



**SARVAJANIK  
UNIVERSITY**

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## **Faculty of Science**

**SHREE RAMKRISHNA INSTITUTE OF COMPUTER EDUCATION  
AND APPLIED SCIENCES, SURAT**

## **B.Sc. Microbiology**

### **Syllabus**

**(Effective from 2021)**

M.T.B College Campus, B/h P.T.Science College, Opp. Chowpati,  
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## **A. About B.Sc. Microbiology Programme**

The Department of Microbiology of SRKI at Sarvajani University runs a **full time three-year program of six semesters**, leading to award of Bachelor of Science (B.Sc.) degree in Microbiology. The curriculum is designed to train the students in basic and advanced areas of Microbiology, keeping in mind the latest advances in the field. Particular emphasis is laid on the practical aspects of the field. Students are taught how to plan experiments, perform them carefully, analyze the data accurately, and present the results both, qualitatively and quantitatively. The students are offered basic and advanced level courses in Microbial Diversity, Microbial Physiology, Virology, Immunology, Enzymology, Environmental Microbiology, Molecular biology, Recombinant DNA technology, Industrial Microbiology, Food Microbiology etc. During the programme students were also exposing to industrial and relevant field visit.

## **B. Programme Objective**

- The objective of the B.Sc. Microbiology is to equip the students to gain fundamental knowledge and analytical skills at an advanced level in the field of microbiology.
- The program emphasizes to apply knowledge acquired about prokaryotic and eukaryotic cellular processes, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms in environment and biological systems to various conditions.
- The laboratory training in addition to theory is included so that the students will acquire the skills to qualify for the positions in industry, clinical laboratory or for further education in a Master program.

## **C. Eligibility**

- The candidate must have passed 10+2 or an equivalent examination with Biology as one of the subjects. **OR** Vocational course in Home Science **OR** Diploma in Pharmacy. **OR** The candidate who has passed equivalent exam from other subjects or boards need to avail eligibility certificate for this programme from the Board of Equivalence (BoE) of the Sarvajani University.



## E. Evaluation Scheme

<b>B.Sc. Microbiology</b>				
<b>Evaluation</b>	<b>Criteria</b>	<b>Theory</b>	<b>Practical</b>	
			<b>Sem – I &amp; II</b>	<b>Sem – III to VI</b>
Internal	Continuous & Comprehensive Evaluation (CCE)	40	30	40
	Attendance	10	10	10
	Assignment	20	--	
	Internal Practical Test and Viva - Voce	--	30	50
External	External Evaluation	30	30	50
Total		100	100	150

<b>Name of faculty: Science</b>	<b>Department: Biotechnology</b>
<b>Program: B.Sc. Microbiology Sem 5</b>	<b>Type: DSE-9</b>
<b>Subject: Molecular Biology</b>	
<b>Credit: 04 + 02</b>	<b>Total learning hours: 60</b>
<b>Course Description:</b> <p>Inculcate strong fundamentals on basic and advanced molecular biology concepts. This is a vital course for the graduate students which provides enhanced knowledge on replication, transcription and translation with their regulatory aspects and also includes content imparting knowledge about protein maturation and post translational modifications.</p>	
<b>Student Learning Outcome:</b> After completion of this course the students will be able to understand the central dogma of molecular biology. Further the syllabus will mainly elaborate the following points <ul style="list-style-type: none"> <li>● Covers the concept of genetic codes and their features. It explains more about the transcription occurring in Bacteria, Eukaryotes and Archaea.</li> <li>● Emphasizes on synthesis of proteins, how are these proteins modeled to give a correct form. It also explains further about protein maturation and how these proteins are targeted to their destination on secretion.</li> <li>● Highlights about the levels of regulation involved in RNA and protein synthesis. It gives information on processes like splicing and RNA editing. It explains about the role of ubiquitylation and chaperon mediated protein folding</li> <li>● Provides information about regulation of genes in viruses additionally. It talks more about global regulatory systems.</li> </ul>	

**Unit-1: DNA replication**
**(Duration: 07 Hrs)**

- 1.1 General features of DNA replication
- 1.2 Replication in prokaryotes
- 1.3 Replication in eukaryotes
- 1.4 Termination of replication
- 1.5 Regulation of replication

**Unit-2: DNA mutations and repair**
**(Duration: 08 Hrs)**

- 2.1 Chemical basis of mutations
- 2.2 Spontaneous and Induced mutations

- 2.3 Effect of mutations
- 2.4 Detection and Isolation of mutants
- 2.5 DNA repair

### **Unit–3 Molecular recombination and gene transfer-I**

**(Duration: 07 Hrs)**

- 3.1 Introduction to recombination and recombination in eukaryotes
- 3.2 Horizontal gene transfer in prokaryotes
- 3.3 Recombination at molecular level
- 3.4 Transposable elements
- 3.5 Bacterial plasmids

### **Unit–4 Molecular recombination and gene transfer-II**

**(Duration: 07 Hrs)**

- 4.1 Bacterial Conjugation
- 4.2 Bacterial Transformation
- 4.3 Transduction
- 4.4 Development of antibiotic resistance in bacteria
- 4.5 Mapping the genome

### **Unit–5 : Transcription and genetic code**

**(Duration: 08 Hrs)**

- 5.1 Transcription in Bacteria
- 5.2 Transcription in Eukaryotes
- 5.3 Transcription in Archaea
- 5.4 Establishment of Genetic Code
- 5.5 Characteristics of Genetic Code

### **Unit–6 :Translation**

**(Duration: 08 Hrs)**

- 6.1 tRNA and amino acid activation
- 6.2 Ribosome Structure
- 6.3 Initiation of Protein Synthesis
- 6.4 Elongation and Termination of Protein Synthesis

6.5 Protein maturation and secretion

**Unit-7 : Regulation of gene expression-I**

**(Duration: 08 Hrs)**

7.1 Levels of Regulation

7.2 Regulation of Transcription initiation

7.3 Regulation of Transcription elongation

7.4 Regulation of Translation

**Unit- 8 :Regulation of gene expression-II**

**(Duration:07 Hrs)**

8.1 Post-translational Regulation

8.2 Global regulatory systems

8.3 Regulation of gene expression in Eukarya and Archaea

8.4 Gene regulation in Bacteriophage  $\lambda$

**Reference Books:**

- Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2008). Prescott, Harley and Klein's Microbiology, 7th Edition, McGraw Hill International Edition.
- Pal, J. K. and Ghaskadbi, S. S. (2009). Fundamentals of Molecular Biology, Oxford University Press.

**List of Practicals**

1. Extraction of bacterial plasmid by alkaline lysis method
2. Extraction and Purification of bacterial DNA using spin column.
3. Restriction digestion of plasmid vector.

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<b>Name of faculty: Science</b>	<b>Department: Biotechnology</b>
<b>Program: B.Sc. Sem 5</b>	<b>Type: DSC-10:</b>
<b>Subject: Fundamentals of Immunology</b>	
<b>Credit: 04 + 02</b>	<b>Total learning hours: 60</b>
<b>Course description:</b> <p>The paper imparts the fundamental aspects of the protective defence system mounted by the host against the foreign threat/invading harmful agents. It encompasses various components and approaches employed by the host defence system to provide protective state – immunity against such invading harmful agents-pathogens. It discusses the applications that are devised using these components and approaches including diagnosis, treatments, therapy, prophylaxis etc. and also elucidate the abnormalities/diseases/disorders arising on account of immune malfunctioning.</p>	
<b>Student learning outcome:</b> <p>On completion of course students will be able to:</p> <ul style="list-style-type: none"> <li>● Understand the immune system, its components and their action to provide the protective state to the host system.</li> <li>● Explain the significance of functioning of innate and adaptive immune systems in eradicating pathogens or harmful agents.</li> <li>● Explain how the protective immune system once developed in the host lasts for lifetime and actively works in removing the antigen efficiently at every moment of attack.</li> <li>● Describe interactions of the immune components (Ag-Ab/cell) in <i>in vitro</i> and <i>in vivo</i> conditions.</li> <li>● Apply these interactions for diagnostic, prognostic purposes i.e. as diagnostic techniques, vaccines, treatments and control of diseases and disorders.</li> <li>● Learn about the various conditions a host may get exposed to if the host immune system does not work in a regulated controlled manner by studying immune related diseases and disorders.</li> </ul>	

**Unit-1: Introduction To Immunology And Immune System: (Duration: 06 Hrs)**

- 1.1. Historical Perspective Of Immunology
- 1.2. Types Of Immune System
- 1.3. Cells Of Immune System
- 1.4. Organs And Tissues Of Immune System



**Unit-2: Innate Immunity****(Duration: 08 Hrs)**

- 2.1 Anatomic/Physical Barriers
- 2.2 Chemical Barriers: (Cytokines, Antimicrobial Peptides, Complement System, Acute Phase Proteins)
- 2.3 Inflammatory Barrier
- 2.4 Phagocytic Barrier (NLR, TLR, PRRs)

**Unit-3: Specific Immunity****(Duration: 08 Hrs)**

- 3.1 Features of Adaptive Immunity
- 3.2 MHC Complex, CDS And Recognition of Foreignness
- 3.3 T-cell Biology (TCRs, T Cell Activation, Types of T Cells)
- 3.4 B-cell Biology (BCRs, B Cell Activation)

**Unit-4: Antigens and Antigen Processing****(Duration: 06 Hrs)**

- 4.1 Immunogenicity V/S Antigenicity
- 4.2 Factors Influencing Immunogenicity
- 4.3 Epitopes and Haptens
- 4.4 Antigen Processing and Presentation (Cytosolic Pathway, Endocytic Pathway)

**Unit-5: Antibodies****(Duration: 09 Hrs)**

- 5.1 Immunoglobulin Structure
- 5.2 Classes of Immunoglobulin
- 5.3 Antibody Mediated Effector Functions
- 5.4 Antibody Diversity
- 5.5 Clonal Selection

**Unit-6: Monoclonal Antibodies and Antigen-antibody Reactions****(Duration: 08 Hrs)**

- 6.1 Monoclonal Antibodies: (Production-Hybridoma Technology, Applications of Monoclonal Antibodies)
- 6.2 Precipitation
- 6.3 Agglutination
- 6.4 ELISA
- 6.5 RIA

6.6 Immunofluorescence

6.7 Immunochromatography

### **Unit-7: Hypersensitivity and Autoimmune Diseases**

**(Duration: 08 Hrs)**

7.1 Hypersensitivities

7.2 Autoimmunity (IDDM, Transplantation Rejection)

7.3 Immunodeficiency Diseases (General Features of Immunodeficiency, Primary Immunodeficiency- SCID, Secondary Immunodeficiency- HIV and AIDS)

### **Unit-8: Vaccines:**

**(Duration: 07 Hrs)**

8.1. Active V/S Passive Immunization

8.2. Designing Vaccines

8.3. Attenuated Vaccines

8.4. Killed Vaccines

8.5. Subunit Vaccines

8.6. Recombinant Vector Vaccines

8.7. DNA Vaccines

### **References Books**

- Janis Kuby, Kindst, Gatsby And Osborne, Kuby Immunology –, 6th Edition, W. H. Freeman Publications. ISBN-13-978-0716767640
- Ashim Chakravarty, Immunology And Immunotechnology- Oxford University Press, ISBN-13: 978-0-19-567688-4
- John P. Harley, Donald A. Klein, Microbiology- Lansing Prescott, 10<sup>th</sup> Edition, Mcgraw Hill Publication. ISBN-13-978-1259281594
- Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press. ISBN-978-0521178747
- A. K Abbas, A. Lichtman, S. Pillai, Cellular and Molecular Immunology-, International Edition, ISBN: 978-1-4160-3122-2 International Edition ISBN: 978-0-8089-2358-9

### **List of Practical**

1. To perform Differential count of blood cells.
2. To detect HIV and Hepatitis through ELISA.
3. To diagnose Salmonella infection through Widal test.
4. To perform and analyse the antigen quantitatively through Mancini's test.

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<b>Name of faculty: Science</b>	<b>Department: Chemistry</b>
<b>Program: B.Sc. Microbiology Sem 5</b>	<b>Type: SEC -3</b>
<b>Subject: Instrumentation and Techniques</b>	
<b>Credit: 04 + 02</b>	<b>Total learning hours: 60</b>
<b>Course description:</b> This course is concerned with the theory and practice of instrumental methods for the separation, identification and quantitative analysis.	
<b>Student learning outcome:</b> Upon completion of this course, students will: <ul style="list-style-type: none"> <li>• Integrate a fundamental understanding of the underlining principles.</li> <li>• Use key instrumental techniques for separation and analysis.</li> <li>• Distinguish between qualitative and quantitative measurements and be able to effectively compare and critically select methods for analyses.</li> </ul>	

### **Unit-1: Introduction to instrumental methods**

**(Duration :4 Hrs)**

- 1.1 Classification of analytical methods
- 1.2 Types of instrumental techniques
- 1.3 Basic functions of instrumentation
- 1.4 Instruments for analysis
- 1.5 Factors affecting the choice of technique

### **Unit-2: Potentiometry**

**(Duration :08 Hrs)**

- 2.1 General principle
- 2.2 Reference electrode: Calomel electrode and silver/silver chloride electrode
- 2.3 Membrane indicator electrode
  - 2.3.1 Types of membrane
  - 2.3.2 Glass electrode for pH measurement
  - 2.3.3 Other ion selective electrodes
- 2.4 Bio-catalytic membrane electrode

### **Unit-3 :Optical methods of analysis**

**(Duration :10 Hrs)**

- 3.1 Origin of spectra, interaction of radiation with matter, Beer-Lambert's law
- 3.2 UV-Visible Spectrometry: Basic principle, instrumentation (single and double beam instrument), application
- 3.3 Infrared Spectrometry: Basic principle, instrumentation (single and

double beam instrument), sampling technique, application

- 3.4 Atomic absorption spectrometry: Basic principles of instrumentation, choice of flame and burner designs, techniques of atomization and sample introduction

**Unit-4 :Thermo-analytical instruments**

**(Duration :06 Hrs)**

- 4.1 Theory of thermogravimetry (TG)
- 4.2 Basic principle of instrumentation
- 4.3 Techniques for quantitative estimation of Ca and Mg from mixture
- 4.4 Applications and limitations

**Unit-5: Chromatography: I**

**(Duration :09 Hrs)**

- 5.1 Classification
- 5.2 Principle and efficiency of the technique
- 5.3 Paper Chromatography: Principles, procedures, developments of chromatogram - ascending, descending and radial, applications
- 5.4 Thin layer Chromatography (TLC): Advantages, principles, adsorbents and solvents preparation of plates development of the chromatogram, spot detection, applications

**Unit-6: Chromatography: II**

**(Duration :10 Hrs)**

- 6.1 Gas chromatography: Principles, stationary and mobile phases, column, detectors (TCD, ECD, FID), application and limitation
- 6.2 HPLC: Basic principle, instrumentation, detectors, application
- 6.3 Ion exchange chromatography
- 6.4 Gel filtration chromatography

**Unit-7: Electrophoresis**

**(Duration :07 Hrs)**

- 7.1 Introduction
- 7.2 Types of electrophoresis
- 7.3 Principle
- 7.4 Application

**Unit-8 :Radiochemical instruments**

**(Duration :06 Hrs)**

- 8.1 Fundamentals of radiochemical methods
- 8.2 Measurement of alpha particles

8.3 Measurement of beta particles

8.4 Measurement of gamma radiation

8.5 Isotope dilution method: Principle and application

### Reference Books:

- Basic Concepts of Analytical Chemistry by S.M. Khopkar
- Elementary organic spectroscopy by Y.R. Sharma
- Instrumental Methods of Analysis by Willard, H.H
- Principles of Instrumental Analysis by Skoog, Holler F.J. Stanley R. Crouch
- Quantitative analytical chemistry by James S. Fritz George H. Schenk
- Instrumental methods of Chemical analysis by Gurdeep R.Chatwal
- Instrumental Methods of Analysis by Willard, Merritt, Dean, Settle

### List of Practicals

1. Determination of pH of soil/aerated drinks/fruit juices/shampoos/soaps
2. Verification of Lambert-Beer's law and determination of concentration of a coloured species ( $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7/\text{Thiocyanatoiron(III)}$ )
3. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography
4. Separation of green leaf pigments/o-and p-nitrophenol/ Sudan yellow and Sudan Red using TLC
5. Analysis of pre-recorded IR spectroscopic data of organic compounds.

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<b>Name of faculty: Sciences</b>	<b>Department: Microbiology</b>
<b>Program: B.Sc. Microbiology Sem 5</b>	<b>Type: DSE-5</b>
<b>Subject: Haematology and Blood Banking</b>	
<b>Credit: 02</b>	<b>Total learning hours: 30</b>
<b>Course description:</b> This is an advanced course in Hematology and Blood Banking for B.Sc students. This course is designed to highlight the important principles and concepts of haematological and blood banking and thereby emphasising on theoretical as well practical knowledge in preparation, handling and testing of various diagnostic criteria related to it.	
<b>Student learning outcome:</b> <ul style="list-style-type: none"> <li>Students will be benefited by understanding the basic concepts of various routes of blood collection, mechanism of blood coagulation and various types of anticoagulant used in vitro</li> <li>Students will be conceptualized about the Haemoglobin, various types of anemia, and clinical diagnosis related to blood coagulation.</li> <li>Students will acquire the understanding about blood banking by learning ABO and Rh typing, various compatibility tests and significance in blood transfusion</li> </ul>	

**Unit-1: Introduction to Haematology**
**(Duration: 04 Hrs)**

- 1.1 Composition of Blood
- 1.2 Collection of Blood in Laboratory
- 1.3 Anticoagulants

**Unit-2: Haematological Analysis**
**(Duration: 05 Hrs)**

- 2.1 Estimation of Haemoglobin (Cyanmethaemoglobin method)
- 2.2 Total Count of WBCs and RBCs
- 2.3 Determination of Erythrocyte Sedimentation Rate (ESR)
- 2.4 Differential count of Leucocytes

**Unit-3: Haematological Disorders and Hemostasis**
**(Duration: 05 Hrs)**

- 3.1 Anaemia
- 3.2 Introduction to Haemostasis and Coagulation
- 3.3 Laboratory Investigations of Bleeding Disorders
  - 3.3.1 Bleeding time Determination: Ivy method

### 3.3.2 Whole Blood Clotting time : Lee White method

#### **Unit-4: Immunohaematology**

**(Duration: 04 Hrs)**

- 4.1 Principles of Immunohaematology
- 4.2 Blood Group Genetics
- 4.3 ABO Blood and Rh Group System

#### **Unit-5: Introduction to Blood Banking**

**(Duration: 02 Hrs)**

- 5.1 Clinical significance of Blood transfusion
- 5.2 Collection and processing of Blood for transfusion
- 5.3 Storage of Blood

#### **Unit-6: Blood components and Compatibility tests**

**(Duration: 04 Hrs)**

- 6.1 Preparation and Use of Blood components
- 6.2 Compatibility testing
- 6.3 Major and Minor Cross matching

#### **Unit-7: Blood transfusion and Other Compatibility tests**

**(Duration: 03 Hrs)**

- 7.1 Antihuman Globulin Test
- 7.2 Hemolytic Disease of Newborn (HDN)

#### **Unit-8: Transfusion Reactions and complications**

**(Duration: 03 Hrs)**

- 8.1 Transfusion therapy
- 8.2 Apheresis/hemapheresis
- 8.3 Automation in Haematology

#### **Reference Books:**

- Barbara A Brown (1988), Haematology: Principles and Procedures, Lea & Febiger. (ISBN: 9780812111255)
- Geoff Daniels et al, (2013), Essential Guide to Blood Groups, Third Edition, John Wiley & Sons, Ltd., (ISBN:9781118688922)
- Mukharjee K. L. (1988), Medical Laboratory Technology, Vol I, Tata McGraw Hill Publishing. (ISBN: 0-07-463260- 4)



- Ochei J. and Kolhatkar A. (2000), Medical Laboratory Science – Theory and Practice, Tata McGraw Hill Publishing. (ISBN: 0-07-463223)
- SR Mehdi, (2013), Essentials of Blood Banking, 2<sup>nd</sup> Edition, Jaypee Brothers Medical publishers (p) ltd: (ISBN: 978-93-80704-52-4)

### **Further Reading:**

- Denise M Hermening (2005), Modern Blood Banking and Transfusion Practices, 6<sup>th</sup> Edi., Library of Congress Cataloging-in-Publication Data. (ISBN: 9780803626829)
- Praful Godkar and Darshan Godkar (2014), *Textbook of Medical Laboratory Technology (Set of 2 Volumes)*, Bhalani Publishing House. (ISBN: 9789381496190)

### **List of Practicals**

1. Estimation of Haemoglobin
2. Total count of RBCs
3. Total count of WBCs
4. Differential count of Leucocytes
5. ABO and Rh typing (Slide Method)

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