disease, Drug resistance, India scenario, Bioterrorism

Biomedical waste Management: Types of biomedical waste, General principles of waste management, Waste treatment, Biomedical waste 2016 Rules.

Laboratory control of antimicrobial therapy: Antibiotic sensitivity test, Antibiotic policy.

Urinary tract infection, Respiratory tract infection, Meningitis.

Reference Books:

1. Microbiology- Prescott, Harley, and Klein's Microbiology, J. M. Willey, L. M. Sherwood, C. J. Woolverton, 7th & 10th Edition (2008), McGraw Hill Higher Education- USA
2. Textbook of Microbiology: 7th & 10th Ananthnarayan & Paniker
3. Medical laboratory technology-K L Mukhaerjee
4. Medical Microbiology- Murray and Drew.

Course Learning Outcomes: US06DMIC26

After successful completion of the course the student will be able to:

- Conceptualize their understanding of blood cells & blood group system
- Understand various techniques of clinical microbiology
- Understand the clinical test in biochemistry
- Understand importance of healthcare and biomedical waste management.

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B.Sc SEMESTER –VI Microbiology

Disipline Specific Elective

US06DMIC27

Microbial Quality Control in Food and Pharmaceutical Industries

(2 credits, 2 hours/ week)

Effective form June 2020

Unit:1 Microbiological Laboratory and Safe Practices

Good laboratory practices – Good laboratory practices, Good microbiological practices

Biosafety cabinets - Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3.

Discarding biohazardous waste – Methodology of disinfection, Autoclaving and Incineration.

Unit:2 Determining Microbes in Food / Pharmaceutical Samples

Culture and microscopic methods – Standard plate count, most probable number, direct microscopic counts,

Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products

Unit:3 Pathogenic Microbes of Importance in Food and Water

Enrichment culture technique, detection of specific microorganisms on :

XLD agar, Salmonella Shigella agar, Mannitol salt agar, EMB agar, MacConkey agar, Sabouraud agar.

Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 minutes Resazurin assay).

Unit:4 HACCP for Food Safety and Microbial Standards

Hazard analysis of critical control point (HACCP) – Principles, flow diagrams, limitations

Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.

References Books:

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic press
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I.K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Morden Food Microbiology, 7th edition, Springer
4. Braid RM, Hodges NA, And Denyer SP (2005) Handbook of Microbiology Quality Control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

Course Learning Outcome for US06DMIC27

After the successful completion of the course a student will be able to:

- Conceptualize their understanding of Good microbiological laboratory practices & Bio safety and also how to Discard biohazardous waste .
- Learn various methods of determining the microbes in Food / Pharmaceuti cal Samples.
- Study the important pathogenic microbes of food & Water
- Gain knowledge of HACCP for Food Safety .