

# **Sardar Patel University**

## **B.Sc SEMESTER –V Microbiology**

US05CMIC21

Molecular Genetics

(4 credits, 4hours/ week)

Effective from June 2020

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### **Unit:1 Gene structure and Replication in prokaryotes**

- (a) DNA as genetic material
- (b) Structure and chemistry of DNA, forms of DNA
- (c) DNA replication in bacteria

DNA replication is semi conservative, DNA replication initiates from a single origin, replication machinery, events at replication fork, termination of replication, and replication of linear chromosomes.

- (d) Models of replication ( $\theta$ , rolling circle)
- (e) Bacterial gene structure

### **Unit:2 Gene Expression I**

- (a) Central Dogma of gene expression and teminism
- (b) Transcription in bacteria :

Introduction, Bacterial RNA polymerase,promoter and stages of transcription: initiation, elongation, rho factor dependent and factor independent termination of transcription.

- (c) Regulation of transcription initiation : Lactose operon, Tryptophan operon
- (d) RNA dependent synthesis of RNA, RNA dependent synthesis of DNA.

### **Unit:3 Gene Expression II**

- (a) Transfer RNA: structure and role
- (b) Ribosome: structure and role
- (c) Genetic code: features and its deciphering
- (d) Translation:

Activation of amino acids and charging of t-RNA, Initiation of protein synthesis, elongation of polypeptide chain, insertion of selenocysteine and pyrrolysine, termination of protein synthesis.

- (e) Protein modifications and secretion: Chemical modifications, Protein folding and molecular chaperones, protein splicing, protein translocation and secretion in bacteria

### **Unit:4 Gene Variation (mutations) and repair.**

- (a) Introduction, spontaneous mutations, induced mutations, Evidence of spontaneous mutation (fluctuation test, replica plate technique)
- (b) Types of mutations
- (c) Chemical and physical mutagenic agents: U.V. radiation, 5BU, Nitrous acid, EMS, acridine dyes
- (d) Detection and isolation of mutants : auxotrophic mutants, antibiotic resistance mutants.
- (e) Mutagen and carcinogen identification (Ame's test)
- (f) DNA repair : Proof reading, mismatch, Exicision, Direct, Recombination and SOS.

## **Reference Books:**

1. Microbiology by Prescott 9<sup>th</sup> Edition
2. General Microbiology by Powar and Daginawala- vol-I
3. Principles of Molecular Biology by Veer Bala Rastogi 2<sup>nd</sup> edition
4. A text book of Microbiology by A.H. Patel

## **Course learning outcome of US05CMIC21:**

The course is structured with the aim to full fill the objective of introducing basic concepts of molecular biology to the under graduate students of Microbiology.

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

- Understand the importance of the master molecule “nucleic acid”, get knowledge of DNA and RNA structures, genome organization of prokaryotes, gene structure and function.
- Understand about mechanism of prokaryotic DNA replication and machinery of DNA replication.
- Get knowledge regarding Central Dogma of gene expression and all steps of the central dogma in detail like, transcription, translation, replication and reverse transcription. Know about regulation of gene expression
- Understand about various RNAs, Ribosome, genetic code and their role in protein synthesis.
- Learn about Protein modifications and secretion occurs in bacteria.
- Understand how mutations and repair of genetic material influence evolutionary process. And will get information regarding chemical and physical mutagenic agents, types of mutations and DNA repair.

# **Sardar Patel University**

## **B.Sc SEMESTER –V Microbiology**

US05CMIC22

Microbial Metabolism

(4 credits, 4hours/ week)

Effective form June2020

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### **Unit-1: Principles of Bioenergetics and Nutrient Transport**

- (a) Biochemical thermodynamics
- (b) Structure and role of ATP
- (c) Biochemical mechanisms of ATP Generation :
  - Oxidative Phosphorylation :- ETC- Components & Organization, Mechanism of Oxidative Phosphorylation
  - Substrate Level Phosphorylation
  - Photophosphorylation.
- (g) Membrane Transport :
  - Nutrient transport across the membrane : Passive Transport – Passive diffusion, Osmosis,& facilitated diffusion. Active transport- porter molecules.

### **Unit-2: Enzymology**

- (a) Structure, properties and specificity of enzymes
- (b) Salient features of Active site
- (c) Mechanisms of ES complex formation
- (d) Factors affecting Enzyme activity
- (e) Salient features of IUB system of Enzyme classification
- (f) Enzyme Kinetics :
  - Defination, First and Zero order kinetics
  - Michealis-Menten Kinetics
  - Definitions of Km, Turnover Number (Kcat)

(g) Enzyme Inhibition

Reversible (Competitive, Non competitive, Uncompetitive) & Irreversible.

(h) Regulation of enzyme action:

Allosteric enzyme & Covalent modification .

Introduction to Zymogen & Isoenzyme

### **UNIT 3: Catabolism of Carbohydrates, Proteins & Lipids**

(a) Introduction to metabolism:

Definitions of Anabolism and Catabolism

Role of precursor metabolites in metabolism

(b) Carbohydrate catabolism:

EMP, TCA, HMP & Glyoxalate pathways with enzymes.

(c) Regulation and bioenergetics of EMP & TCA.

(d) Protein Catabolism:

Transamination, Deamination, Decarboxylation and Stickland Reaction.

(e) Lipid Catabolism:

Types of Lipid Catabolism :  $\alpha$  ,  $\beta$  &  $\omega$  oxidation of fatty acids.

$\beta$ -Oxidation of palmitic acid with enzymes, regulation and energetic.

### **UNIT 4: Anabolism of Carbohydrates, Proteins & Lipids**

(a) Strategies of biosynthesis

(b) Methods of studying biosynthesis -Use of biochemical mutants, Pulse labeling technique.

(c) Carbohydrate biosynthesis :

Gluconeogenesis, Reductive TCA cycle & Calvin - Bensen Cycle.

(d) Lipid biosynthesis - Biosynthesis of palmitic acid

(e) Amino acid biosynthesis- Biosynthesis of Aromatic amino acids

(f) Peptidoglycan Biosynthesis

**Reference Books: :**

1. Principles of Biochemistry- Lehninger, Nelson & Cox. - 4th edition
2. General Microbiology- Stanier, R. Y. - 5th edition.
3. Biochemistry- U. Satyanarayan
4. Biochemistry – Zubay G.L.- 4th edition.
5. Enzymes - T. Palmer

**Course Learning Outcome for US05CMIC22**

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

- Conceptualize their understanding of Microbial Metabolism
- Understand the Principle of Thermodynamics
- Able to describe the structure, role and different modes of ATP generation in bacteria.
- Explain transport systems of nutrient & proteins across the bacterial membrane
- Gain knowledge of enzymes, enzyme kinetics and their regulation.
- Understand the pathways for degradation and biosynthesis of carbohydrate, lipid & proteins and also biosynthesis of peptidoglycan

# Sardar Patel University

## B.Sc SEMESTER –V Microbiology

US05CMIC23

Virology and Mycology

(4 credits, 4hours/ week)

Effective from June2020

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### Unit:1 Viruses of Bacteria.

- (a) Classification of bacterial viruses
- (b) One step growth experiment, Doermann's Premature lysis experiment
- (c) Lytic cycle of virulent phage T4.  
Adsorption, penetration, synthesis of phage nucleic acids and proteins,  
Assembly of phage particles and release of phage particles.
- (d) Temperate phages and lysogeny ( lambda as model)  
Molecular mechanism for decision making process for establishing lysogeny  
or lytic pathway. Lysogenic conversion and its mechanism
- (e) S-S DNA Phages
- (f) Ø X-174, Fd
- (g) RNA phages:  
ds-RNA: Ø6 of *Ps syringae*  
ss-RNA phages MS2, QB

### Unit:2 Viruses of Eucaryotes

- (a) Animal Viruses  
Introduction, Reproduction of animal viruses: adsorption, penetration and  
un-coating, replication and transcription in DNA and RNA viruses, synthesis  
and assembly, release.  
Cytocidal infections and cell damage.
- (b) Plant Viruses: Introduction and replication of T.M.V.
- (c) Viruses of fungi and protists.  
Insect viruses
- (d) Persistent, latent and slow viruses.  
Viruses and cancer. ( oncogenic viruses)
- (e) Viruses and Human  
Diseases, viruses and Industry, Viruses and biological control.

### **Unit:3 Fungi: General**

- (a) General characters, Thallus, kinds of mycelia, structure of fungal cell, fungal flagella, Aggregation and modification of hyphae
- (b) Nutrition in fungi:  
Nutritional requirements, Essential elements, sources of macroelements, modes of nutrition, mechanism of nutrition, symbiosis, mycorrhiza.
- (c) Homothallism and Heterothalium
- (d) Classification of Fungi:  
Introduction, Classifications proposed by Gwynne- Vaughan and Harnes, Bassey, Martin. Recent classification.
- (e) Reproduction in fungi:  
Sexuality, Asexual reproduction, Sexual reproduction
- (f) Parasexual cycle

### **Unit:4 Significance of Fungi**

- (a) Economic Importance of fungi
- (b) Secondary metabolites of fungi
- (c) Mycotoxins  
Mycotoxins of food and feed Stuff aflatoxins, zearalenone, sporodesmins, ochratoxins, Ergot toxins, Mushroom toxins, Toxins produced by mushrooms other than amanita.
- (d) Sex hormones in fungi
- (e) Human Diseases caused by fungi (Mycoses)  
Fungal pathogens ,  
Airborne diseases: blastomycosis, coccidiomycosis, cryptococcosis, Histoplasmosis.  
Opportunistic diseases: Aspergillosis, candidiasis, Microsporidiosis, Pneumocystis pneumonia



## Reference Books:

1. Dube H C, (1990), An Introduction to Fungi, 2nd edn, Vikas Publishing House Pvt Ltd
2. Botany for Degree students FUNGI, B.R. Vashishta, A.K. Sinha, Anil Kumar. Revised edition, S. Chand company PVt
3. Prescott L, Harley J P, and Klein D A, (2008), Microbiology, 7th edn. Wm C. Brown - McGraw Hill, Dubuque, IA ltd.
4. Microbiology by Prescott Harley Klein 9<sup>th</sup> edition
5. Stent and Calendar 2<sup>nd</sup> edition.
6. Viruses by S.B. Biswas

## Course Learning outcome: US05CMIC23:

The course is prepared with the aim to full fill the objective of introducing basic concepts of virology and Mycology to under graduate students of Microbiology.

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

- Understand the characteristics and importance of the viruses.
  - Understand life cycles of virulent and temperate bacteriophages and will be introduced to single stranded DNA containing phages like  $\phi$  X-174,  $\phi$ d, RNA phages like,  $\phi$ 6 of *Ps syringae* and MS2, QB.
  - Know about viruses of animals, plants, fungi, insects and other forms of life. What are the interactions of viruses with various hosts? How Viruses cause cancer. (oncogenic viruses). To know the impact of Viruses on Human life by understanding how they cause diseases, how they influence various Industries and can be exploited in biological control.
  - Understand about general characters, classification, Nutrition and reproduction in fungi, the most exploited eukaryotic microbe.
  - Know about symbiosis, mycorrhiza, Homothallic and Heterothallicism.
  - Understand Significance of Fungi by knowing their economic Importance, involvement in Secondary metabolites production, capacity of various kind of mycotoxin production, sex hormones production.
  - Apart from economic significance, students will be able to know about airborne and opportunistic human Diseases caused by fungi (Mycoses) and various fungal pathogens.
  - Learn that how these viruses and fungi offer the potential to range in severity from the harmless to the downright system crippling and can implement knowledge in management of our resources.
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# **Sardar Patel University**

## **B.Sc SEMESTER –V Microbiology**

US05CMIC24

Fermentation Technology-I

(4 credits, 4hours/ week)

Effective from June2020

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### **Unit:1 Introduction to fermentation technology**

- (a) Concept of fermentation technology
- (b) Range of processes and products
- (c) Industrially fermentation important microorganisms and their screening- Primary screening (antibiotic, organic acid, amylase and growth factor) and significance of secondary screening
- (d) Fermentation process outline (Up stream and Down stream Processes)

### **Unit :2 Up stream Processing-1**

- (a) Inoculum development Criteria for an ideal inoculum and principles of inoculum development.
- (b) Media for industrial fermentation (Ideal Characteristics)
- (c) Substrates for industrial fermentations (Carbon and Nitrogen Source)
- (d) Role of precursors, inhibitors and inducers in fermentation medium.
- (e) Sterilization of air and media
- (f) Scale up and scale down

### **Unit:3 Fermenter design, type & control**

- (a) Methods of fermentation : Batch, Fed batch and Continuous, solid state fermentation including tray fermenters
- (b) Industrial fermenter design (Criteria for the design, design of typical fermenter)
- (c) Types of fermenter.
- (d) Components of fermenter and their uses.
- (f) Introduction to mass transfer of oxygen, factors affecting  $K_La$  and methods for its determination.

#### **Unit:4 Downstream processing of fermentation products**

- (a) Criteria for the selection of recovery process.
- (b) Separation of cells by filtration and centrifugation.
- (c) Techniques for the disruption of microbial cells
- (d) Liquid: Liquid extraction of fermentation products
- (e) Product purification by chromatographic techniques
- (f) Product concentration by precipitation, reverse osmosis and ultrafiltration.

## Reference Books:

1. Principles of Fermentation Technology 2<sup>nd</sup> 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

## Course Learning Outcomes for US05CMIC24

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

- Recognize the potential of microorganisms which can produce variety of economically viable products.
- Learn how microorganisms can be screened for production of various metabolites.
- Understand how inoculums for the industrial fermentations can be prepared and maintained.
- Appreciate the requirement of aseptic conditions and control of contaminations during the bioprocess.
- Identify and select appropriate media constituent required to produce the desire product.
- Understand on what basis cultivation methods are decided for a particular bioprocess
- Know the types of bioreactor configurations available for bioprocesses and will also be able to learn importance of various important components which constitute various parts of bioreactor.
- Understand the need for monitoring and control of various essential bioprocess parameters
- Learn various methods available for recovery and purification of fermentation products from the complex fermentation broth.

# **Sardar Patel University**

## **B.Sc SEMESTER –V Microbiology**

US05CMIC25

Microbiology Practical

(6 credits, 12 hours/ week)

Effective from June 2020

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1. Screening of Amylase producing organisms
2. Screening of Organic acid producing organisms
3. Titration of bacteriophage.
4. Estimation of reducing sugar by DNS method.
5. Estimation of reducing sugar by Cole's method.
6. Protein estimation by Folin's method.
7. Ethanol estimation by Dichromate method
8. Separation and identification of amino acids by TLC.
9. Measurement of rate of aeration by Sulfite oxidation method
10. Study of microbiocidal effect of UV rays.
11. Isolation of pigmentless mutant of *S. marcescens* using U.V. as mutagen
12. Isolation of antibiotic resistant mutants by grid/ replica technique.
13. Study of Enzyme (Amylase) assay.
14. Study of antibiogram.
15. Determination of MIC of an effective antibiotic.

# **Sardar Patel University**

## **B.Sc SEMESTER –V Microbiology**

Disipline Specific Elective

US05DMIC26

Bioinstrumentation and Biotechniques

(2 credits, 2 hours/ week)

Effective form June2020

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### **Unit: 1 Spectroscopy**

- (a) Beer's and Lamberts Law.
- (b) Principle, working and applications of :
  - UV- Visible Spectrophotometer
  - Atomic Absorption spectroscopy
  - Infra Red Spectroscopy

### **Unit:2 Electrophoresis:**

- (a) Principle, Support media, Methods and applications of electrophoresis
- (b) Separation of Protein and nucleic acids:
  - PAGE,SDS-PAGE, Agarose and IEF

#### **Centrifugation:**

- (a) Principle of centrifugation.
- (b) Separation methods in preparative centrifuge , differential and density gradient centrifugation.
- (c) Ultracentrifugation-introduction and applications.

**Unit:3 Chromatography**

- (a) Principle of Chromatography, Types of Chromatography.
- (b) Working and Applications of Thin Layer Chromatography, Adsorption chromatography, Ion exchange Chromatography, Molecular Sieve Chromatography, Gas liquid Chromatography, Affinity Chromatography and HPLC.

**Unit:4 (a) Biosensors: Principle, Method and Application**

**(b) Radioactivity:**

Nature of Radioactivity, Types of radioactive decay, Measurement of Radioactivity: Applications and safety of Radioactivity.

## Reference Books:

1. Instrumental Methods of Chemical Analysis Chatwal and Anand
2. Practical Biochemistry and Molecular Biology – Wilson and Walker
3. Instrumental Methods of Analysis in Biotechnology- D. K. Chantana and P.S. Mehra
4. Microbiology- Prescott 8<sup>th</sup> edn.
5. Biophysical Chemistry- Principles and Techniques- Upadhyay, Upadhyay and Nath

## Course Learning Outcomes of US05DMIC26:

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

A comprehensive knowledge of the equipment used in Microbiology and Biotechnology will be offered in the course along with the applications. Additionally, an overview of the instruments used in isolation and separation of molecules will also be provided. This will enable the students to understand all subjects of Biotechnology as these tools and techniques will be used therein. This is a basic foundation course for the undergraduate students of Biotechnology

- To develop the skills of the application of basic and advanced techniques employed in quantitative and qualitative analysis of bio molecules.
- To be able to use selected analytical techniques.
- Familiar with working principals, tools and techniques of analytical techniques
- To understand the strengths, limitations and creative use of techniques for problem-solving.



# **Sardar Patel University**

## **B.Sc SEMESTER –V Microbiology**

Disipline Specific Elective

US05CMIC27

Microbial Diversity and Ecology

(2 credits, 2 hours/ week)

Effective form June2020

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### **Unit:1 Ecosystem**

- (a) Introduction to Ecology and Ecosystem.
- (b) Structure of Ecosystem
- (c) Components of Ecosystem.
- (d) The physical environment.
- (e) Microorganism Movement between Ecosystem.
- (f) Extreme Environment

### **Unit:2 Fungal and viral diversity.**

- (a) Characteristics of fungal divisions.
  - Chytridiomycota
  - Zygomycota
  - Ascomycota
  - Basidiomycota
- (b) Characteristics of HIV
- (c) Severe Acute Respiratory Syndrome
- (d) Persistent, Latent and slow Virus Infections

**Unit:3 Bacterial diversity- I**

Spirochaetes

Mycoplasma

Rickettsia

Chlamydia.

Endosymbionts

**Unit:4 Bacterial diversity- II**

Sulfur metabolizing bacteria.

Streptomyces

Photosynthetic bacteria: oxygenic & anoxygenic.

Archaeobacteria.

**Reference Books:**

1. Microbiology -Prescott ,Harley and Klein 7<sup>th</sup> edition
2. Microbiology by Pelczar, Chan and Krieg,5<sup>th</sup> edition
3. Textbook of Microbiology-Ananthnarayan and Paniker 7<sup>th</sup> edition

**Course learning outcome of US05DMIC27:**

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

- Learn about structure and component of ecosystem
- Get knowledge regarding extreme environment
- Understand characteristics of fungal division & human immunodeficiency virus
- Conceptualize their knowledge regarding bacterial diversity.