

SARVAJANIK UNIVERSITY
FACULTY OF SCIENCE



Faculty of Science

B. Sc. (Honors)

Biotechnology

DETAILED CURRICULUM

(W.E.F. 2025-26)

Semester 6

B.Sc. (Hons) Biotechnology Semester 6			
Sr. No.	Category	Course Title	Course Type
1	Major	Microbial Physiology and Metabolism	Compulsory
2		Animal and Plant Biotechnology	Compulsory
3		rDNA Technology	Compulsory
4	Minor 1	Forest and Agricultural Pathology	Elective
		Instrumentation Techniques of analysis	
		DNA Typing	
		Fermenter Design and Downstream Processing	
		Fire Safety and Audit	
		Diagnostic Microbiology and Serology	
5	SEC	Internship	Compulsory
6	AEC	Human Values and Professional Ethics (Mulya Pravah 2.0)	Elective
		Professional Skills	

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Name of faculty: Science	Department: Microbiology
Program: B.Sc Microbiology Sem-6	Type: Major
Subject: Microbial Physiology and Metabolism	
Credit: 4	Total learning hours: 45
Course description: Microbial Physiology is a concentrated course with the goal of integrating microbial biochemistry and physiology to enhance the understanding of the microbial cell and the diverse nature of various life processes, which provides opportunity to re-address the learning about general scientific conceptions. The paper emphasizes metabolic processes used by bacteria for generation of energy. It mainly covers the study of various chemoorganotrophic, chemolithotrophic and phototrophic metabolic processes found in various microbes	
Student learning outcome: ● Students shall understand the basic principles and concepts of microbial metabolism and shall gain knowledge of the energy generating mechanisms in microbes with various metabolic processes. ● To better understand the basic concepts and principles about microbial metabolism. ● To acquire knowledge, explore and get acquainted with different metabolic processes.	

References

1. Willey Sherwood woolverton . Mc Graw Hill International Edition. Prescotts Microbiology 10th edition (2017) ISBN 978—981-3151-26-0
2. Marjorie Kelly Cowan Heidi Smith Microbiology A systems approach: 5th edition ISBN 978-1-259-92194
3. Berg, Jeremy M, Tymoczko, JohnL., Stever, Lubert Biochemistry 6th edition Published by W.H Freeman. (2006) ISBN 0716787245
4. Rastogi P.D. Sharma Microbiology 4th edition (2020) ISBN9788193887585
5. Robert K Murray,Daryl K Granner, Victor W Rodwekk Harpers Illustrated Biochemistry. 27th Edition Mc Graw Hill (2006). ISBN 007-125301-7(India)

Further Reading:

- U. Satyanarayana, U Chakrapani Biochemistry 5th edition Elsevier (2020) ISBN 978-8131262535
- J.L.Jain , Sunjay Jain, Nitin Jain Fundamentals of Biochemistry S.Chand Publishing (1979). 9788121924535

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

UNIT 1 Microbial Metabolism

(Duration: 7 Hrs)

- 1.1 Important, principles and concepts of metabolism
- 1.2 Metabolic role of ATP
- 1.3 Oxidation and Reduction reactions
- 1.4 Electron Transport chain

UNIT 2 Introduction to Chemolithotrophs and Phototrophs

(Duration: 8 Hrs)

- 2.1 Metabolism of Chemolithotrophs
- 2.2 Metabolism of Phototrophs

Unit 3 Transport of Biomolecules

(Duration: 6 Hrs)

- 3.1 Properties of Biomolecules
- 3.2 Transport of molecules

Unit 4 Enzymes and Reactions of life

(Duration: 8 Hrs)

- 4.1 Characteristics and structure of enzymes
- 4.2 Enzyme nomenclature, Co-factors, enzyme substrate reactions of life
- 4.3 Location of enzyme and regulation of enzyme activity

Unit 5 Metabolism of Chemoorganotrophs Part I

(Duration: 8 Hrs)

- 5.1 Respiration: Aerobic and Anaerobic
- 5.2 Pathways: EMP, ED and PPP
- 5.3 Cycles : TCA and Glyoxylate Bypass
- 5.4 Electron Transport Chain, and Oxidative Phosphorylation
- 5.5 Fermentation

Unit 6 Metabolism of Chemoorganotrophs Part II

(Duration: 8 Hrs)

- 6.1 Catabolism of Carbohydrates other than glucose
- 6.2 catabolism of Protein and Amino acid
- 6.3 catabolism of Lipids
- 6.4 Principles governing Biosynthesis and CO₂ fixation

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

List of Practical

1. Estimation of Reducing Sugar by Cole's method
2. Estimation of Protein by Folin Lowrys method
3. Determination of Thermal Death Time (TDT)
4. Determination of Thermal Death Point (TDP)

Name of faculty: Science	Department: Biotechnology
Program: B.Sc. (Hons) Biotechnology	Type: Theory + Practical
Subject: Animal and Plant Biotechnology	Semester: 6
Credits: 03 + 01	Total learning hours: 45
Course Description: This syllabus aims to provide a comprehensive understanding of plant and animal biotechnology, blending foundational knowledge with cutting-edge advancements to prepare students for research and industrial applications.	
Student Learning Outcome: Students will: 1. Recognize and remember theoretical and practical understanding of essential plant and animal cell culture methods 2. Understand applications of animal biotechnology, stem cells technology and artificial reproductive technology 3. Apply this understanding with the skills necessary for research and industrial applications 4. Analyze the knowledge of advanced techniques such as genetic transformation, genome editing (CRISPR, TALEN, ZFN), and secondary metabolite production 5. Evaluate innovative methods in plant biotechnology and crop improvement 6. Create new research methodology in animal and plant biotechnology	

Unit I: Fundamentals of Plant Tissue Culture

(07 Hours)

- 1.1 Definition, History, and Scope of Plant Tissue Culture (PTC)
- 1.2 Laboratory Organization, Sterilization Techniques: Media, Instruments, and Explant selection
- 1.3 Types of Culture Media: MS and B5 Medium,
- 1.4 Role of Various Component and Phytohormones used in PTC Media
- 1.5 Micro propagation, Somatic Embryogenesis and Organogenesis

Unit-2 Advanced Techniques in Plant Tissue Culture

(07 Hours)

- 2.1 Methods of Protoplast Isolation and Culture
- 2.2 Somatic Hybridization and its Applications in Crop Improvement
- 2.3 Methods of Genetic Transformation
- 2.4 Synthetic Seed Technology, Haploid and Double Haploid Production



Unit-3 Modern and Emerging Concepts in Plant Tissue Culture (09 Hours)

- 3.1 Introduction, Function and use of Secondary Metabolites in Plants
- 3.2 Germplasm Conservation and Cryopreservation
- 3.3 Physical and Chemical Mutagenesis in Plant Cultures
- 3.4 Introduction to Genome Editing Techniques
- 3.5 Success Stories of Commercially Viable Tissue Culture Products

Unit-4 Introduction to Animal Biotechnology (04 Hours)

- 4.1 Definition, Scope & History of Animal Biotechnology
- 4.2 Applications & Importance of Animal Biotechnology
- 4.3 Ethical Concerns & Guidelines in Animal Biotechnology

Unit-5 Animal cell culture Techniques (12 Hours)

- 5.1 Basics of Animal Cell Culture
- 5.2 Types of Animal Cell Cultures
- 5.3 Cell Culture Media, Growth Factors, and Supplements
- 5.4 Laboratory Requirements for Cell Culture
- 5.5 Aseptic Techniques and Maintenance of Cell Cultures

Unit-6 Applications of Animal Biotechnology (06 Hours)

- 6.1 Genetic Engineering in Animals (r-DNA Technology: Gene Transfer Methods, Gene Cloning, Vectors)
- 6.2 Animal Bioreactors (Therapeutic & Pharmaceutical Protein Production etc)
- 6.3 Reproductive Biotechnology
- 6.4 Animal Models for Research (Knockout Mice, Gnotobiotics etc)

References & Text Books:

1. S. S. Bhojwani & M.K. Razdan, Plant Tissue Culture, Theory and Practice, a Revised Edition., Elsevier, ISBN: 9780080539096
2. H. S. Chawla, Introduction to Plant Biotechnology, 3rd Ed., Oxford & IBH Publishing Co Pvt.Ltd, ISBN: 9788120417328
3. B.D. Singh, Biotechnology, Kalyani Publishers, ISSN: 9789327220650
4. C Veeresham & CK Kokate, Medicinal plant biotechnology. CBS Publishers and Distributors; 2006. ISBN: 9788123910970
5. MK Razdan. Introduction To Plant Tissue Culture, 2/E. Oxford and IBH publishing; 2002. ISBN: 9788120417939
6. Ian Freshney, Culture of Animal Cells: A Manual of Basic techniques, 7th Edition, Wiley Blackwell, ISBN: 9781118873656
7. M.M. Ranga, Animal Biotechnology, 3rd Edition, Aros Bios, ISBN 10: 9788177543094
8. B. Singh, Textbook of Animal Biotechnology, The Energy and Resources Institute, TERI ISBN 13: 978-8179933275



Practicals:

1. Preparation of culture media and explant sterilization.
2. Inoculation of sterilized explant and Initiation of callus cultures.
3. To isolate mononuclear cells through density gradient centrifugation and perform cell viability count.
4. Maintenance of animal cell culture

Reference and Textbooks for Practical:

1. Laboratory Manual for Biotechnology. By Ashish S Verma, Surjit Das, Anchal Singh, S Chand Publishers



Name of Faculty: Science	Department: Biotechnology
Program: B.Sc. (Hons)	Type: Major
Subject: rDNA Technology	Semester: 6
Credits: 03 + 01 = 04	
Course description: This paper introduces fundamental Recombinant DNA Technology, its tools and techniques and explains its core applications.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: 1. Understand the Principles of rDNA Technology. 2. Explain the fundamental concepts, tools, and techniques used in recombinant DNA technology. 3. Describe the role of restriction enzymes, ligases, vectors, and host systems in gene cloning. 4. Analyse Genetic Engineering Applications 5. Evaluate the applications of rDNA technology in medicine and agriculture.	

UNIT 1: Enzymes used in rDNA Technology

(07 hrs)

- 1.1 What is Gene Cloning and PCR?
- 1.2 Importance of Gene Cloning and PCR
- 1.3 Range of DNA Manipulating Enzymes
- 1.4 Restriction Endonucleases
- 1.5 Ligation Enzymes

Unit 2: Vectors for Bacteria

(08 hrs)

- 2.1 Vectors: Characteristics and Types
- 2.2 Cloning Vectors Based on Plasmids
- 2.3 Cloning Vectors Based on Bacteriophage Lambda
- 2.4 Vectors Based on M13
- 2.5 Bacterial Artificial Chromosomes

Unit 3: Vectors for Eukaryotes

(07 hrs)

- 3.1 Vectors for Yeasts and Other Fungi
- 3.2 Vectors for Higher Plants
- 3.3 Vectors for Animals
- 3.4 Human Artificial Chromosomes

Unit 4: Core Methods of rDNA Technology**(08 hrs)**

- 4.1 Transformation
- 4.2 Selection for Transformed Cells
- 4.3 Identification of Recombinants
- 4.4 Introduction of DNA in Non-bacterial Cells
- 4.5 Colony and Plaque Hybridization

Unit 5: rDNA Technology in Medicine and Agriculture**(07 hrs)**

- 5.1 Recombinant Insulin
- 5.2 Recombinant Vaccines
- 5.3 Gene Therapy for Inherited Diseases
- 5.4 Insect Resistant Maize
- 5.5 Nutritionally Improved Transgenic Plants

Unit 6: rDNA Technology in Research**(08 hrs)**

- 6.1 Introduction and Principle of PCR
- 6.2 Applications of PCR
- 6.3 Chain-termination DNA Sequencing
- 6.4 Next-Generation Sequencing
- 6.5 Human Genome Project

Reference:

1. Brown, T. A., Gene Cloning and DNA Analysis: An Introduction An Indian Adaptation, ISBN: 978-9354643644

Practicals:

1. Extraction of Bacterial Chromosomal DNA by Spin Column Method
2. Restriction Digestion of Phage Lambda DNA
3. Transformation by Cold CaCl_2 Method
4. Blue-White Screening of Recombinants

Name of Faculty: Science	Department: Environmental Science
Program: B.Sc. (Hons)	Type: Minor
Subject: Forest and Agricultural Pathology	Semester: 6
Credits: 03 + 01 = 04	
Course Description: This course aims to develop understanding of the fundamental concepts of plant pathology in forest and agricultural systems. It also explores the causes, symptoms, and impact of plant diseases and their management.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: 1. Identify major plant diseases affecting forest and agricultural crops. 2. Understand the role of fungi, bacteria, viruses, and environmental factors in plant pathology. 3. Assess different plant disease management strategies, including biological and chemical control. 4. Develop skills in diagnosing plant diseases and recommending sustainable solutions. 5. Apply knowledge of plant-microbe interactions in forestry and agricultural productivity.	

Unit 1: Introduction to Plant Pathology

(07 Hours)

- 1.1 Definition, scope, and history of plant pathology.
- 1.2 Major diseases affecting forest and agricultural crops.
- 1.3 Economic and ecological significance of plant diseases.

Unit 2: Pathogens and Disease Development

(07 Hours)

- 2.1 Types of plant pathogens: fungi, bacteria, viruses, nematodes.
- 2.2 Disease cycle, epidemiology, and environmental factors.
- 2.3 Host-pathogen interactions and disease resistance mechanisms.

Unit 3: Forest Pathology

(08 Hours)

- 3.1 Major tree diseases: root rots, cankers, leaf spots, wilts.
- 3.2 Role of fungi and bacteria in forest ecosystems.
- 3.3 Disease management in natural and planted forests.

Unit 4: Agricultural Crop Diseases

(08 Hours)

- 4.1 Major diseases of cereals, pulses, fruits, and vegetables.
- 4.2 Disease diagnosis and symptoms.
- 4.3 Integrated pest and disease management (IPDM) strategies.

Unit 5: Disease Control and Management

(07 Hours)

- 5.1 Biological, chemical, and cultural control methods.
- 5.2 Use of resistant crop varieties and biotechnology.
- 5.3 Quarantine measures and legal regulations.

Unit 6: Recent Advances in Plant Pathology**(08 Hours)**

- 6.1 Role of molecular biology in plant disease management.
- 6.2 Climate change and emerging plant diseases.
- 6.3 Biotechnological approaches: genetic engineering and disease forecasting.

Practicals:

- 1. Isolation and identification of fungal and bacterial pathogen on PDA and NA plates. (Sugarcane and Citrus canker)
- 2. Microscopic identification of plant pathogenic fungi.
- 3. Evaluation of fungicide efficacy by measuring fungal growth inhibition.
- 4. Preparation of disease herbarium and photographic documentation.

References:

- 1. Agrios, G. N. (2005). *Plant Pathology*. Academic Press.
- 2. Mehrotra, R. S., & Aggarwal, A. (2017). *Plant Pathology*. Tata McGraw-Hill.
- 3. Singh, R. S. (2002). *Introduction to Principles of Plant Pathology*. Oxford & IBH Publishing.
- 4. Manion, P. D. (1991). *Tree Disease Concepts*. Prentice Hall.
- 5. Sharma, P. D. (2011). *Plant Pathology*. Rastogi Publications.

Department: Chemistry	
Program: B.Sc.	Type: Theory + Practical (NEP-2020-NEW)
Subject: Minor: Instrumentation techniques of analysis	Semester: 6
Credit: (3T + 1P)	Total learning hours: (45 T + 30 P) Hrs
Course description: This Course Paper proposes to teach about: Various instrumental techniques i.e. electro-analysis, spectroscopy and chromatography analysis required in different area of instrumental analysis.	
Student learning outcome: After completing this course, the students will be able to learn: The history, origin, laws, principles, theories, instrumental set up, its' working mechanism, various components and it's working pattern, procedure of analysis and applications in the various field of analysis about: pH meter, Potentiometer, Ion Selective Electrodes, Conductivity meter, Colorimeter, Flame photometer, Ion exchange and Ion exclusion chromatography, Chemical sensors and Biosensors	

Unit-1 pH metric measurements (06 Hrs)

- 1.2 Concept of pH and pH range
- 1.2 pH indicator and colour key
- 1.3 Principle of pH measurement and glass electrode
- 1.4 Applications of pH meter

Unit-2 Electrometric analysis (06 Hrs)

- 2.1 Principle, instrumental set up and applications
 - 2.1.1 Potentiometer
 - 2.1.2 Ion selective electrodes
 - 2.1.3 Conductivity meter

Unit-3 Absorption spectroscopy (09 Hrs)

- 3.1 Introduction: EMR regions, energy changes, concept of color wheel
- 3.2 Principle of colorimeter
- 3.3 Instrumental set up of colorimeter: source, intensity control, sample holder, monochromator, detector and read out device
- 3.4 Advantages, disadvantages and applications of colorimeter

Unit-4 Emission spectroscopy (09 Hrs)

- 4.1 Principle of flame photometer and process in a flame
- 4.2 Instrumental set up of flame photometer: sample introduction, nebulizer, spray chamber, flame excitation unit-burner system, spectral isolator, monochromator, filter, detector and read out system
- 4.3 Procedure of flame photometer
- 4.4 Applications of flame photometer
- 4.5 Limitations of flame photometer

Unit-5 Ion exchange chromatography (09 Hrs)

- 5.1 Ion exchangers – types, characteristics and properties
- 5.2 Ion exchange equilibrium and factors affecting it
- 5.3 Instrumental set up of IEC- columns and detector
- 5.4 Principle, procedure and applications of IEC

Unit-6 Sensors**(06 Hrs)**

- 6.1 Definition and classification of sensors, signal and noise
- 6.2 Efficiency of sensors, sensitivity and limit of detection
- 6.3 Solid state electrode and mass sensitive sensors
- 6.4 Optical sensors and thermal sensors
- 6.5 Biosensors and biocatalytic biosensors

Laboratory practical (Any four)**(30 Hrs)**

- 1. To determine divalent metal ion (Fe^{+2}) of water sample.
- 2. To determine trivalent metal ion (Al^{+3}) of water sample.
- 3. To determine hexavalent metal ion (Cr^{+6}) of water sample.
- 4. To determine monovalent anion (NO_2^{-1}) of water sample.
- 5. To determine divalent anion (SO_4^{-2}) of water sample.
- 6. To determine trivalent anion (PO_4^{-3}) of water sample.

Reference Books:

- 1. Principles of Instrumental Analysis, D.A. Skoog, F.J. Holler, and S.R. Crouche, 11th Edition, 2012, Cengage Learning
- 2. Instrumental Methods of Analysis, H.H. Willard, L.L. Meritt and J.A. Dean, 7th Edition 1st Edition, 1986, CBS Publishers
- 3. Analytical Instrumentation, G. Currell, 1st Edition, 2002, (1st Reprint, 2010), Wiley India
- 4. Handbook of Analytical Instruments, R.S. Khandpur, 2nd Edition, 2006, (3rd Reprint, 2008) Tata Mc Graw Hill Publications
- 5. Instrumental Methods of Analysis, B.K. Sharma, 24th Edition, 2005, Krishna Prakashan.
- 6. Instrumental Methods of Chemical Analysis, H. Kaur, 8th Edition, 2012, Pragati Prakashan
- 7. Environmental Chemistry, H. Kaur, 9th Edition, 2015, Pragati Prakashan

Name of Faculty: Science	Department: Environmental Science
Program: B.Sc. (Hons)	Type: Minor
Subject: DNA Typing	Semester: 6
Credits: 03 + 01 = 04	
Course Description: This course provides an introductory understanding of DNA markers and their use in polymorphism detection in forensic sciences. It also discusses techniques and instruments involved in this.	
Student Learning Outcomes (SLOs): At the end of this course, students will be able to: 1. To have knowledge of the molecular basis of DNA differences. 2. To understand use of DNA sequence diversity in DNA typing. 3. To relate various DNA typing techniques. 4. To analyze outcomes of methods like RFLP, STR analysis and mtDNA typing. 5. Evaluate procedures involved in DNA extraction, quantification, amplification (PCR), and electrophoresis. 6. To create reports of case studies related to DNA typing.	

Unit 1: Introduction to DNA as Evidence

(07 Hours)

- 1.1 Polymorphism and DNA Polymorphism
- 1.2 Human DNA Polymorphic Markers
- 1.3 History of DNA Polymorphism Profiling in Forensics
- 1.4 Tissues as Sources of DNA

Unit 2: Techniques of DNA Profiling-1

(07 Hours)

- 2.1 Methods of DNA extraction
- 2.2 Slot Blot Assay for DNA Quantification
- 2.3 Fluorescent Intercalating Dye Assay
- 2.4 Basic Principles of Polymerase Chain Reaction

Unit 3: Techniques of DNA Profiling-2

(08 Hours)

- 3.1 Basic Principles of Electrophoresis
- 3.2 Supporting Matrices for Electrophoresis
- 3.3 Apparatus for Electrophoresis and Forensic Applications
- 3.4 Fluorescent Intercalating Dye Staining
- 3.5 Detection Methods for PCR-Based Assays

Unit 4: Variable Number Tandem Repeat (VNTR) Profiling

(07 Hours)

- 4.1 Restriction Fragment Length Polymorphism
 - 4.1.1 Restriction Endonuclease Digestion
 - 4.1.2 Southern Transfer

- 4.1.3 Hybridization with Probes
- 4.1.4 Detection
- 4.2 Amplified Fragment Length Polymorphism

Unit 5 : Autosomal STR and mtDNA Profiling

(08 Hours)

- 5.1 Characteristics of STR Loci
- 5.2 STR Loci Commonly Used for Forensic DNA Profiling
- 5.3 Forensic STR Analysis
- 5.4 *Amelogenin* Locus
- 5.5 mtDNA Polymorphic Regions
- 5.6 mtDNA Screen Assay

Unit 6: Forensic DNA Databases and QC

(08 Hours)

- 6.1 History of Forensic DNA Databases
- 6.2 Infrastructure of CODIS
- 6.3 Indexes of CODIS
- 6.4 Routine Database Searches for Forensic Investigations
- 6.5 Familial Search Strategies
- 6.6 Laboratory Accreditation and Validation

Practicals:

1. Demonstration and theoretical case study of mitochondrial DNA analysis.
2. Characterization of DNA by electrophoresis
3. Case studies of results and interpretation of DNA Profiles.
4. Visit to Forensic Science Laboratory.

References:

1. Forensic Biology by Richard Li, CRC Press. ISBN: 978-1032098791.

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Name of Faculty: Sciences	Department: Microbiology
Program: B.Sc. (Hons) Sem 6	Type: Minor
Subject: Fermenter Design and Downstream Processing	
Credit: 4	Duration: 45 hours
Course description: This course provides an in-depth understanding of fermenter design principles, types of fermenters, and downstream processing techniques. It covers reactor engineering, optimization of fermentation parameters, product recovery, and industrial effluent treatment.	
Learning Outcomes: By the end of the course, students will be able to: ● Explain the principles of fermenter design and design parameters. ● Analyze microbial kinetics and optimize fermentation conditions. ● Apply downstream processing techniques for product purification. ● Understand industrial effluent treatment and waste valorization. ● Evaluate real-world applications of fermentation in various industries.	

Unit 1: Introduction to Fermenter Design

(6 Hours)

- 1.1 Fundamentals of Fermentation Technology
- 1.2 Ideal Design and Construction of a Fermenter
- 1.3 Design Criteria for Fermenters: Aeration, Agitation, pH & Temperature Control
- 1.4 Materials of Construction & Sterilization Considerations

Unit 2: Types of Fermenters

(9 Hours)

- 2.1 CSTF, Column and Fluidized Bed Fermenter
- 2.2 The Waldhof-type Fermenter
- 2.3 The Tower Fermenter
- 2.4 Air-lift Fermenters
- 2.5 The deep-jet Fermenter
- 2.6 The Packed Tower

Unit 3: Introduction to Downstream Processing

(7 Hours)

- 3.1 Introduction to Recovery of Fermentation Products
- 3.2 Solid-Liquid Separation Methods: Filtration, Centrifugation, Sedimentation
- 3.3 Cell Disruption Techniques: Mechanical, Chemical, Enzymatic, and Physical Methods

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Unit 4: Downstream Processing Techniques -I

(8 Hours)

- 4.1 Precipitation Techniques: Ammonium sulphate & Solvent precipitation
- 4.2 Extraction Techniques: Liquid-Liquid, Aqueous Two-Phase, Supercritical Fluid Extraction
- 4.3 Membrane-Based Separations: Ultrafiltration, Microfiltration, and Reverse Osmosis

Unit 5: Downstream Processing Techniques -II

(9 Hours)

- 5.1 Chromatographic Techniques: Adsorption, Ion Exchange, Gel Permeation, Affinity, Hydrophobic, Metal chelate, and HPLC
- 5.2 Distillation
- 5.3 Crystallization and Drying of Bioproducts

Unit 6: Treatment of Industrial Effluent

(6 Hours)

- 6.1 Site Surveys
- 6.2 Strengths of Fermentation Effluents
- 6.3 Disposal of Effluents
- 6.4 Waste Management: Breweries, Amino acid and Fuel alcohol wastes

Reference:

1. Stanbury, P.F., (2006). Principles of Fermentation Technology, 2nd Ed., Elsevier Science Ltd. ISBN: 9780750645010.
2. Waites, M.J., et al., (2001). Industrial Microbiology: An Introduction, 1st Ed., Blackwell Publishing. ISBN: 9780632053070.

Further reading:

1. Crueger, W., Crueger, A., (2017). Crueger's Biotechnology: A textbook of Industrial Microbiology, 3rd Ed., Medtech publisher.
2. Patel, A. H., (2016). Industrial Microbiology, 2nd Ed., Trinity press; An Imprint of Laxmi Publications PVT. Ltd. ISBN: 9789385750267.
3. Richard K.M. & Durbin S.R., (2020). Fermentation and Biochemical Engineering, Vol 1, CBS Publishers & Distributors Pvt Ltd. ISBN: 9789389185911.
4. Shivkumar P. K., Joe M. M., Sukesh K., (2010). An Introduction to Industrial Microbiology, S Chand Publishers. ISBN: 9788121935197.

List of Practical

1. Microbial cell breakage by sonication.
2. Partial purification of enzyme by ammonium sulphate precipitation and dialysis.
3. Separation of carbohydrate & amino acids by TLC.

Name of Faculty: Science	Department: Environmental Science
Program: B.Sc. (Hons)	Type: Minor
Subject: Fire Safety and Audit	Semester: 6
Credits: 03 + 01 = 04	
Course Description: This course provide an in-depth understanding of industrial safety standards and regulations. 1. To understand fire chemistry, fire hazards, and fire prevention strategies. 2. To study fire safety regulations, codes, and standards. 3. To explore fire detection, suppression, and emergency response systems. 4. To develop skills in conducting fire safety audits and risk assessments. 5. To analyze case studies and best practices in fire safety management.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: 1. Identify fire hazards and apply appropriate fire prevention measures. 2. Implement fire safety standards and compliance regulations. 3. Operate and maintain fire detection and suppression systems. 4. Conduct fire safety audits and risk assessments effectively. 5. Develop fire emergency response and evacuation plans.	

Unit 1: Fundamentals of Fire and Fire Chemistry (7 Hours)

- 1.1 Fire triangle and tetrahedron concepts.
- 1.2 Types of fires and their classifications.
- 1.3 Combustion process and fire behavior.
- 1.4 Common fire hazards in industrial, commercial, and residential settings.

Unit 2: Fire Prevention and Protection Measures (7 Hours)

- 2.1 Fire prevention principles and risk reduction strategies.
- 2.2 Fire-resistant materials and construction techniques.
- 2.3 Fire load calculation and fire zoning.
- 2.4 Electrical and chemical fire hazards and their mitigation.

Unit 3: Fire Detection and Suppression Systems (8 Hours)

1. Fire detection devices (smoke detectors, heat detectors, flame detectors).
2. Fire suppression systems (sprinklers, gas-based suppression, foam systems).
3. Fire extinguishers: types, selection, and usage.
4. Maintenance and testing of fire protection systems.

Unit 4: Fire Safety Regulations and Compliance (8 Hours)

1. National and international fire safety standards (NFPA, NBC, OSHA).
2. Fire safety laws and building codes.
3. Role of government agencies and fire departments.
4. Fire insurance and legal liabilities.

Unit 5: Fire Safety Audit and Risk Assessment (7 Hours)

1. Principles of fire safety audits and their importance.
2. Fire risk assessment techniques and hazard analysis.
3. Fire drill planning and emergency preparedness.
4. Documentation and reporting in fire safety audits.

Unit 6: Emergency Planning and Fire Response Management (8 Hours)

1. Evacuation procedures and fire escape planning.
2. Roles and responsibilities during a fire emergency.
3. Disaster management and post-fire recovery measures.
4. Case studies on major fire incidents and lessons learned.

Practical Components: (4 Practicals)

1. **Fire Extinguisher Handling and Demonstration:**
 - Hands-on training on different types of fire extinguishers.
 - Practical application of fire suppression techniques.
2. **Fire Safety Audit and Risk Assessment:**
 - Conducting a fire safety audit in an institutional or industrial setting.
 - Identifying fire hazards and recommending corrective actions.
3. **Fire Detection and Alarm System Demonstration:**
 - Understanding the working of smoke, heat, and flame detectors.
 - Testing and maintenance of fire alarm systems.
4. **Emergency Evacuation and Fire Drill Simulation:**
 - Planning and executing a fire evacuation drill.
 - Role-playing different emergency response scenarios.

Suggested References:

1. Kumar, S. (2020). *Fire Safety and Prevention Engineering*. XYZ Publishers.
2. Gupta, R. (2018). *Fire Safety Management Handbook*. McGraw-Hill.
3. NFPA (2019). *National Fire Protection Association Codes and Standards*.
4. NBC (2020). *National Building Code of India – Fire Safety Provisions*.
5. Fire Safety Institute (2021). *Principles of Fire Risk Assessment in Buildings*.

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Name of faculty: Science	Department: Microbiology
Program: B. Sc Sem-6	Type: Minor
Subject: Diagnostic Microbiology and Serology	
Credit: 4	Total learning hours: 45
Course description: The main aim of the subject is to inform the knowledge about human microbe interactions, collection and Processing of Clinical Specimens and laboratory diagnosis of various microbial diseases. Serology course has been added to convey basic information about immune system development. Also included antigen & antibody in detail. Topics included like Ag-Ab reactions will help the students to know latest diagnostic methods.	
Student learning outcome: At the end of the course, the students will get knowledge of ● Epidemiological studies ● Hospital Acquired Infection ● Disease-causing bacteria and microbiological examination of different clinical samples to find the cause. ● Antimicrobial Sensitivity Test to find drug of choice ● Basic aspects of immunity, antigens, antibodies ● Immune system and the cells involved, which are routinely estimated in different diseases ● Performance of various antigen-antibody reactions	

Reference Book:

- P.B. Godkar, (2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)
- Cheesbrough Monica ,District laboratory practice in tropical countries VOL-1 & 2, Cambridge University Press.(ISBN: 9780521665476)
- Prescott's Microbiology, Willey, Sandman & Wood., 12th edition, McGraw Hill. (ISBN: 9781265123031)
- Chakraborty P. Text book of Microbiology, 3rd ed., New central book agency (ISBN: 9788173818769)
- Dulsy Fatima (2014), Immunology, Saras publication (ISBN:9789382459880)

Unit-1: Human-microbe interactions

(Duration: 08 Hrs)

1.1 Normal flora of human body

1.2 Epidemiology and epidemiological methods

1.3 Nosocomial infections: Source, mode of transmission and prevention

1.4 Emerging and Re-emerging infectious disease and pathogens

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Unit-2: Causative Agents, Pathogenesis and Laboratory diagnosis of Bacterial Disease

(Duration: 08 Hrs)

2.1 Urinary Tract Infection

2.2 Respiratory Tract Infection: Diphtheria; Pertussis; Pneumonia

2.3 Gastrointestinal Diseases: Typhoid; Diarrhoea and Food Poisoning

2.4 Sexually Transmitted Disease: Syphilis; Gonorrhea

Unit-3: Collection and Processing of Clinical Specimens

(Duration: 08 Hrs)

3.1 Collection, Transportation and Examination of Clinical specimen: Urine, Sputum, Pus, Faeces, Blood, CSF

3.2 Collection, Transportation and Examination of Clinical specimen for Viral Diseases

3.3 Collection, Transportation and Examination of Clinical specimen for Fungal Diseases

3.4 Antimicrobial Sensitivity Test: Disc Diffusion and MIC

Unit-4: Immunity and immune system

(Duration: 07 Hrs)

4.1 Introduction, Definition, Classification of Immunity

4.2 Innate immunity: Types and Mechanisms

4.3 Acquired immunity: Types and Mechanisms

4.4 Cells of immune system

Unit-5: Antigen & Antibody

(Duration: 07 Hrs)

5.1 Types of Antigen- Haptens and Epitopes

5.2 Factors determining antigenicity

5.3 Antibodies: Characteristics, Functions, Structure & Types of immunoglobulin

5.4 Monoclonal Antibodies and their production

Unit-6: Antigen-Antibody reaction

(Duration: 07 Hrs)

6.1 Mechanism and Factors affecting antigen –antibody reactions.

6.2 Precipitation and Agglutination Reaction

6.3 Immunochromatographic Technique

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6.4 ELISA and RIA

List of Practical

1. Slide test for typhoid
2. Slide test for syphilis
3. ICT/Dot immunoassay/ Flow through assay for HIV Antibody.
4. Antimicrobial sensitivity test: Kirby-Bauer method.
5. Determination of MIC by tube dilution method.

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Human Values and Professional Ethics (*Mulya Pravah 2.0*)

Name of Faculty: Sciences	Department: All
Program: B.Sc. (Hons)	Type: VAC / AEC
Subject: Human Values and Professional Ethics (<i>Mulya Pravah 2.0</i>)	
Credit: 02	Total teaching hours: 30
Course description: This course on “Mulya Pravah” creates a new paradigm towards an equitable world for all. It draws upon the innate space of universal values within individuals and communities to plan and implement strategic change and generate measurable results. It develops the capacity of individuals, groups, and communities to look within themselves to source their inner potential and universal values to ensure that their actions enable justice and equity for all. It strengthens them to envision new patterns and leverages systemic and cultural change and economic and social transformation, through equitable actions.	
Learning Outcomes: By the end of the course, students will be able to: ● Understand India’s rich cultural legacy and human values of which we are the custodians. ● Focus on professional ethics, which help citizens to discern desirable and undesirable actions ● Understand constitutional values, universal values, and holistic education to create integrated citizens.	

Reference:

- Blanchard, Kenneth and Peale, Norman Vincent. 1988. The Power of Ethical Management. New York: William Morrow and Company, Inc.
- Gandhi, Mohandas Karamchand. 1971. Pathway to God compiled by MS Deshpande. Ahmedabad: Navajivan Mudranalaya, Navjivan Trust.
- Kashyap, Subhash C. 2019 .Constitution of India. A handbook for students. New Delhi: National Book Trust.
- Lama, D. 1999. Ethics for the New Millennium. New York: Riverhead Books
- Lama, D. 2012. Beyond Religion: Ethics for a Whole World. India: Harper Collins.
- Mahadevan, B., Bhat, V.R. and Nagendra, P.R.N. 2022. Introduction to Indian Knowledge System. Delhi: PHI.
- Niti Shatak, Chaukhamba Prakashan, Varanasi
- Rodriguez, S. and Juvva, S. 2018. Embodying Universal Values and Ethical Leadership in Higher Education: Creating Change Agents for Social Transformation. In B. Chatterjee, A. Banerji and P. Arya (Eds.). Resolution to Resolve: Sustainability Practices in Industry and Education. New Delhi: Bloomsbury [ISBN: 978-938-74-7168-9].

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Unit-1: Introduction to Indian Ethos

(07 Hours)

- 1.1 Meaning of ethos and cultural essence of India
- 1.2 Scriptures as the base of the Indian Knowledge System (IKS)
- 1.3 Integrating the two methodologies: interiorization process for self-exploration, and exterior scientific pursuit for the prosperity of world
- 1.4 The Law of Karma and Nishkama Karma (The Law of action and selfless action)

Unit-2: Human Values and Ethics

(08 Hours)

- 2.1 Knowing the Self and the universal values that we stand for. This is self enquiry & self discovery.
- 2.2 Background conversations and deep listening, recognizing the assumptions that we make the biases we have, and the implications for ethical action.
- 2.3 Self-identity: distinguishing and embracing oneself (and others) four profiles (inner potential, social, professional, personality)
- 2.4 Distinguish ideology, perspectives beliefs from embodying values.

Unit-3: Constitutional Values and Global Citizenship

(07 Hours)

- 3.1 Values embedded in the Preamble of the Indian Constitution Integration of Human Rights and duties
- 3.2 Directive principles and responsibilities as citizens of India
- 3.3 Sensibility and responsibilities towards global environment, Loksangraha and Vasudhaiva Kutumbakam.

Unit-4: Integrated Personality and Well-being

(08 Hours)

- 4.1 The three gunas (qualities of sattva—purity and harmony, rajas —activity and passion, tamas —darkness and chaos), the four antah-karanas (inner instruments), and panch kosha (five sheaths).
- 4.2 Stress management: meditated personality and agitated personality.
- 4.3 Oneness, non-duality, and equanimity
- 4.4 Physical, mental, social, and spiritual well-being

Name of Faculty: Science	Department: Allied (English)
Program: UG	Type: AEC- 6
Subject: Professional Skills	

Credit: 02	Total Learning Hours: 30 Hours
The Objectives are to help learners ● Acquire career skills and fully pursue to partake in a successful career path ● Prepare a good résumé ● Prepare for interviews and group discussions ● Understand the significance of Team Skills ● Acquire Team Skills ● Design, develop, and adapt to situations as an individual and as a team member	
Student Learning Outcome: After completion of the course the student will be able to ● Prepare their résumé on an appropriate template without grammatical and other errors and using proper syntax. ● Actively participate in group discussions towards gainful employment. ● Perform appropriately and effectively in group discussions. ● Explore and Identify career opportunities. ● Demonstrate a set of non-cognitive skills such as empathy, creativity, teamwork, and collaboration, for the smooth and efficient functioning at a workplace. ● Actively use and operate online team communication tools, such as: Webinar, Skype, Zoom, Google, and Hangout. ● Demonstrate a set of cognitive skills and non-cognitive skills such as critical thinking, problem-solving, ability to learn for maintaining good interpersonal relations, smooth and efficient functioning at a workplace, empathy, creativity and teamwork skills.	

Unit -1

1.1 Résumé Skills: Preparation and Presentation (03 hours)

- Introduction of Résumé and Related Terms
- Importance of Preparing a Good Résumé
- Difference between a CV, Résumé, and Biodata
- Essential Components of a Good Résumé

1.2 Résumé Skills: Common Errors

- Common Errors
- Guidelines for Résumé Preparation

Unit -2

2.1 Interview Skills: Preparation and Presentation (06 hours)

- Meaning of Interview
- Types of Interviews

- STAR Approach for Facing an Interview
- 2.2. Interview Procedure
 - Dos and Don'ts
 - Important Questions Generally Asked in a Job Interview
- 2.3 Interview Skills: Common Errors
 - Common Errors
 - Interview Questions for Assessing Your Strengths and Weaknesses
- 2.4 Simulation
 - Job Simulation Formats
 - Comment Critically on Simulated Interviews
- 2.5 Demonstrate an Ideal Interview

Unit – 3

3.1 Meaning and Importance of a Group Discussion (GD) (06 hours)

- Meaning of a Group Discussion
- Importance of a Group Discussion
- Types of Group Discussions.

3.2 Procedure of a Group Discussion

- Methodology
- Ground Rules
- Evaluation of a Group Discussion

3.3 Group Discussion: Common Errors

3.4 Group Discussion: Simulation

Unit – 4

4.1 Process of Career Exploration (03 hours)

- Knowing Yourself — Personal Characteristics
- Knowledge about the World of Work, Requirements of Jobs Including Self-employment.
- Sources of Career Information
- Preparing for a Career Based on Potentials of Learners and Availability of Opportunities

Unit –5

5.1 Cognitive Skills: Meaning, types of cognitive skills, strategies to develop cognitive skills. (06 hours)

- Critical Thinking Skills.
- Problem-solving Skills
- Ability to Learn.

5.2 Non-cognitive Skills

- Empathy
- Creativity
- Teamwork
- Collaboration
- Resilience

- Interpersonal skills
- Perseverance
- Social Control
- Social Skill

Unit – 6

6.1 Presentation: Meaning and Types (6hours)

- Meaning of Presentation
- Types of Presentations
- Presentation for Internal and External Communication
- Presentation Strategies
- Ways to Improve Presentation Skills Over Time

Recommended Reading:

1. Plomin, R. (1999). Genetics and general cognitive ability, *Nature*, 402, C25-C29.
2. Plomin, R. & Von Stumm, S. (2018). The new genetics of intelligence, *Nature Reviews Genetics*, 19 (3): 148-159.
3. Mumford, M. D., Todd, E. M., Higgs, C. & McIntosh, T. (2017). Cognitive skills and leadership performance: The nine critical skills, *The Leadership Quarterly*, 28(1): 24-39.
4. Welsh, J. A., Nix, R. L., Blair, C., Bierman, K. L. and Nelson, K. E. (2010). The Development of cognitive skills and gains in academic school readiness for children from low-income families, *J Educ Psychol.* 102(1): 43–53.
5. Nickerson, R.S. (1999). “Enhancing Creativity” ed. Sternberg, R.J. *Handbook of Creativity*, Cambridge University Press.
6. Snee, R. D. (2001). “Dealing with the Achilles Heel of Six Sigma—Project Selection Is the Key to Success,” *Quality Progress* 66–72.
7. Scholtes, P. R., Joiner, B. L. and Streibel, B. J. (2003). *The Team Handbook*, 3rd ed. (Madison, WI: Joiner Associates.
8. Ibid.
9. GOAL/QPC & Joiner Associates, *The Team Memory Jogger* (Madison, WI: 1996).
10. Doyle, M. and Straus, D. (1982). *How to Make Meetings Work*; New York: Jove Books.
11. Snee, R. D., Kelleher, K. H. and Reynard, S. (May 1998). “Improving Team Effectiveness,” *Quality Progress*, 43–48.
12. Hoerl, R. and Snee, R. (2012). *Statistical Thinking: Improving Business Performance, Second Edition* Copyright ©
13. Berber, N., Slavić, A. and Aleksić M. (2020). Relationship between perceived teamwork effectiveness and team performance in banking sector of Serbia, *Sustainability*, 12(20), 8753 (<https://doi.org/10.3390/su12208753>)
14. Gutman, L. M., & Schoon, I. (2013). The Impact of Non-Cognitive Skills on Outcomes for Young People (pp. 1-5). London: Education Endowment Foundation. Leading Education and Social Research.

15. Megargee, E. I. (1966). Undercontrolled and overcontrolled personality types in extreme antisocial aggression. *Psychological Monographs: General and Applied*, 80(3), 1–29. <https://doi.org/10.1037/h0093894>
16. Kjøbli, John and Ogden, Terie (2014). A randomized effectiveness trial of individual child social skills training: Six-month follow-up, *Child and Adolescent Psychiatry and Mental Health* 8 (31)
17. Driskell, J. E., Salas, E. & Driskell, T. (2018). Foundations of teamwork and collaboration. *American Psychologist*, 73 (4), 334-338. (<https://doi.org/10.1037/amp0000241>)

Web links

1. <https://www.edublox.com/what-are-cognitive-skills/>
2. <https://mybrainware.com/cognitive-skills/cognitive-skills-foundation-for-learning/>
<https://www.thebalancecareers.com/cognitive-skills-definition-and-examples-2063736>
3. https://www.rungila.com/en/cognitive_skill
4. <https://news.harvard.edu/gazette/story/2015/03/smarter-by-the-minute-sort-of/>
5. https://en.wikipedia.org/wiki/Cognitive_skill
6. <https://www.indeed.com/career-advice/career-development/cognitive-skills-how-to-improve-them>
7. <https://www.skillsyouneed.com/ips/problem-solving.html/>

Videos

1. <https://www.youtube.com/watch?v=k-8K9IksLh8>
2. <https://youtu.be/y0FtXhSu0J0>
3. <https://youtu.be/RuQjYzP9PMo>
4. <https://youtu.be/4ET3SvXJyhw>
5. <https://youtu.be/FXJUDyqobbM>
6. <https://youtu.be/UzPMMSKfKZQ>
7. <https://youtu.be/EGvI1BTCm5w>
8. <https://www.youtube.com/watch?v=E2jYdEO18nU> Self Control: Teaching Students About Their Greatest Inner Strength with Nathan DeWall-
9. <https://www.youtube.com/watch?v=mZUTZKbe4hI> Self control is the key to success. Lessons from the Marshmallow Test
10. https://www.youtube.com/watch?v=4StLXX1k_9I How Instant Gratification is Harming Society and What to Do About It | John Davidson | TEDxCSUS
11. <https://www.youtube.com/watch?v=E2jYdEO18nU> Self Control: Teaching Students About Their Greatest Inner Strength with Nathan DeWall-
12. <https://www.youtube.com/watch?v=mZUTZKbe4hI> Self control is the key to success. Lessons from the Marshmallow Test
13. https://www.youtube.com/watch?v=4StLXX1k_9I How Instant Gratification is Harming Society and What to Do About It | John Davidson | TEDxCSUS
14. https://www.youtube.com/watch?v=lw_2qDIeV8s How To Develop Self-Control To Create An Amazing Life”